ILLINOIS SITE REMEDIATION PROGRAM

SUPPLEMENT TO COMPREHENSIVE SITE INVESTIGATION, REMEDIATION OBJECTIVES REPORT & REMEDIAL ACTION PLAN

PROJECT SITE:

SPARTANS' SQUARE SHOPPING CENTER
NWC ILLINOIS ROUTE 53 & ALEXANDER CIRCLE
(3-23 TERRACE LANE, 615-625 ACCESS DRIVE)
ROMEOVILLE, DUPAGE, ILLINOIS
IEPA BOL Site No. 1970905180

PREPARED FOR:

VILLAGE OF ROMEOVILLE
1050 W. ROMEO ROAD
ROMEOVILLE, ILLINOIS 60446

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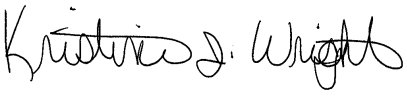
This report has been prepared by V3 Companies (V3), on behalf of the Remediation Applicant, in conformance with the requirements of 35 IAC Sections 740.425, 740.440, 740.445, and 740.450 for the purpose of documenting completion of the Comprehensive Site Investigation, Remediation Objectives Report and Remedial Action Plan.

Prepared by:



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EXECUTIVE SUMMARY

Introduction

V3 Companies has prepared this Supplement to the Comprehensive Site Investigation Report, Remediation Objectives Report and Remedial Action Plan (CSI/ROR/RAP) on behalf of the Village of Romeoville, for the Remediation Site referred to as Spartans' Square Shopping Center (Site), located at the northwest corner of Illinois Route 53 and Alexander Circle, in Romeoville, Illinois. The Site consists of 2.39-acres with a former one-story strip mall (recently demolished and removed) and asphalt parking.

Background: The Site was enrolled in the Site Remediation Program (SRP) in August 2008 under the name Spartans' Square Shopping Center to secure a "comprehensive" No Further Remediation (NFR) letter. In May 2010, V3 submitted a Comprehensive Site Investigation Report and Remedial Objectives Report (CSI/ROR) for IEPA review. The IEPA review of the CSI/ROR indicated that completion of Tier 2 modeling and a Remedial Action Plan were needed. In addition, VOC concentrations identified in Site soils and groundwater, along with the IEPA proposed vapor intrusion rules, indicated that the indoor inhalation exposure route needed to be evaluated as part of the Supplemental Site Investigation (SSI). In February 2013, V3 performed the SSI to evaluate the indoor inhalation exposure route. This report addresses the SSI and TACO evaluation performed in pursuit of a comprehensive NFR letter for the Site. In addition, this report also includes the remedial action plan (RAP) to address impacts identified at the Site.

Report Organization: The report has been organized to initially present (**Section 2.0**) the results of a soil gas investigation performed to address the indoor inhalation exposure pathway. This section also discusses additional site characterization data not previously available within the CSIR. **Section 3.0** updates the baseline conditions at the Site that were determined through the CSI and includes the Tier 2 modeling. The later discussions establish ROs and the areas requiring remediation and/or institutional controls to achieve site-specific ROs (**Section 4.0**).

The following Recognized Environmental Conditions (RECs) have been previously identified at the Site and are grouped on the basis of their general operational, historic and/or physical nature.

The following summarizes the resulting Site RECs designated by the Comprehensive Site Investigation (CSI):

- **VOCs Impacts from Former Dry Cleaning Operations:** This includes soil and groundwater VOC impacts that resulted from former dry cleaners operations at the Site.
- **Metals in Groundwater:** This includes metals groundwater impacts identified in two wells sampled on the southeast side of the Site.

Supplemental Site Investigation

Based on the Site data, a Soil Gas Assessment Work Plan was developed to evaluate the potential indoor inhalation exposure pathway, based upon the identified VOC soil impacts documented in the CSIR. The IEPA reviewed the work plan and provided conditional approval in a letter dated October 12, 2012.

In February 2013, following IEPA's conditional approval of the SSI work plan, V3 performed the supplemental site investigation at the Site. The sampling included active soil gas sampling at indoor and outdoor locations throughout the Site.

Remediation Objectives Evaluation

The first phase of a TACO evaluation is to determine if complete exposure routes exist pursuant to Illinois Administrative Code (IAC) 742.300 (Subpart C: Exposure Route Evaluation). Where a complete exposure pathway (source – transport – availability for exposure – receptor) does not exist, development of ROs for that exposure route is not required. An exposure route evaluation was accomplished on a constituent specific basis.

Evaluation of Site data indicates that conditions achieve the TACO Subpart C criteria for demonstrating that source material is not present, with one exception. The evaluation of Site data indicates the following:

- Soil attenuation capacity, as measured by the conservative TACO default value of 0.2% (2,000 mg/kg), has not been exceeded when compared to the sum of organics in each boring (see **Tables 2.1, 2.2 and 2.4**).
- Soil does not exhibit pH values less than or equal to 2.0 or greater than or equal to 12.5 (see **Table 2.3**).
- There is no evidence of hazardous metals at the Site (investigation did not identify the presence of RCRA metals as COCs). See **Table 2.3**.
- No characteristics of reactivity have been identified (see **Table 2.3**).
- There is no evidence of PCBs in soil in excess of 50 parts per million at the Site (investigation did not identify PCBs as COCs). See Table 2.4 for documentation.
- Field observations did not indicate the presence of "free product" or COC saturated soil.

The following exception to TACO Subpart C criteria is present at the Site:

- The soil saturation limits for each COC have not been exceeded, with the exception of a concentration of 800 mg/kg of tetrachloroethene at SM-GP-108 (8-11) that exceeds the updated limit of 310 mg/kg. As a result, this area will require remedial efforts to allow exclusion of exposure pathways.

As a result of the above, pathway exclusion, once the noted exception is addressed, is allowable per 35 *IAC Section 742.300 (Subpart C: Exposure Route Evaluation)*.

Site COCs: The supplemental site investigation did not identify any additional site COCs. The delineation of COCs was completed through subsurface investigations and analytical testing. The confirmed Site COCs include:

- Soils: VOCs (tetrachloroethylene, trichloroethylene)
- Groundwater: VOCs (tetrachloroethylene, bromodichloromethane, bromoform, chloroform) and Metals (aluminum, iron, lead, manganese)

Remediation Objectives: The following site ROs, along with necessary remedial measures (in-situ soil treatment and engineered barriers (as needed)) and institutional controls, are proposed to exclude exposure pathways at the Site:

- Tier 1 Industrial-Commercial and Construction Worker ROs for the soil inhalation and ingestion exposure pathways and Class I groundwater ingestion ROs.

- Tier 2 soil component of the Class I groundwater ingestion and Tier 2 Class I direct ingestion groundwater ROs on-site. A groundwater use restriction at the Site will move the compliance point to the Site boundaries.
    - The Village of Romeoville maintains two limited groundwater ordinances which prohibit the use of groundwater for potable purposes. To exclude the groundwater ingestion route, the ordinances, one of which has been previously accepted by IEPA for use an institutional control, will be invoked as a groundwater use restriction at the Site and for potentially impacted off-site areas, and will move the compliance point to and beyond the Site boundaries. A second limited groundwater ordinance is being submitted concurrently for IEPA review.
    - Tier 2 simulations demonstrate Tier 2 site-specific ROs and residual concentrations are protective (e.g., Tier 1, Class I direct ingestion groundwater ROs are achieved at the Site boundaries), with some exceptions (see **Figure 2.2**). Off-site notification will be required to the potentially affected off-site owners.

Based on the approval of Tier 1 and 2 evaluations, the implementation of proposed remedial actions (in-situ soil mixing and engineered barriers (as needed)), and the following institutional controls, the Site can qualify for an NFR determination:

- Restrict subsurface construction and maintenance (in specified areas) to qualified personnel (i.e., in accordance with applicable OSHA regulations) via construction worker notification;
- Restrict groundwater usage at the Site utilizing the existing groundwater ordinances;
- Maintain barriers to exclude exposure routes as applicable to specified areas of ingestion and inhalation concentrations above Tier 1 ROs, as necessary; and
- Require any existing or potential buildings located over the current extent of soil gas and/or groundwater contamination to have a full concrete slab-on-grade floor or full concrete basement floor and walls with no sump(s).

Remedial Action Plan

The RAP outlines the remedial actions intended to address the environmental concerns associated with the former Site operations. The primary remedial goals of the RAP include:

- Perform remediation (in-situ soil mixing treatment) of soils at and near SM-GP-08 and SM-GP-108 and along adjoining building utility lines. A general treatment area of 60 feet x 45 feet encompassing these locations is shown on **Figures 3.1** and **3.2**. Specifically, the treated areas are:
    - At and between locations SM-GP-08 and SM-GP-108, an area of 35 ft by 15 ft and depth of 7.5 to 13.5 feet bgs at SM-GP-108 to the northeast and at shallower depth of 5 to 8 ft at SM-GP-08 to the southwest, and
    - Along the existing water line (30 ft long by 6 ft wide) at depths of generally 3 to 6 feet bgs and along sewer line (85 ft long by 6 ft wide) at depths of 6 to 9 feet bgs (depending on actual depth of utility lines),

- The goal is to decrease PCE concentrations at location SM-GP-108 to below the TACO updated soil saturation limit (310 mg/kg) for the soil component of the groundwater ingestion exposure route. For the entire Remediation Area, the goal is to decrease PCE concentrations below 60 mg/kg, to meet RCRA Land Disposal Restriction Treatment Standards (35 IAC Part 728.149) and reduce the need for additional pre-treatment prior to any potential soil disposal.
- Based on results of in-situ soil treatment, address any remaining TACO risks for residual PCE in excess of Tier 1 industrial-commercial ingestion (110 mg/kg) or outdoor inhalation (20 mg/kg) ROs by the installation of engineered barriers to exclude exposure pathways, and
- Place institutional controls on the Site. A groundwater use restriction will be used. Based on results of in-situ soil treatment, engineered barriers and/or construction worker notification areas may be implemented.

Soil verification sampling will be performed approximately 3 weeks following in-situ soil mixing, to allow the applied reagents to reduce site concentrations. If needed, engineered barriers will be placed at the specific locations of any remaining ingestion or outdoor inhalation residual soils. Following the installation of any engineered barriers, a Remedial Action Completion Report (RACR) will be submitted to the IEPA SRP for Site closure. This report shall provide the basis for the RA's pursuit of a "comprehensive" No Further Remediation (NFR) letter.

1.0 INTRODUCTION

V3 Companies has prepared this Supplement to the Comprehensive Site Investigation Report, Remediation Objectives Report and Remedial Action Plan (S-CSI/ROR/RAP) on behalf of the Village of Romeoville, for the Remediation Site referred to as Spartans' Square Shopping Center (Site). The Site consists of 2.39-acres located at the northwest corner of Illinois Route 53 and Alexander Circle, in Romeoville, DuPage County, Illinois (**Figures 1.1 and 1.2**). The S-CSI/ROR/RAP, provided herein, has been developed in conformance with the requirements of 35 Illinois Administration Code (IAC) Part 740 Section 740.420 and 740.425, Sections 740.440, 740.445 and 740.450 to accomplish the following:

- Complete the presentation of site characterization data;
- Present remediation objectives (ROs) for soil and groundwater developed in accordance with 35 IAC Part 742 - Tiered Approach to Corrective Action Objectives (TACO); and
- Present the proposed remedial goals.

The S-CSI/ROR/RAP is intended to support Site Remediation Program (SRP) closure of the Site in accordance with 35 IAC Part 740. This report and prior submittals provide the basis for the RA's pursuit of a "comprehensive" NFR letter for the Site.

1.1 BACKGROUND

The Site was enrolled in the Site Remediation Program (SRP) in August 2008 under the name Spartans' Square Shopping Center. Currently, the Site is vacant since demolition of the shopping center was recently completed in June 2013. In the future, the property will be redeveloped and remain commercial land use as part of the Romeoville Downtown Master Plan.

In May 2010, V3 submitted a Comprehensive Site Investigation Report and Remedial Objectives Report (CSI/ROR) for IEPA review. The IEPA review of the CSI/ROR indicated Tier 2 modeling and the Remedial Action Plan to be completed. In addition, VOC concentrations identified in Site soils and groundwater, along with the IEPA proposed vapor intrusion rules indicated that the indoor inhalation exposure route be evaluated as part of the Supplemental Site Investigation (SSI).

In February 2013, V3 performed the SSI to address the indoor inhalation route. This report addresses the SSI and brief TACO evaluation performed in pursuit of a comprehensive NFR letter for the Site. In addition, this report also includes the remedial action plan (RAP) to address impacts identified at the Site.

1.2 REPORT ORGANIZATION

The following sections of the report are organized in the following manner:

Section 2 –Supplement to Comprehensive Site Investigation: Presents the results of the SSI performed to evaluate the indoor inhalation route. This section provides additional site characterization data not previously available in the CSIR.

Section 3 – Remediation Objectives Evaluation: Defines Recognized Environmental Conditions (RECs) at the Site. Provides a "pre-remediation" TACO evaluation, including a discussion of applicable exposure routes and related evaluations, and then discusses the

Tier 1 and 2 ROs selected for closure of the Site. The section briefly discusses those areas requiring active remediation to achieve specified site ROs.

Section 4 – Remedial Action Plan: Summarizes the remediation methods and technologies proposed to achieve ROs at the Site. In addition, this section discusses in more detail the engineering and institutional controls proposed to exclude exposure routes.

Section 5 – Conclusions: Summarizes the Site's planned future use and the appropriateness of the Site investigation, proposed remediation objectives and exclusion of exposure routes as the basis for the receipt of an NFR letter for the Site.

Section 6 – Licensed Professional Engineer (LPE) Affirmation: Affirmation by the LPE directing the investigation of the Site.

1.3 RECOGNIZED ENVIRONMENTAL CONDITIONS (RECs)

The following summarizes the resulting Site RECs designated in the CSI:

- **REC 1 – Former Dry Cleaning Operations:** This REC addresses the possible impacts to the Site from a former dry cleaner that operated in the space where Mrs. Clean Laundromat was most recently located. Mrs. Clean Laundromat was strictly a laundromat and dry cleaning operations were not conducted on-site.
- **REC 2 – Hydraulic Lifts:** This REC addresses possible impacts from three out-of-use hydraulic lifts located on the south side of the former grocery store and hardware store.
- **REC 3 – East Adjacent Gas Station:** This REC addresses possible soil and groundwater impacts from the off-site east adjacent Phillips 66 Gas Station (Former Clark Station and LUST site) to the northeast corner of the Site, which has also been closed and demolished.

Based upon the findings of the field observations and laboratory sample analyses, V3 has not identified impacts associated with REC 2 and REC 3. As a result, V3 has redefined the three previously defined Site RECs as two RECs:

- **VOCs Impacts from Former Dry Cleaning Operations:** This includes soil and groundwater VOC impacts that resulted from former dry cleaners operations at the Site.
- **Metals in Groundwater:** This includes metals groundwater impacts identified in two wells sampled on the southeast side of the Site.

The designation of RECs was based on the following considerations:

- Physical distribution of the Contaminants of Concern (COCs) in soil and groundwater media;
- Additional site characterization data requirements;
- Characterization of any "source material/free product" areas;
- Complete exposure routes and pathways;
- Planned Future Use of Site Areas;
- Pathway exclusion options;
- Potential use of engineered barriers; and,
- Potential Remedial Actions.

2.0 SUPPLEMENT TO COMPREHENSIVE SITE INVESTIGATION

The following subsections present the results of Supplemental Site Investigation (SSI) performed to evaluate the indoor inhalation exposure pathway. This section discusses additional site characterization data not previously available within the CSIR.

2.1 SUPPLEMENTAL SITE INVESTIGATION

The Supplemental Site Investigation (SSI) Soil Gas Assessment Work Plan (**Appendix A**) was developed by V3 to evaluate the potential indoor inhalation exposure pathway, based upon the identified VOC soil impacts documented in the CSIR. The IEPA reviewed the work plan and provided conditional approval in a letter dated October 12, 2012. The condition to the work plan was to add one additional interior soil gas collection point.

The objectives of the SSI included the following:

- Install active soil gas collection points to evaluate the subsurface below the existing and potential future building foundations.
- Evaluate potential indoor inhalation risks within interior and exterior areas of the Site and determine if indoor inhalation issues need to be addressed within the Remedial Action Plan.
    - *Inside existing building*: The proposed interior sample locations are intended to evaluate conditions beneath the former dry cleaner location, where groundwater and soil results indicate the presence of tetrachloroethylene (PCE).
    - *Outside existing building*: The soil gas sampling locations are intended to evaluate the potential for migration of VOC vapors in soil gas in excess of the pending Tier 1 indoor inhalation ROs. These locations are within the Remediation Area boundary, where buildings may be constructed in the future, and also down-gradient of previous groundwater samples, which indicate the presence of PCE.

In February 2013, following IEPA's conditional approval of the SSI work plan, V3 performed the SSI to evaluate the potential indoor inhalation exposure pathway. The sampling event included collecting soil gas samples at indoor and outdoor locations within and around the known areas of subsurface impacts at the Site (**Figure 2.1**).

The results of the soil gas and previous soil and groundwater sampling efforts are summarized in **Table 1.1** and **Tables 2.1 to 2.2, 3.1 to 3.5,** and **4.1 to 4.2**. The field activities relative to the soil gas investigation are discussed below. Geological conditions and the prior site-specific sampling plans are discussed in **Sections 2.0 and 3.0** in the May 2010 CSIR/ROR that V3 previously submitted to the IEPA.

2.1.1 Indoor Inhalation Exposure Pathway – Initial Screening

The pending amendments to *35 IAC Part 742* contain two separate exposure routes that are used to evaluate the indoor inhalation pathway: soil gas and groundwater. In evaluating areas of concern for indoor inhalation risks, V3 initially evaluated existing groundwater data.

Groundwater Data Review: Existing groundwater data was compared to the pending Tier 1 industrial/commercial groundwater ROs for the inhalation exposure pathway provided in

Appendix B, Table H of the proposed amendments to *Part 742*. The Tier 1 ROs in *Appendix B, Table H* consider both diffusion and advection, are the most stringent, and are required to be used within 5 feet of a building.

Table 2.2 compares the most recent groundwater results for the Site to the proposed Tier 1 ROs of *Appendix B, Table H*. For Site wells with detections of VOCs in groundwater, the concentrations do not exceed the proposed indoor inhalation industrial-commercial Tier 1 ROs.

2.1.2 Soil Gas Investigation

Soil gas sampling services were provided by Cabeno Environmental Field Services (Cabeno) on February 19, 2013, under the supervision of V3's site geologist, using the Geoprobe® PRT (Post-Run Tubing) direct push method and sampling system. A total of six soil gas samples were collected for laboratory chemical analysis from the locations shown in **Figure 2.1**.

The conditional approval of the Soil Gas Assessment Work Plan called for the collection of one additional interior sample just inside the back entrance to the former dry cleaner facility. However, this location could not be used due to the presence of underground utilities and limited access within this portion of the building. To adjust for this condition, the nearby exterior sample point was moved closer to the building.

The following borings were advanced as part of the investigation:

- *Inside the existing building:* Sample Location SM-SG-01 was placed in the northern portion of the former dry cleaner facility.
- *Outside the existing building:* Sample Locations SM-SG-02, SM-SG-03, SM-SG-04, SM-SG-05, and SM-SG-06 were placed around the existing building, within the source area, and down-gradient of identified soil and groundwater impacts.

Work was conducted in general accordance with the *Interim Protocol for Active Soil Gas Sampling* guidance document prepared by the Illinois EPA (IEPA) in January 2010, and the conditionally approved Soil Gas Assessment Work Plan.

Soil gas collection points were installed in concrete and asphalt paved areas to a minimum depth of 3 feet below the ground surface (bgs) using the Geoprobe® PRT system. Each sampling point consists of a metal tip and a short section of perforated metal pipe, which is connected to 1/8-inch I.D. nylon (Nylaflow) tubing. The tubing is threaded through a 3/4-inch diameter hollow metal rod, into which the metal tip is secured. An electronic jackhammer was used to drive the sampling string into the ground at the interior location, and a Geoprobe® was used to drive the sampling string into the ground at exterior locations. The rod was retracted a few inches (leaving the metal sampling tip in the boring). A liberal amount of modeling clay was applied at the ground surface around the sampling rod.

Prior to collecting the actual soil gas sample for chemical analysis, a field quality control (QC) soil gas sample was collected at each sampling location to determine the degree that the sampling point or sampling train was leaking. A rigid containment shroud was placed over the sampling rod and string, and 100 percent helium (used as a tracer gas to detect leaks) was fed through a tube into the shroud. The influent side of a small hand-pump was connected to the sampling tube that was in turn connected to the metal sample tip in the ground. Another tube was connected to the effluent side of the hand pump. The pump was used to purge the sampling string of at least 3 volumes of soil gas, at a maximum rate of 200 milliliters/minute. A

portable helium detector was used to measure the concentration of helium in the soil gas sample by inserting the wand of the detector into the effluent sample tube.

To evaluate sample integrity, a "leakage factor" was calculated at each sampling location, based on results of the field QC soil gas testing. The leakage factor (the proportion of ambient air leakage) is the ratio of the helium in the QC soil gas sample to the stabilized helium concentration in the shroud. The leakage factor is calculated as a percent (X% of helium in the sample divided by X% of helium in the shroud), thereby providing an estimate of the amount of ambient air leakage in the sample collection process. An allowable leakage factor is presumed to be 5% or less, based on the quantitative leak testing procedures presented in the guidance document published by the California EPA, Department of Toxic Substances Control at: http://dtsc.ca.gov/SiteCleanup/upload/VI_ActiveSoilGasAdvisory_FINAL_043012.pdf.

The leakage factors for all of the QC leak test samples were less than 5%, indicating that the sampling string was not leaking in excess of guidance tolerance, and validating the soil gas sample laboratory chemical analytical results. Refer to **Table 2.3** for field QC leak test sample results.

Following helium leak testing at each sampling location, the hand pump was used to again purge soil gas (at least 3 volumes of the sampling string). A soil gas sample was collected at a maximum flow rate of 200 milliliters/minute into a 1-Liter Tedlar bag and submitted to the laboratory for chemical analysis.

Proper chain-of-custody procedures and forms were used to document the transport and handling of soil gas samples to the laboratory. Laboratory services were provided by STAT Analytical Laboratories, Inc. located in Chicago, IL, which is a NELAP-certified laboratory. Soil gas samples were analyzed using the TO-15 method.

Soil gas samples were analyzed for VOCs and a limited list of SVOC constituents. The analytical results for these sampling efforts are summarized in **Table 1.1** and **Tables 2.1 to 2.2**. Compliance was proposed in accordance with pending Section 742.515(c), using the proposed Tier 1 ROs for industrial/commercial land use contained within Appendix B, Table H. The sampling locations are identified on **Figure 2.1**.

Appendix C provides representative photographic documentation of the field installations, QC leak testing and soil gas sampling procedures.

3.0 REMEDIAL OBJECTIVES EVALUATION

The following sections establish the baseline conditions at the Site that were determined through the Supplemental Site Investigation (SSI). The later discussions establish site ROs, and the areas requiring active remediation to achieve ROs and/or provide for exposure pathway exclusion where ROs are exceeded.

3.1 BASELINE TACO EVALUATION (PRE-REMEDIATION)

The identification of potential receptors and exposure pathways is an important component of the investigation/remedial strategy for the Site because it allows for an evaluation and determination of site-specific risk and ROs. Where no potential receptor is exposed to COCs at a concentration exceeding TACO ROs, remedial actions are not required.

The initial step used to establish Site ROs was the development of a "baseline" TACO evaluation. The objectives of this evaluation were limited to determining the following:

- If known releases to the environment have resulted in residual concentrations of COCs greater than TACO Subpart C criteria; and
- If such residual concentrations represent unacceptable risk under Tier 1 or 2

The first phase of a TACO evaluation is to determine if complete exposure routes exist pursuant to Title 35 of the Illinois Administrative Code (IAC) 742.300 (Subpart C: Exposure Route Evaluation). Where a complete exposure pathway (source – transport – availability for exposure – receptor) does not exist, development of ROs for that exposure route is not required. An exposure route evaluation was accomplished on a constituent specific basis for each REC. Before a potential exposure route can be eliminated from further consideration, the following conditions must be satisfied:

1. The horizontal and vertical extent and constituent concentrations must be determined;
2. The sum total of organic constituent concentrations cannot exceed the soil attenuation capacity as measured by the natural organic carbon fraction (f_{oc}) of the soil;
3. Non-aqueous phase liquids (NAPL) or free product must be removed to the maximum extent practicable;
4. The concentration of any organic constituent cannot exceed the soil saturation limit;
5. The soil cannot be classified as a characteristic RCRA hazardous waste for reactivity, corrosivity, or toxicity (RCRA metals only).
6. The concentration of any PCBs in soil shall not exceed 50 parts per million (ppm).

As indicated in the May 2010 CSI/ROR, evaluation of Site data indicates conditions in the RECs achieve the TACO Subpart C criteria for demonstrating that source material is not present, with one exception. The evaluation of Site data indicates the following:

- Soil attenuation capacity, as measured by the conservative TACO default value of 0.2% (2,000 mg/kg), has not been exceeded when compared to the sum of organics in each boring (see **Tables 3.1, 3.2 and 3.4**).
- Soil does not exhibit pH values less than or equal to 2.0 or greater than or equal to 12.5 (see **Table 3.3**).

- There is no evidence of hazardous metals at the Site (the investigation did not identify the presence of RCRA metals as COCs). See **Table 3.3**.
- No characteristics of reactivity have been identified (see **Table 3.3**).
- There is no evidence of PCBs in soil in excess of 50 parts per million at the Site (the investigation did not identify PCBs as COCs). See **Table 3.4** for documentation.
- Field observations did not indicate the presence of "free product" or COC saturated soil.

The following exception to TACO Subpart C criteria is present at the Site:

- The soil saturation limits for each COC have not been exceeded, with the exception of a concentration of 800 mg/kg of tetrachloroethene at SM-GP-108 (8-11) that exceeds the updated limit of 310 mg/kg. As a result, this area will require remedial efforts to allow exclusion of exposure pathways.

The results from the SSI do not affect the judgment detailed in the CSI/ROR that source material is present. As a result of the above, pathway exclusion, once the noted exception is addressed, is allowable per 35 IAC Section 742.300 (Subpart C: Exposure Route Evaluation).

A summary of soil and groundwater sample analysis results in which constituent concentrations are above applicable TACO Tier 1 ROs (COCs) are provided in **Table 1.1**, which includes analytical results obtained during the CSIR. Refer to **Tables 3.1 to 3.5** and **4.1 to 4.2** for complete analytical results. The following section establishes the baseline TACO conditions at the Site, followed by a summary of the TACO Tier 1 evaluation.

3.2 BASELINE TACO CONDITIONS

The results of the CSI have established the baseline TACO conditions for the Site.

3.2.1 Site COCs

The results of the SSI completed a delineation of the vertical and horizontal extent of COCs. The delineation of COCs was completed through subsurface investigations and analytical testing. The confirmed Site COCs include:

- Soils: VOCs (tetrachloroethylene, trichloroethylene)
- Groundwater: VOCs (tetrachloroethylene, bromodichloromethane, bromoform, chloroform) and Metals (aluminum, iron, lead, manganese)

PCBs have not been detected, and based upon the historical land use and sample laboratory results; there is no evidence of pesticides at the Site.

The analytical results obtained through the CSI, as supplemented during the SSI, were compared to the Tier 1 ROs of Title 35 of the Illinois Administrative Code (IAC) Part 742, Tiered Approach to Corrective Action Objectives (TACO), effective February 15, 2007. The soil gas results were compared to the pending indoor inhalation exposure route ROs as listed in Part 742, second notice dated March 7, 2013. Further, analytical and physical site data were considered in accordance with 35 IAC Part 742, Subpart C; Exposure Route Evaluations.

A summary of soil and groundwater sample analysis results in which constituent concentrations are above applicable TACO Tier 1 ROs (e.g., the Site COCs) are provided in **Tables 2.1-2.2** for soil gas samples, **Tables 3.1 to 3.5** for soil samples and **Tables 4.1 to 4.2** for groundwater. A summary of samples exceeding Tier 1 ROs is provided as **Table 1.1**.

3.2.2 Migration Pathways, Receptors And Exposure Routes

Existing and potential migration pathways that could transport contaminants off-site include underground utilities that exit the property, groundwater, fugitive dust, and surface water runoff.

Utility Review and Potential Migration Pathway Evaluation
The location of utilities was discussed in the CSIR/ROR and additional data collected during the SSI has not indicated any changes to the utility locations.

Potential Exposure Pathways and Receptors
The potential exposure pathways and receptors were discussed in the CSIR/ROR and additional data collected during the SSI has not indicated any changes to the potential exposure pathways and receptors.

3.2.3 Groundwater Classification

As discussed in the May 2010 CSIR/ROR, the groundwater beneath the Site classifies as a Class I: Potable Resource Groundwater, in accordance with Title 35: Environmental Protection, Subtitle F: Public Water Supplies, Chapter I: Pollution Control Board Part 620b: Groundwater Classification.

3.3 TACO TIER 1 EVALUATION

To define the nature and extent of contamination at the Site, and evaluate possible transport of contaminants, investigation analytical results were compared to Tier 1 ROs for industrial-commercial land use and the construction worker scenario. The future use of the property will be commercial, and therefore the following exposure routes were evaluated:

- Soil ingestion for the industrial/commercial and construction worker receptor population,
- Soil inhalation for industrial/commercial and construction worker receptor population,
- Class I groundwater ingestion based on the migration potential of concentrations detected in soils, and
- Class I groundwater ingestion.

Where Tier 1 groundwater ingestion (and soil component of groundwater ingestion) ROs have been exceeded, TACO risk-based corrective action (RBCA) equation R-26 simulations have been completed to predict the distances from the COC sources (represented by groundwater monitoring wells) required to achieve Tier 1 groundwater ROs. Groundwater pathway exclusion is anticipated via the Village of Romeoville ordinances prohibiting potable use of groundwater. TACO equation R-12 simulations are also completed to determine Tier 2 soil component of the groundwater ingestion ROs. See **Appendix D** for the development of Tier 2 ROs and summary result tables.

A summary of soil and groundwater samples in which concentrations are above applicable TACO Tier 1 ROs is provided in **Table 1.1**. Details of analytical results are provided in **Tables**

2.1-2.2 for soil gas samples, **Tables 3.1 to 3.5** for soil samples and **Tables 4.1 to 4.2** for groundwater. The following sections discuss the results of Tier 1 TACO evaluation as it relates to each identified REC. The data utilized in developing these assessments includes data from the V3 CSI, as amended by the SSI, and historical data.

3.3.1 VOCs Impacts From Former Dry Cleaning Operations

Analytical results from the previous investigations are evaluated and described in the May 2010 CSIR/ROR, and are summarized in **Table 1.1** and **Tables 3.1-3.5** and **4.1 to 4.2**. The following Tier 1 evaluation summarizes only the results from the 2013 SSI.

Tier 1 Indoor Inhalation Evaluation

The laboratory analytical results from the soil gas investigation were evaluated by comparison to the Tier 1 soil gas ROs as described within *Section 742.515* of the proposed amendments to *Part 742* initially filed in November 2010, and as adopted in March 2013 for Second Notice by the Illinois Pollution Control Board. Compliance demonstrations for both soil gas and groundwater were performed in accordance with pending *Section 742.515(c)*, using the proposed Tier 1 ROs for industrial/commercial land use contained with *Appendix B, Table H*.

Industrial/Commercial Indoor Inhalation Exposure Pathway – Soil Gas: The analytical results for soil gas are summarized for TACO comparison within **Table 2.1**. The results indicate that no soil gas concentrations for VOCs were detected in excess of proposed Tier 1 ROs.

Industrial/Commercial Indoor Inhalation Exposure Pathway – Groundwater: The analytical results for groundwater from the May 2010 CSI/ROR are summarized for TACO comparison within **Table 2.2**. The detected monitoring well VOC concentrations were detected below the proposed Tier 1 ROs contained in *Appendix B, Table H*.

Tier 1 Industrial/Commercial Indoor Inhalation Exposure Pathways Compliance Demonstration: In accordance with *Section 742.515(c)* of the pending Part 742 amendments, compliance with Tier 1 ROs for Appendix B, Table H is achieved by meeting either the soil gas ROs or the groundwater ROs. As a result, the soil gas and groundwater results indicate an indoor inhalation exposure pathway risk is not present.

3.3.2 Metals in Groundwater

Tier 1 Indoor Inhalation Evaluation

Industrial/Commercial Indoor Inhalation Exposure Pathway – Soil Gas: Mercury is the only inorganic that is considered a volatile chemical and has a soil gas RO. However, mercury was not detected in groundwater and is not a site COC.

Industrial/Commercial Indoor Inhalation Exposure Pathway – Groundwater: The analytical results for groundwater from the May 2010 CSI/ROR are summarized for TACO comparison within **Table 2.2**. Mercury was not detected in site monitoring wells, and is therefore, below the proposed Tier 1 ROs contained in *Appendix B, Table H*.

Tier 1 Industrial/Commercial Indoor Inhalation Exposure Pathways Compliance Demonstration: In accordance with *Section 742.515(c)* of the pending Part 742 amendments, compliance with Tier 1 ROs for Appendix B, Table H is achieved by meeting either the soil gas ROs or the

groundwater ROs. As a result, the groundwater results indicate an indoor inhalation exposure pathway risk is not present.

3.4 TACO TIER 2 EVALUATION

When investigation data for a COC are less than Tier 1 ROs, no further TACO evaluation or remedial action is necessary. Tier 2 evaluations were performed for any remaining COCs not eliminated from consideration under Tier 1 as described below. Tier 2 remediation objectives were determined by RBCA modeling for the soil component of the groundwater ingestion and the groundwater direct ingestion exposure routes. The Tier 2 modeling documentation and summary tables are attached in **Appendix D** and the Tier 2 results are discussed below.

Tier 2 groundwater remediation objectives can be developed if a groundwater use restriction is used to "move" the Tier 1 compliance point. For this Remediation Site, the property boundary is the compliance point. Tier 1 Class I ROs are used for evaluating groundwater compliance.

Tier 2 Evaluation

Based on the Tier 1 evaluation, a Tier 2 evaluation was performed to develop site-specific, risk-based soil and groundwater remediation objectives in accordance with the applicable provisions of Part 742 (IAC Section 742.600 et seq.) for the constituents of concern that exceed Tier 1 remediation objectives for the following exposure routes:

- Soil Component of the Groundwater Ingestion Exposure Route and
- Groundwater Direct Ingestion Exposure Route.

A spreadsheet (**Appendix D.4**), which incorporates the equations, algorithms, and default values of the Risk-Based Corrective Action (RBCA) model, was used to develop Tier 2 ROs. V3 completed a RBCA equation R26 simulation for groundwater samples and R12 simulation for soil samples to address the ingestion route related to groundwater.

Soil Component of the Groundwater Ingestion Exposure Route

Tier 2 ROs were calculated for following constituents detected at concentrations above Tier 1 ROs:

- PCE: SM-GP-03, SM-GP-07, SM-GP-08, SM-GP-103, SM-GP-104, SM-GP-107, SM-GP-108, SM-GP-110, SM-GP-111, SM-GP-114, SM-GP-115, SM-GP-116, and SM-GP-117.
- TCE: SM-GP-108

The following paragraphs establish the background and basis of the soil component to groundwater exposure pathway Tier 2 simulations.

The Tier 2 modeling was performed using a site-specific hydraulic conductivity value.

V3 completed RBCA equation R12 simulations to determine Tier 2 soil component of the groundwater ingestion remediation objectives. Based on the southwestward direction of groundwater flow, the Site's west and south property boundary was used as the down-gradient compliance point for the development of the Tier 2 ROs.

The use of the Site boundary as the compliance point will require a groundwater use restriction on the Site, which would prevent the installation and/or use of potable wells. There are no potable groundwater supply wells on-site.

A discussion and table summarizing the model parameters (inputs) used in the equations are attached in **Appendix D, Table D.2**, along with simulation results. Calculation documentation is provided in **Appendix D.4**. A Tier 2 RO was calculated for each soil sample above Tier 1 ROs for the soil component of the groundwater ingestion route.

The modeling results are summarized below:

- Based upon the RBCA simulated groundwater concentration, the observed soil concentrations (**Appendix D, Table D.2**) are greater at five locations for PCE than the calculated Tier 2, Class I groundwater protection remediation objective (e.g., simulations indicate the Class I Tier 1 groundwater RO for PCE would not be achieved at the property boundary, the down-gradient compliance point).
- However, three locations SM-GP-07, SM-GP-08, SM-GP-108 with soil impacts are the same boring locations as groundwater samples, which did detect PCE concentrations above the Tier 1 Class I groundwater ingestion RO, but Tier 2 modeling indicated Class I RO compliance at the property boundary (discussed further below).
- The Tier 1, Class I groundwater remediation objective is achieved for TCE prior to reaching the property boundary.

Because the RBCA simulations failed to achieve Tier 1 Class I groundwater ROs at the property boundary, the Village of Romeoville groundwater ordinances will be used as an institutional control for on-site and off-site groundwater use restriction.

Groundwater Direct Ingestion Exposure Route

Tier 2 ROs were calculated for the following sample locations with constituents detected at concentrations above Tier 1, Class I groundwater pathway ROs:

- PCE: SM-GP-07 (GW), SM-GP-08 (GW), SM-GP-117, SM-MW-01, SM-MW-02, and SM-MW-03
- Bromodichloromethane: SM-MW-02 and SM-MW-03
- Bromoform: SM-MW-02
- Chloroform: SM-MW-02 and SM-MW-03
- Aluminum: SM-MW-01 and SM-MW-04
- Iron: SM-MW-01 and SM-MW-04
- Manganese: SM-MW-01 and SM-MW-04
- Lead: SM-MW-01 and SM-MW-04

V3 completed a RBCA equation R26 simulation for the groundwater concentrations to determine:

- The distance from the source at which the predicted concentrations of COCs achieved Tier 1, Class I Groundwater remediation objectives within groundwater, and
- The predicted concentrations within groundwater at the compliance point.

Based on the southeastward direction of groundwater flow, the Site's east and south property boundaries were used as the down-gradient compliance point for the development of the Tier 2 ROs. The use of the Site boundary as the compliance point will require a groundwater use restriction on the Site, which would prevent the installation and/or use of potable wells. There are no potable groundwater supply wells on-site.

A discussion and table summarizing the model parameters (inputs) used in the equations are attached in **Appendix D, Table D.3**, along with simulation results and calculations.

The modeling results are summarized below:

- Based upon the RBCA groundwater simulations, the Tier 1, Class I groundwater remediation objectives are not achieved before reaching the property boundary for PCE concentrations at location SM-MW-03. However, the observed PCE concentrations at locations SM-GP-07 (GW), SM-GP-08 (GW), SM-GP-117, SM-MW-01, and SM-MW-02 did achieve Tier 1, Class I groundwater remediation objectives at the property boundary.
- The Tier 1, Class I groundwater remediation objectives are not achieved before reaching the property boundary for bromodichloromethane and chloroform concentrations at locations SM-MW-02 and SM-MW-03.
- The Tier 1, Class I groundwater remediation objective for bromoform is achieved at SM-MW-02 prior to reaching the property boundary.
- The Tier 1, Class I groundwater remediation objectives are not achieved before reaching the property boundary for aluminum, iron, lead and manganese concentrations at locations SM-MW-01 and SM-MW-04 on the south side of the Site.

Because the RBCA simulations failed to achieve Tier 1 Class I groundwater ROs at the property boundary, the Village of Romeoville groundwater ordinances will be used as an institutional control for on-site and off-site groundwater use restriction. Figure 2.2 indicates the areas of modeling simulations and potential areas affected. Off-site notification will be required to those off-site owners potentially affected.

3.5 REMEDIATION OBJECTIVES

The following presents the proposed Site remediation objectives (ROs), as well as the institutional controls necessary for development of site-specific ROs.

Institutional Controls

Section 742.1000 (Subpart J; IAC Part 742) requires the establishment of institutional controls for ROs developed based on industrial-commercial property use and the exclusion of exposure routes/pathways. As per Section 742.1000(a), institutional controls will be placed on the Site that would:

- Restrict subsurface construction and maintenance (in specified areas) to qualified personnel (i.e., in accordance with applicable OSHA regulations) via construction worker notification;
- Restrict groundwater usage at the Site, and in potentially impacted off-site areas, utilizing the existing groundwater ordinance;

  - The Village of Romeoville maintains a limited groundwater ordinance which prohibits the use of groundwater for potable purposes (copy provided in CSIR/ROR dated May 2010). To exclude the groundwater ingestion route, the ordinance, accepted by IEPA for use an institutional control, will be invoked as a groundwater use restriction at the Site and adjoining properties, and will move the compliance point to the Site boundaries.
  - An additional on-site limited groundwater ordinance prohibits the use of groundwater for potable purposes at the Spartan's Square property. This ordinance is provided concurrently for IEPA review;
- Maintain barriers to exclude exposure routes as applicable to specified areas of ingestion and inhalation concentrations above Tier 1 ROs, as necessary; and
- Require any existing or potential buildings located over the current extent of soil gas and/or groundwater contamination to have a full concrete slab-on-grade floor or full concrete basement floor and walls with no sump(s).

As per Section 742.310(b) and 742.315(a), the soil outdoor inhalation and ingestion routes, respectively, may be excluded from consideration if an appropriate engineered barrier, as set forth in Subpart K, is in place.

The No Further Remediation (NFR) letter will require current and future property owners to maintain the integrity of any specified barriers, as well as restrict all subsurface construction to qualified personnel (i.e., in accordance with applicable OSHA regulations) as applicable to the specified areas.

Section 742.320 specifies the conditions under which the groundwater ingestion exposure route may be excluded. [Note: The conditions for excluding the groundwater exposure pathway are satisfied per the simulations and evaluations presented in **Section 3.4**, and by using the Village of Romeoville groundwater ordinances for restricting groundwater use on-site, and in potentially impacted off-site areas.]

Remediation Objectives
The following ROs are proposed for the Site:

- Tier 1 industrial-commercial and construction worker ROs for the soil inhalation and soil ingestion exposure pathways and Class I groundwater ingestion ROs;
- Tier 2 soil component of the Class I groundwater ingestion, Tier 2 Class I direct ingestion groundwater ROs.
  - The Village of Romeoville maintains two limited groundwater ordinances that prohibit the use of groundwater for potable purposes. To exclude the groundwater ingestion route, the ordinances, one already accepted by IEPA for use as an institutional control, will be invoked as a groundwater use restriction at the Site and adjoining properties, and will move the compliance point to and beyond the Site boundaries. A second limited groundwater ordinance is being submitted concurrently for IEPA review.
  - Tier 2 simulations demonstrate that Tier 2 site-specific ROs and residual concentrations are protective (e.g., Tier 1, Class I direct ingestion groundwater ROs

are achieved at the Site boundaries), with some exceptions (see **Figure 2.2**). Off-site notification will be required to the potentially affected off-site owners.

Active Remediation

Active remediation is anticipated to address the identified soil saturation PCE exceedance location. In addition, in-situ soil treatment will reduce concentrations to below the soil saturation limit, and will attempt to reduce concentrations below the industrial-commercial Tier 1 ingestion and inhalation ROs exceedances, as identified at the following sample locations:

- SM-GP-108, and
- SM-GP-08

Based on the approval of Tier 1 and 2 evaluations, the implementation of proposed remedial measures (**Section 4.0**) and institutional controls, the Site can qualify for comprehensive NFR letter determination.

4.0 REMEDIAL ACTION PLAN

The following sections discuss the RAP designed to address COCs at the Site that are present in exceedance of site-specific soil ROs. The RAP discusses overall remediation goals and those areas of the Site where remedial measures will be used to exclude exposure pathways. Pathway exclusion will be accomplished by in-situ soil treatment, a groundwater use restriction, and as needed, the installation of engineered barriers, and the use of construction worker notifications as institutional controls.

4.1 REMEDIATION GOALS

As discussed in **Section 3.2.1**, the primary COCs within Site soils include VOCs and metals (aluminum, iron, lead, and manganese). Concentrations of these constituents were detected above one or more of the following Tier 1 ROs: industrial-commercial inhalation and ingestion, construction worker inhalation, Class I soil component of the groundwater ingestion and Class I groundwater ingestion pathway ROs. The primary concern driving remedial efforts is the elevated soil saturation conditions for PCE at one location.

Demolition of Spartans' Square Shopping Center has been completed as of this writing. The current and future zoning for the Site is commercial land use. Subsequent to completion of proposed remediation work (discussed below), the Site redevelopment plan calls for a parking lot on the west half of the Remediation Site and an open outlot for future commercial use on the east half.

Based on the above described impacts and in accordance with Site ROs (**Section 3.5**), the remedial goals for the Site are summarized as follows:

- Perform soil remediation (in-situ treatment) at and in the vicinity of soil borings SM-GP-08 and SM-GP-108 (the main treatment area), and along adjoining underground utility lines. The general treatment area of 60 feet x 45 feet encompassing these locations and features is shown on **Figures 3.1** and **3.2**. Specifically, the treated areas are:
    - At and between boring locations SM-GP-08 and SM-GP-108, an area of 35 ft by 15 ft and depth of 7.5 to 13.5 feet bgs at SM-GP-108 and a shallower interval of 5 to 8 feet deep at SM-GP-08, and
    - Along the existing water line (30 ft long by 6 ft wide) at depths of generally 3 to 6 feet bgs and along the existing sewer line (85 ft long by 6 ft wide) at depths of 6 to 9 feet bgs (depending on the actual depths of utility lines),
- The goal is to decrease PCE concentrations at location SM-GP-108 to below the TACO updated soil saturation limit (310 mg/kg) for the soil component of the groundwater ingestion exposure route. For the entire Remediation Area, the goal is to decrease PCE concentrations below 60 mg/kg, to meet RCRA Land Disposal Restriction Treatment Standards (35 IAC Part 728.149) and reduce the need for additional pre-treatment prior to any potential soil disposal.
- Based on results of in-situ soil treatment, address any remaining TACO risks for residual PCE in excess of Tier 1 industrial-commercial ingestion (110 mg/kg) or outdoor inhalation (20 mg/kg) ROs by the installation of engineered barriers to exclude exposure pathways, and
- Place institutional controls on the Site (refer to Section 3.5 above). Based on results of in-situ soil treatment, engineered barriers and/or construction worker notification areas may be implemented.

A detailed discussion regarding how the remediation goals will be met is presented in

subsequent sections of the RAP. Refer to **Table 1.1** for a summary of exceedances.

4.2 IN-SITU SOIL TREATMENT

As discussed in **Section 3.1**, a hotspot of PCE was identified above soil saturation limits at sample SM-GP-108 from 10-11 feet. Soils at and around this location contain PCE at concentrations above Tier 1 ROs. The proposed treatment method for these soils is in-situ mixing of soil with a chemical oxidizer.

4.2.1 Regulatory (RCRA) Considerations

Based on the former operation of a dry cleaning establishment at the Site, and the use of PCE in the dry cleaning operations, the PCE-impacted soils are considered a listed hazardous waste under RCRA regulations. The plan for addressing the RCRA listed soils includes onsite treatment by in-situ mixing of soils with a chemical oxidant. Once treated, it is intended that the soils will remain in place. To maintain compliance with RCRA regulations, at no time prior to, during or immediately following treatment, will the soils be excavated, consolidated, stockpiled or otherwise removed from the treatment area to any above-ground location. The chemical treatment must occur in-place without excavating or otherwise moving the soils from the treatment area. This will be adhered to until verification samples indicate treatment has effectively taken place.

Discussions with Rob Watson of the IEPA RCRA Permit Section indicate special permits or determinations are not required for performing this in-situ treatment. If soils are excavated in the future, these treated soils still need to be evaluated for waste disposal purposes and would need to be formally de-listed with the IEPA in order to dispose of soils as a special non-hazardous waste (otherwise it is still considered a listed hazardous waste). For any soils from this area that may require excavation for construction in the future, a "Contained-Out" Determination of the Contained-in Policy will be obtained from the IEPA RCRA Permit Section.

4.2.2 Insitu Chemical Oxidation

Industry-proven chemical oxidation products for solvent desorption and oxidation will be utilized and applied by a qualified remediation contractor. The specific product (oxidizer) utilized will be dependent upon the bid-approved remediation contractor and associated proprietary chemical make-up. At this time, the use of RegenOx or similar chemical oxidation product is anticipated.

Based on previous site investigation analytical results, overburden soils ranging from 3 to 7.5 feet deep (depending on location within the soil treatment area) will be excavated and stockpiled onsite for later use as backfill in the remediation area. The underlying impacted soils will be treated in-place in a number of successive "lifts" by placing an appropriate application rate of reagents on top of the soil, and then mixing it into the underlying materials with a backhoe bucket (or equivalent machinery).

The main treatment area will be divided into smaller cells. Each lift within a cell will be approximately 2-3 feet thick, so that the application rate can be controlled and the soils evenly mixed. The adjacent cells will be treated in a leap-frog manner from one end of the treatment area to the other, to keep the untreated contaminated soils and treated soils inside of the excavation (per RCRA regulations). This method of treatment will continue until the impacted depth interval of the entire treatment area has been treated.

Any remaining underground utility lines (water, sewer and the like) present within the treatment area will be severed and plugged at the edges of the treatment areas. The severed lines will be removed from the treatment areas and the trench soils will be chemically treated and mixed as described above.

Groundwater that is encountered in the treatment interval will be treated with the soil. If the water needs to be managed, it will be removed and hauled offsite for disposal by a licensed liquid waste hauler/disposal company, as needed.

4.2.3 Remediation Verification Sampling

The chemical oxidation treatment process typically reduces VOC concentrations by 50% over the first 24 hours, and continues to reduce concentrations over a 2-3 week period. At approximately 3 weeks following the chemical application, verification soil samples will be collected and submitted to the laboratory for chemical analysis of VOCs.

Verification samples will be collected utilizing push-probe technology. Samples will be collected a maximum of every 20 feet of lateral spacing from the sidewalls of the treatment interval and from the bottoms of the treatment areas. Samples will also be collected from the vertical center of the treated soils using a maximum lateral spacing of 20 feet.

Cleanup actions will be deemed successful when soil verification samples are below the soil saturation limit. Beyond this, the goal is to treat soils below Tier 1 ROs for ingestion and inhalation. However, if some of the verification sample concentrations are above Tier 1 ROs, the option to re-treat or install engineered barriers and building-related controls will be considered at that time.

4.2.4 Excavation Backfill

Following successful soil treatment and verification sampling, the previously excavated and stockpiled 3 to 7.5 ft of overburden soils will be used to complete the backfill of the soil treatment areas.

The final grade of the Site will be completed by adding 18-inches of imported fill soil. The imported soil will consist of previously certified TACO clean material, or will be sampled for chemical analysis and evaluated by V3 for Tier 1 residential compliance prior to accepting and bringing the soils onsite. Representative samples of the proposed imported fill soil will be collected and submitted to an Illinois NELAP accredited laboratory for chemical analysis. One representative soil sample will be collected for every 500 cubic yards of soil, which will be analyzed for Target Compound List (TCL) analytes and pH. Any soils imported onto the Site must achieve Tier 1 Residential ROs. V3 will review the laboratory reports and communicate to the contractor which soils are acceptable for import. Any imported soils deemed unsuitable will not be used at the Site.

4.3 SITE PREPARATION

Site preparation may include, but is not limited to, the following:

- Installation of temporary security fencing;
- Use of ambient air monitoring equipment (PID); and
- Field locating site underground utilities.

4.4 ENGINEERED BARRIERS AND INSTITUTIONAL CONTROLS

4.4.1 Engineered Barriers

The construction of engineered barriers will be included as part of the remedial action plan, if

the in-situ soil treatment does not meet outdoor inhalation or ingestion ROs. As per Section 742.310(a)(1) and 742.315(b), the soil outdoor inhalation and ingestion exposure routes, respectively, may be excluded from consideration if an appropriate engineered barrier is in place, as set forth in Subpart K. The NFR letter will require current and future property owners to maintain the integrity of the specified surface barriers as well as restrict all subsurface construction to qualified personnel (i.e., in accordance with applicable OSHA regulations) as applicable to the specified areas. As per Section 742.1105(c)(2) and 742.1105(c)(3), these barriers will exclude the soil ingestion and outdoor inhalation routes.

The outdoor inhalation RO for PCE is lower than the ingestion RO (20 mg/kg vs. 110 mg/kg). Therefore, any engineered barrier will need to first meet outdoor inhalation barrier requirements, which are more restrictive, and will also meet ingestion barrier requirements.

The areas of the Site, where COC concentrations exceed the ROs for the industrial-commercial soil ingestion and outdoor inhalation exposure routes, will be covered with an engineered barrier that will include:

- Type I Engineered Barrier: "Alternative" subsurface barrier of two feet of clean soil (clay) underlain by a 60-mil HDPE geomembrane per 742.1105(c)(2)(A) and 742.1105(c)(3)(A).
- Type II Engineered Barrier: Hardened engineered barriers constructed of asphalt or concrete pavements and concrete building slabs.

The need for engineered barriers will be evaluated following the verification sampling of in-situ soil treatment. If installed, barriers will include a combination of the Type I and Type II engineered barriers, more specifically described below.

The maximum area for the potential barrier is 60 feet x 45 feet (**Figure 3.3**).

Type IA Engineered Barrier Approval: If needed to avoid a second application of treatment chemicals or to minimize any residual soil requiring removal and disposal, and to minimize required grade alterations, the RA is requesting approval of the use of the Type IA barrier with a minimum soil cover thickness of 2-ft underlain by a 60-mil HDPE geomembrane for outdoor inhalation and ingestion exposure. The HDPE geomembrane is compatible with the COCs and is a strong material that will prevent unintended access to and deter the ingestion and inhalation of the underlying soils. In combination with the proposed 2-ft of overlying fill, it is our judgment this barrier type provides a strong and effective ingestion and outdoor inhalation barrier equivalent to 3' and 10' of clean soil, respectively. Example specifications for a 60-mil geomembrane or similar brand are anticipated, and are provided in **Appendix E**.

During future utility construction, at any points where constructed utilities (e.g., sanitary or storm sewer, water main, etc.) intersect the lateral extent of the engineered barrier, a 10-foot length of "flowable" fill that encapsulates the utility will be placed from the edge of the geomembrane limits outward from the barrier. Flowable fill will be used rather than typical granular trench backfill to prevent vapor migration. The fill will be constructed in accordance with the controlled low-strength material (CLSM) specification provided in the "IDOT Supplemental Specifications and Recurring Special Provisions Manual, Checksheet #24".

Imported soil or aggregate fill that is needed to complete the Site barriers will either be certified TACO clean, or sampled and evaluated by V3 for Tier 1 residential compliance prior to accepting and bringing the soils onsite.

As necessary, representative samples of imported soil or aggregate will be collected and submitted to an Illinois NELAP accredited laboratory for chemical analysis. One representative soil sample for every 500 cubic yards of soil will be collected for laboratory analysis for Target Compound List (TCL) analytes and pH. Any soils imported onto the Site must achieve Tier 1 Residential ROs. V3 will review the laboratory reports and communicate to the contractor which soils are acceptable for import. Any imported soils deemed unsuitable will not be used at the Site.

Type II Engineered Barrier Approval: A Type II engineered barrier will be a concrete or asphalt surface that may be used for building slabs, sidewalks, parking areas and internal roadways. The concrete or asphalt will be constructed of a structurally appropriate thickness according to its use with a structurally appropriate thickness of granular base material underneath. Any slabs or pavements used as barrier will include a minimum 4" of concrete or asphalt underlain by a minimum 4" of granular base.

4.4.2 Institutional Controls

Section 742.1000 (Title 35 IAC Part 742) of TACO requires establishment of institutional controls when ROs are based on industrial-commercial property use. The Village of Romeoville is planning on maintaining the Site for commercial use. Institutional controls and the use of engineered barriers may be considered as remedial solutions to exclude the ingestion and inhalation pathways, after the Subpart C source criteria are first satisfied.

As per Section 742.1000(a), institutional controls will be placed on the Site that will:

- Restrict all subsurface construction to qualified personnel (i.e., in accordance with applicable OSHA regulations) and provide notification to construction workers of site conditions as applicable to a maximum area of 60 feet x 45 feet area;
- Prevent the installation and/or use of potable wells and restrict groundwater usage at the Site, and in potentially impacted off-site areas, by using the Village of Romeoville limited groundwater ordinances as an institutional control for excluding groundwater use. Copies of the southern adjoining ordinance was provided in CSIR/ROR dated April 26, 2010 and the Spartans' Square groundwater use ordinance is concurrently being submitted for review;
- Maintain engineered barriers to exclude exposure routes as applicable to specified areas; and,
- Require any existing or potential buildings located over the current extent of soil gas and/or groundwater contamination to have a full concrete slab-on-grade floor or full concrete basement floor and walls with no sump(s).

Based upon the results of the soil gas investigation, there are no existing buildings with indoor inhalation exposure risks. The soil gas investigation also indicates that risks are not present where PCE in groundwater was a concern, and that off-site migration of VOCs within soil gas in excess of Tier 1 ROs is not occurring.

4.5 REMEDIAL ACTION COMPLETION REPORT (RACR)

Upon completion of remedial activities and post-remediation data evaluation, a RACR will be prepared for submittal to IEPA. The report will describe the field activities performed in addition to summarizing the following:

- Completion of the remedial action in accordance with the approved RAP;
- Results of the post-remediation data evaluation; and,

- Documentation that Tier 1 and Site-specific ROs, as well as any other requirements of the RAP, have been attained.

4.6 NO FURTHER REMEDIATION (NFR) LETTER

A NFR letter will be warranted, once exposure routes are excluded through remediation, potential engineered barrier construction, and the placement of deed restrictions on the property that would:

- Restrict subsurface construction in specific areas to qualified personnel (i.e., in accordance with applicable OSHA regulations);
- Restrict groundwater usage at the Site, and potentially impacted off-site areas;
- Require maintenance of the engineered barriers established to exclude exposure routes; and,
- Require any existing or potential buildings located over the current extent of soil gas and/or groundwater contamination to have a full concrete slab-on-grade floor or full concrete basement floor and walls with no sump(s).

5.0 CONCLUSIONS

This report, combined with the previously submitted CSIR/ROR as addended by this report, documents the completion of the Comprehensive Site Investigation, Remediation Objectives report along with the Remedial Action Plan.

In February 2013, V3 performed the additional site characterization activities necessary to evaluate the potential indoor inhalation exposure pathway, based upon the identified VOC soil impacts documented in the CSIR. This report addresses the SSI and TACO evaluation performed in pursuit of a comprehensive NFR letter for the Site. It is the judgment of the Site's licensed professional engineer (LPE) that the supporting data relied upon by V3 Companies meets the intent of the Illinois Environmental Protection Act, as relied upon, and is suitable for consideration by the Agency as supplemental site data.

The supplemental investigation and related evaluations, in conjunction with the data and evaluations from V3's CSI/ROR, performed in conformance with the requirements of 35 IAC Section 740.425, 740.440, 740.445, 740.450, provides a complete presentation of historical data, and investigations related to the Site. It is the LPE's judgment the data and associated evaluations of this CSI/ROR/RAP are adequate for characterization of the identified Site RECs.

The following redefined RECs were evaluated:

- **VOCs Impacts from Former Dry Cleaning Operations:** This includes soil and groundwater VOC impacts that resulted from former dry cleaners operations at the Site.
- **Metals in Groundwater:** This includes metals groundwater impacts identified in two wells sampled on the southeast side of the Site.

Site COCs: As documented in the CSIR, the confirmed Site COCs include:

- **Metals (groundwater)**
  - Four metals (aluminum, iron, lead and manganese) have been identified in groundwater in excess of Tier 1 RO at two wells. However, it is not apparent that the encountered concentrations represent a notable groundwater concern, and may be the result of relatively high suspended solids within collected samples.
  - The exposure pathway of concern for metals is only the Tier 1 direct groundwater ingestion route.
- **VOCs (soil and groundwater)**
  - VOCs were identified in excess of Tier 1 ROs in multiple soil samples and monitoring wells. Identified PCE concentrations and its daughter products are due to former dry cleaning operations. Chloroform is also identified as a historical dry cleaning solvent. However, the presence of chloroform, bromodichloromethane, and bromoform could be the result of disinfection byproducts of drinking water or laboratory standard reagents for analysis, unrelated to the Site. BTEX was not identified in the laboratory analysis above Tier 1 ROs, and only one low detection of toluene was noted.
  - The exposure pathways of concern are Tier 1 soil ingestion, inhalation, soil component of the groundwater ingestion route and direct groundwater ingestion.

Based on the approval of Tier 1 and 2 evaluations, the implementation of proposed remedial actions (in-situ soil treatment and engineered barriers (as needed)), and the following institutional controls, the Site can qualify for an NFR determination:

- Provide pathway exclusion for the ingestion and/or inhalation exposure route through the maintenance of an engineered barrier;
- Provide notification to construction workers of site conditions and assure all work is completed pursuant to OSHA requirements;
- Prevent the installation and/or use of potable wells and restrict groundwater usage at the Site, and in potentially impacted off-site areas, by using the Village of Romeoville limited groundwater ordinances as an institutional control for excluding groundwater use; and,
- Require any existing or potential buildings located over the current extent of soil gas and/or groundwater contamination to have a full concrete slab-on-grade floor or full concrete basement floor and walls with no sump(s).

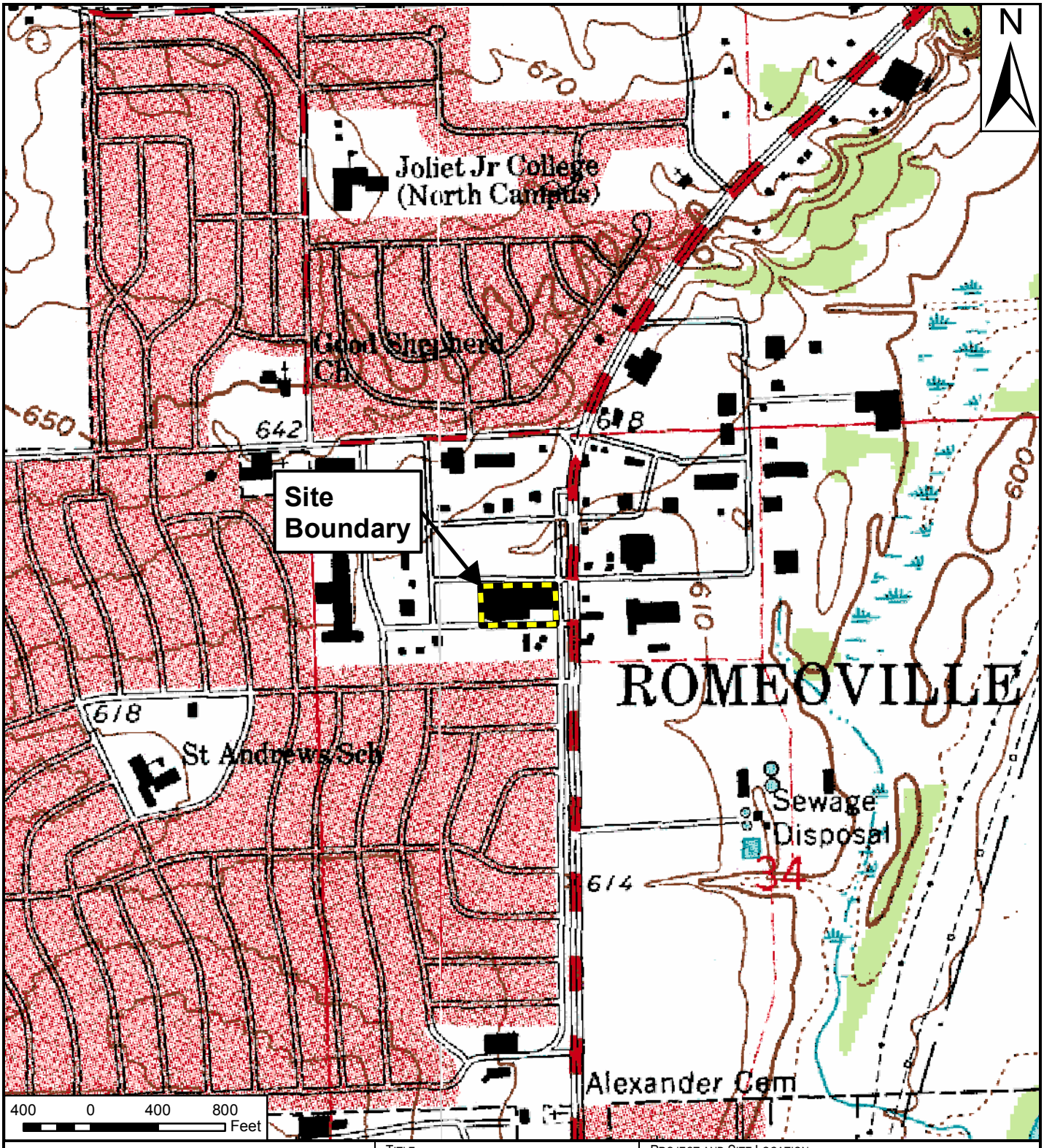
6.0 LICENSED PROFESSIONAL ENGINEER AFFIRMATION

I attest that the Site Investigation and/or remedial measures, with the exception of those performed by others (namely ERS), that are the subject of this plan or report were performed under my direction and this document and all attachments were prepared under my direction or reviewed by me, and, to the best of my knowledge and belief, the work described in the plan or report has been designed or completed in accordance with the Act, 35 Ill. Adm. Code 740, and generally accepted engineering practices, and the information presented is accurate and complete, except as otherwise noted. While V3 Companies cannot fully validate analytical results reviewed within historical site reports, in accordance with 35 Ill. Adm. Code 740, Section 740.410, it is my judgment that the historical data documenting previous site investigations performed by others (namely ERS), and relied upon by V3 Companies, meet the intent of the Illinois Environmental Protection Act, as relied upon, and are suitable for consideration by the Agency as supplemental site data.

Rachael K. Berthiaume, P.E.
V3 COMPANIES

June 2013
Date

FIGURES



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630.724.9202 fax
www.v3co.com

TITLE: **Site Location Map**	PROJECT AND SITE LOCATION: **Spartans' Square Shopping Center NWC Illinois Route 53 and Alexander Circle Romeoville, Illinois 60446**		
BASE LAYER: USGS Topographic Map (1993)	PROJECT NO. 07292	FIGURE: 1.1	SHEET: 1 OF: 1
CLIENT: **Village of Romeoville 13 Montrose Drive Romeoville, Illinois 60446**	QUADRANGLE: Romeoville, IL	DATE: 12/04/09	SCALE: See Scale Bar

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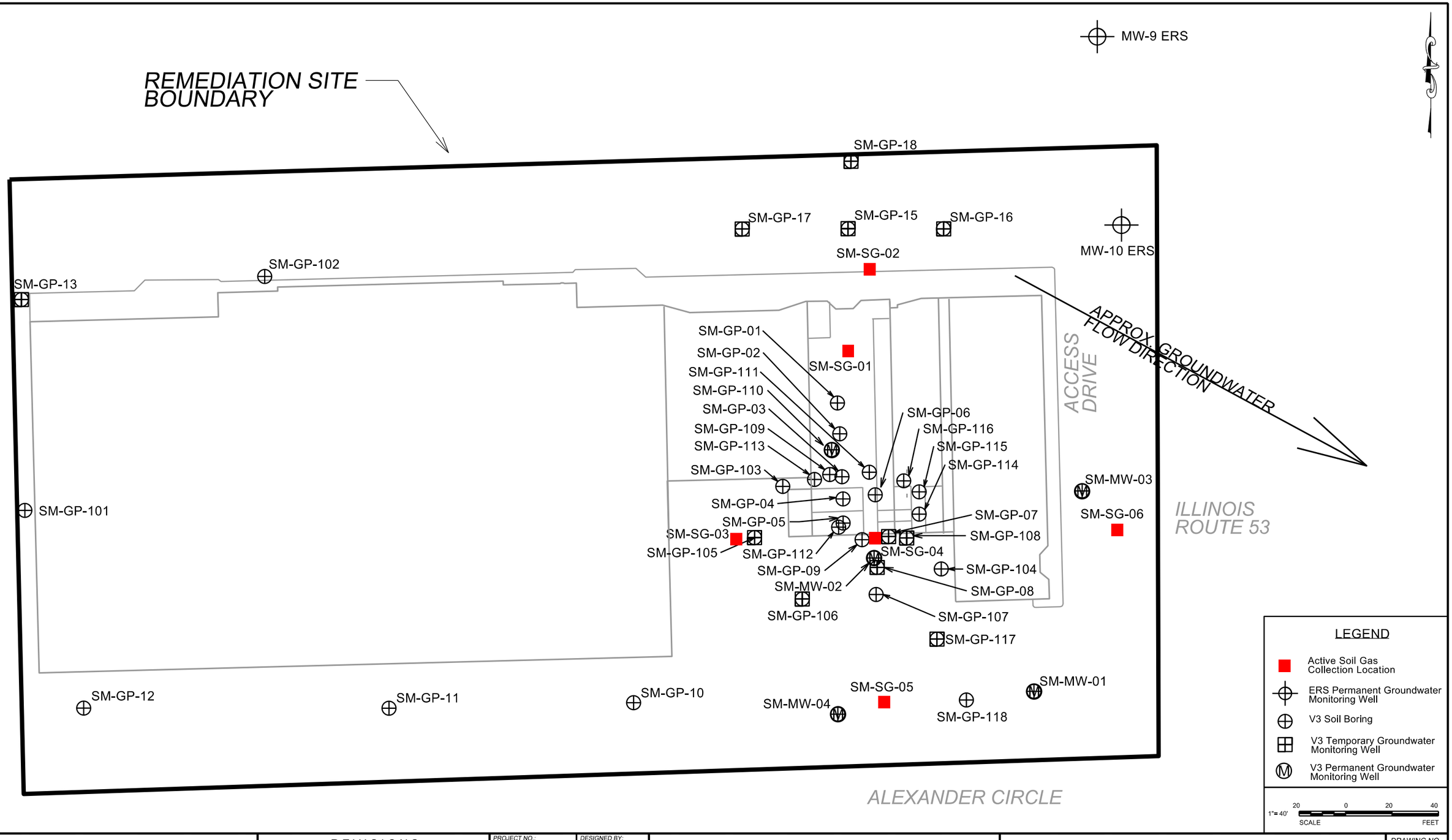
TITLE: **Site Vicinity Map**	PROJECT AND SITE LOCATION: **Spartans' Square Shopping Center NWC Illinois Route 53 and Alexander Circle Romeoville, Illinois 60446**		
BASE LAYER: DigitalGlobe (2011)	PROJECT NO. 07292	FIGURE: 1.2	SHEET: 1 OF: 1
CLIENT: **Village of Romeoville 13 Montrose Drive Romeoville, Illinois 60446**	QUADRANGLE: N/A	DATE: 12/04/09	SCALE: See Scale Bar



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REVISIONS

NO.	DATE	DESCRIPTION

PROJECT NO.: 07292	DESIGNED BY: KJW
FILE NAME: FIG_SGSsamples_active	DRAWN BY: RKB
DATE: 02/28/13	CHECKED BY: CAM
SCALE: 1"=40'	PROJECT MANAGER: CAM

SPARTANS' SQUARE SHOPPING CENTER

ROMEOVILLE ILLINOIS

SOIL BORING, SOIL GAS AND MONITORING WELL LOCATION MAP

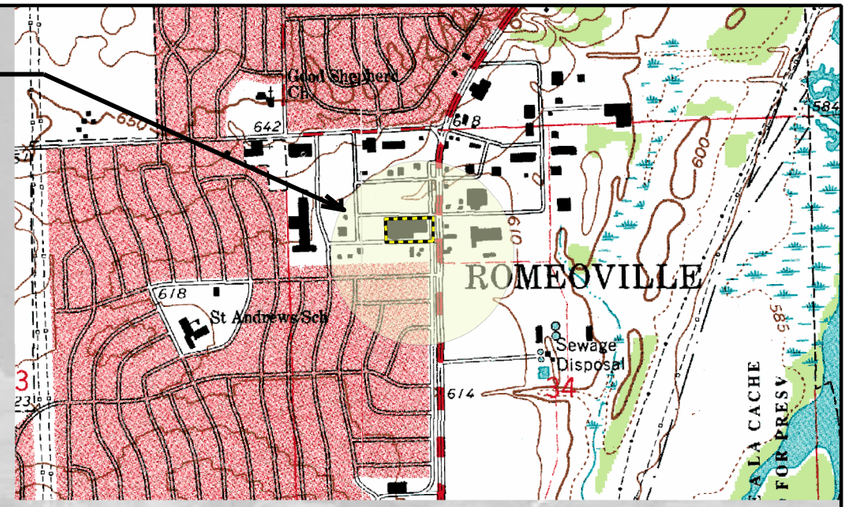
DRAWING NO. **2.1**

07292 - ACTIVE SOIL GAS COLLECTION LOCATIONS

E:\2007\07292\Drawings\Mstn\Supp CSI-ROR-RAP\FIG_SGSsamples_active07292.dgn 8/21/2013 4:23:38 PM

FIG_SGSsamples_active07292.dgn 6/21/2013 4:23:38 PM

GROUNDWATER ORDINANCE



REMEDIATION SITE BOUNDARY

ILLINOIS ROUTE 53

ACCESS DRIVE

ALEXANDER CIRCLE

EXTENT OF PREDICTED CONTAMINATE OF CONCERN PLUME

1"= 80' SCALE 40 0 40 80 FEET

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NO.	DATE	DESCRIPTION

PROJECT NO.: 07292	DESIGNED BY: KJW
FILE NAME: FIGtier2_07292	DRAWN BY: KJW
DATE: 02/28/13	CHECKED BY: CAM
SCALE: 1"=80'	PROJECT MANAGER: CAM

SPARTANS' SQUARE SHOPPING CENTER

ROMEOVILLE ILLINOIS

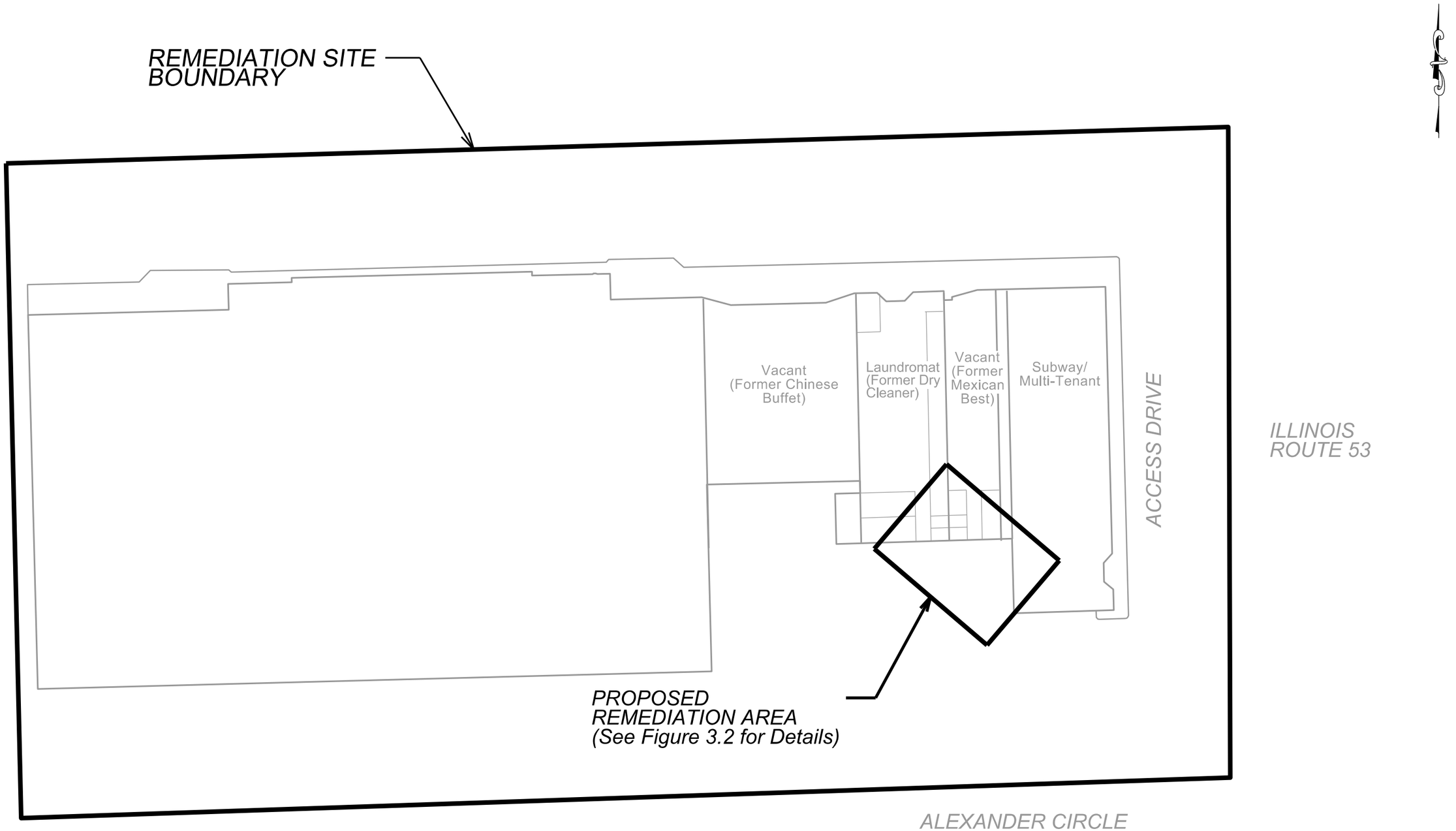
TIER 2 SIMULATION MAP AND ORDINANCE AREA

DRAWING NO. 2.2

07292 - TIER 2 SIMULATION MAP AND ORDINANCE AREA

E:\2007\07292\Drawings\Mstn\Supp CSI-ROR-RAP\FIGtier2_07292.dgn 8/21/2013 4:57:21 PM

FIGtier2_07292.dgn 6/21/2013 4:57:24 PM



1"= 40' SCALE 20 0 20 40 FEET

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NO.	DATE	DESCRIPTION

PROJECT NO.: 07292	DESIGNED BY: KJW
FILE NAME: FIGpsoil_rem07292	DRAWN BY: RKB
DATE: 02/28/13	CHECKED BY: CAM
SCALE: 1"=40'	PROJECT MANAGER: CAM

SPARTANS' SQUARE SHOPPING CENTER

ROMEOVILLE ILLINOIS

PROPOSED SOIL REMEDIATION AREA

DRAWING NO. 3.1

07292 - PROPOSED SOIL REMEDIATION AREAS

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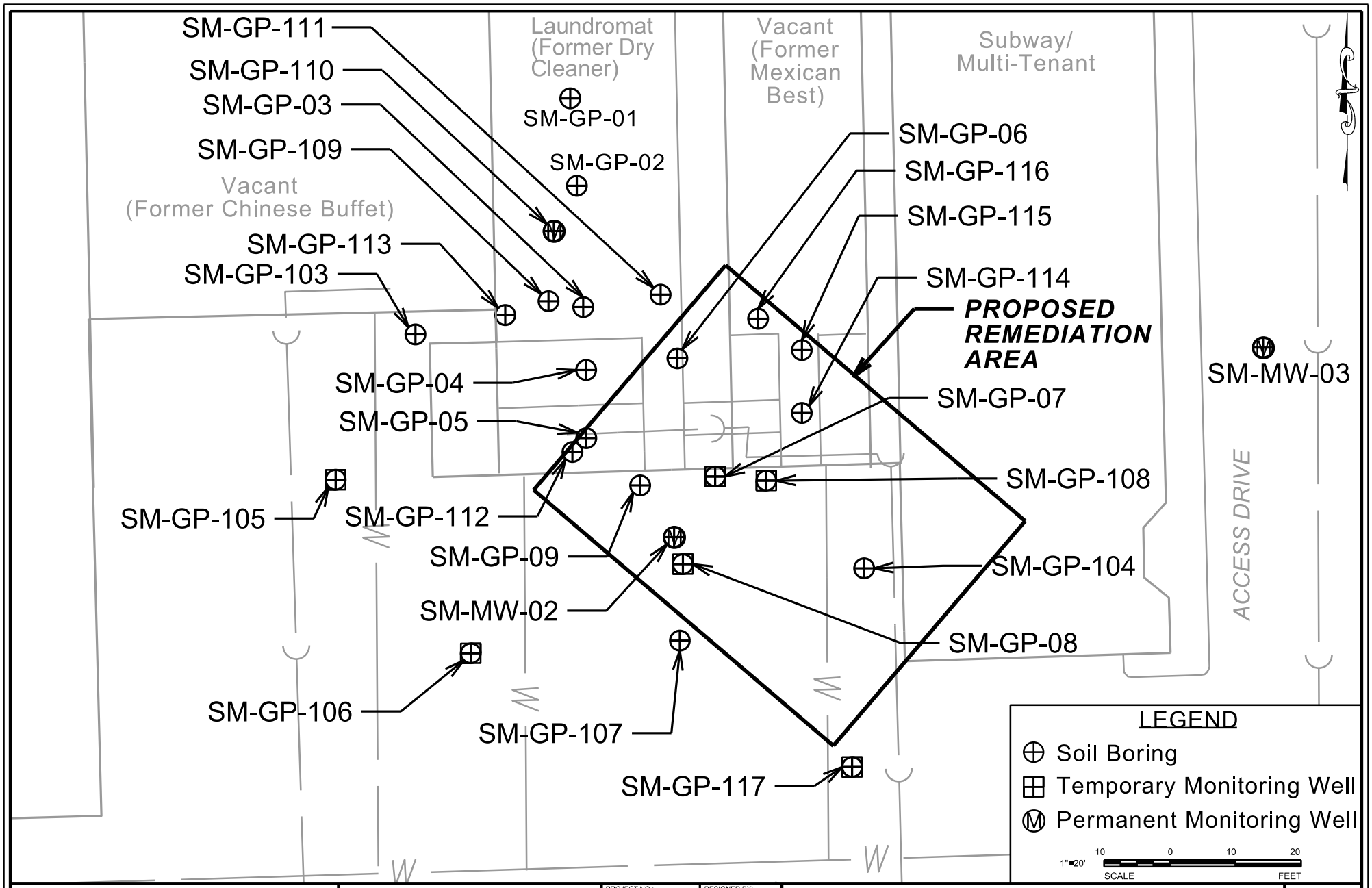
FIGpsoil_rem07292.dgn 6/21/2013 3:30:51 PM



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NO.	DATE	DESCRIPTION

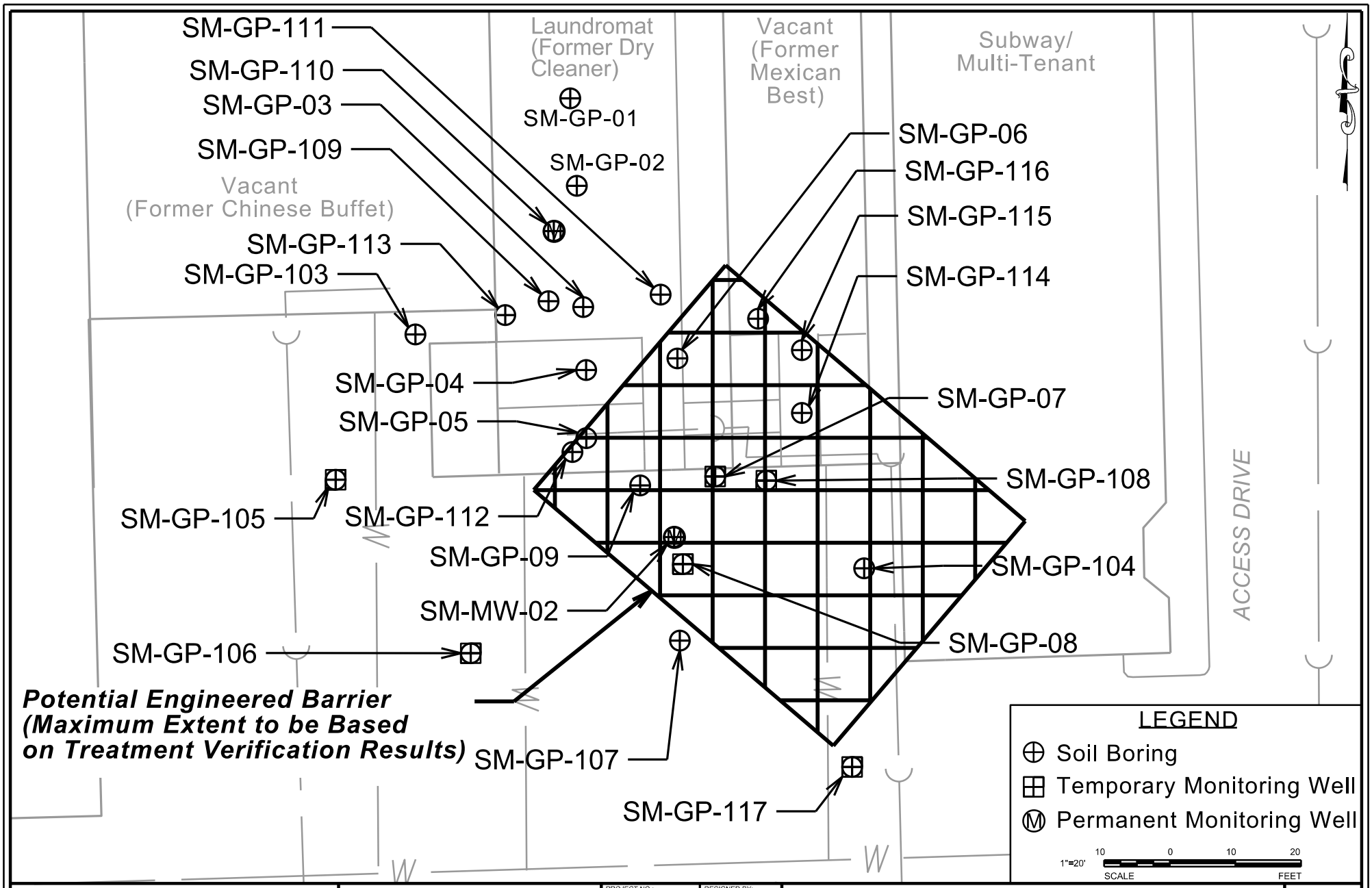
PROJECT NO.: 07292	DESIGNED BY: KJW
FILE NAME: FIGrem07292	DRAWN BY: KJW
DATE: 02/28/13	CHECKED BY: CAM
SCALE: 1"=20'	PROJECT MANAGER: CAM

PROPOSED IN-SITU TREATMENT AREA
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE ILLINOIS

DRAWING NO. **3.2**

E:\2007\07292\Drawings\Mstn\Supp CSI-ROR-RAP\FIGrem07292.dgn 6/21/2013 5:00:25 PM

FIGrem07292.dgn 6/21/2013 5:00:25 PM



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NO.	DATE	DESCRIPTION

PROJECT NO.: 07292	DESIGNED BY: KJW
FILE NAME: FIGpeng_barrier07292	DRAWN BY: KJW
DATE: 02/28/13	CHECKED BY: CAM
SCALE: 1"=20'	PROJECT MANAGER: CAM

PROPOSED ENGINEERED BARRIER

SPARTANS' SQUARE SHOPPING CENTER

ROMEOVILLE ILLINOIS

DRAWING NO. 3.3

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FIGpeng_barrier07292.dgn 6/21/2013 4:58:18 PM

TABLES

Table 1.1
Summary of Soil and Groundwater Samples Above TACO Tier 1 ROs
Spartans Square Shopping Center, Romeoville, IL

SAMPLE I.D.	Soil Sample Depth	Soil Sample	Groundwater Sample	Soil Gas Sample	ANALYSES PERFORMED: VOCs	BTEX+MTBE	SVOCs	PNAs	TAL Metals	Pesticides/PCBs	Exceedances of TACO Tier 1 Remediation Objectives	TIER 1 REMEDIATION OBJECTIVES EXCEEDANCES: Industrial-Commercial Ingestion	Industrial-Commercial Inhalation	Construction Worker Ingestion	Construction Worker Inhalation	Residential Ingestion	Residential Inhalation	Soil Component of the Groundwater Ingestion Exposure Route	Groundwater
												Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class I
ERS Monitoring Wells																			
MW-9 (Sampled by ERS 10/11/06)			X			X		X			**5 PNAs**								**BAA, BBF, BKF, BAP, IP**
MW-10 (Sampled by ERS 10/11/06)			X			X		X			**4 PNAs**								**BAA, BBF, BKF, BAP (see updated V3 sample)**
MW-10 (Sampled by V3 11/19/08)			X		X			X											
V3 Investigation January 2008																			
SM-GP-01	0-2	X			X														
SM-GP-02	2-4	X			X														
SM-GP-03	0-2	X			X						**1 VOC**							**PCE**	
	6-7	X			X														
SM-GP-04	0-2	X			X														
SM-GP-05	0-2	X			X														
	2-4	X			X														
SM-GP-07	10-12	X			X						**1 VOC**					**PCE**	**PCE**	**PCE**	
SM-GP-07-GW (Temp Well) SM-GP-07			X		X						**1 VOC**								**PCE**
SM-GP-08	8-10	X			X						**1 VOC**		**PCE**		**PCE**	**PCE**	**PCE**	**PCE**	
SM-GP-08-GW (Temp Well) SM-GP-08			X		X						**1 VOC**								**PCE**
SM-GP-09	0-2	X			X														
V3 Supplemental Investigation April 2008																			
Soil																			
SM-GP-10	4-6	X						X											
SM-GP-11	6-8	X						X											
SM-GP-12	4-6	X						X											
SM-GP-13 (GW) (Temp Well) SM-GP-13			X		X														
SM-GP-14 (GW) (Temp Well) SM-GP-14 [off-Site]			X			X													
SM-GP-15	0-2	X			X														
SM-GP-15 (GW) (Temp Well) SM-GP-15			X		X														
SM-GP-16 (GW) (Temp Well) SM-GP-16			X		X														
SM-GP-17 (GW) (Temp Well) SM-GP-17			X		X														
SM-GP-18 (GW) (Temp Well) SM-GP-18			X		X														
V3/OSE Supplemental Investigation November 2008																			
Soil																			
X101 SM-GP-101	10-12	X			X		X		X										
X102 SM-GP-102	14-16	X			X		X	X	X	X									
X103 SM-GP-103	10-11	X			X						**1 VOC**							**PCE**	
X104 SM-GP-104	10-11	X			X		X				**1 VOC**							**PCE**	
X105A SM-GP-105	2-3	X			X														
X105B SM-GP-105	10-11	X			X														
G105 (Temp Well) SM-GP-105			X		X														
X106 SM-GP-106	10-11	X			X														
G106 (Temp Well) SM-GP-106			X		X														
X107A SM-GP-107 MS/MSD	2-3	X			X						**1 VOC**							**PCE**	
X107B SM-GP-107 MS/MSD	7-9	X			X						**1 VOC**							**PCE**	
X108A SM-GP-108	2-3	X			X														
X108B SM-GP-108 MS/MSD	10-11	X			X			X			**2 VOCs, Exceeds Soil Sat. for PCE**	**PCE**	**PCE**		**PCE**	**PCE**	**PCE**	**PCE, TCE**	
G108 (Temp Well) SM-GP-108			X		X		X		X	X	**1 VOC**								**PCE**
X110A SM-GP-110	2-3	X			X														
X110B SM-GP-110	10-11	X			X						**1 VOC**							**PCE**	
G110 (Temp Well) SM-GP-110			X		X														
X111A SM-GP-111	2-3	X			X		X		X	X									
X111B SM-GP-111	8-9	X			X			X	X	X	**1 VOC**							**PCE**	
X112A SM-GP-112	2-3	X			X														
X112B SM-GP-112	8-9	X			X														
X113A SM-GP-113	5-6	X			X														
X113B SM-GP-113	7-8	X			X														
X114A SM-GP-114	2-3	X			X		X		X	X									
X114B SM-GP-114	8-9	X			X			X			**1 VOC**							**PCE**	
X115 SM-GP-115	7.5-8.5	X			X			X			**1 VOC**							**PCE**	

Table 1.1
Summary of Soil and Groundwater Samples Above TACO Tier 1 ROs
Spartans Square Shopping Center, Romeoville, IL

SAMPLE I.D.	Soil Sample Depth	Soil Sample	Groundwater Sample	Soil Gas Sample	ANALYSES PERFORMED: VOCs	BTEX+MTBE	SVOCs	PNAs	TAL Metals	Pesticides/PCBs	Exceedances of TACO Tier 1 Remediation Objectives	TIER 1 REMEDIATION OBJECTIVES EXCEEDANCES: Industrial-Commercial Ingestion	Industrial-Commercial Inhalation	Construction Worker Ingestion	Construction Worker Inhalation	Residential Ingestion	Residential Inhalation	Soil Component of the Groundwater Ingestion Exposure Route	Groundwater
												Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class I
X116 SM-GP-116	7.5-8.5	X			X			X			1 VOC							PCE	
X11 7 SM-GP-117	10-11	X			X		X		X	X	1 VOC							PCE	
G117 (Temp Well) SM-GP-117			X		X		X	X	X	X	1 VOC								PCE
X118A SM-GP-118	2-3	X			X														
X118B SM-GP-118	9-10	X			X														
V3/OSE Well Installation May 2009																			
G101 SM-MW-01 G101 MS/MSD			X		X		X		X	X	1 VOC, 3 Metals								PCE, Al, Fe, Pb, Mn
G102 SM-MW-02			X		X		X		X	X	4 VOCs								PCE, BDM, Bromoform, Chloroform
G103 SM-MW-03			X		X		X		X	X	3 VOCs								BDM, Chloroform, PCE
G104 SM-MW-04			X		X		X		X	X	4 Metals								Al, Fe, Pb, Mn
V3 Soil Gas Survey February 2013																			
SM-SG-01				X	X														
SM-SG-02				X	X														
SM-SG-03				X	X														
SM-SG-04				X	X														
SM-SG-05				X	X														
SM-SG-06				X	X														

BAA =Benzo(a)anthracene, BBF= Benzo(b)fluoranthene, BAP=Benzo(a)pyrene, BKF=benzo(k)flouranthene, IP=Indeno(1,2,3, cd)pyrene
PCE= Tetrachloroethene, BDM= Bromodichloromethane
Al=Aluminum, Fe=Iron, Pb=Lead, Mn=Manganese
X112 = OSE Sample/Boring Location
MS/MSD = Matrix Spike/Matrix Spike Duplicate
G105 = OSE Sample/Well Location
Chemicals with laboratory reporting limits > Remediation Objectives are not indicated on this table.
SM-GP-101 = V3 Geoprobe (GP) Location
SM-MW-01 = V3 Monitoring Well (MW) Location

TABLE 2.1 - SOIL GAS ANALYTICAL RESULTS (VOCs)
SPARTANS ' SQUARE
ROMEOVILLE, IL

Proposed TACO Amendments [Second Notice 03-07-2013]

Appendix B, Table H: Tier 1 Soil Gas Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection (Qsoil = 83.33 cm3/sec) [a]

Chemical Name	Soil Gas Industrial/ Commercial (mg/m^3)	V3 02/19/13 SM-SG-01 mg/m^3	V3 02/19/13 SM-SG-02 mg/m^3	V3 02/19/13 SM-SG-03 mg/m^3	V3 02/19/13 SM-SG-04 mg/m^3	V3 02/19/13 SM-SG-05 mg/m^3	V3 02/19/13 SM-SG-06 mg/m^3
Volatile Organic Compounds (Method - TO-15)							
1,1,1-Trichloroethane	41,000[b]	< 0.0016	< 0.0016	< 0.0017	< 0.0016	< 0.0016	< 0.0017
1,1,2,2-Tetrachloroethane	----	< 0.0021	< 0.0021	< 0.0021	< 0.0021	< 0.0021	< 0.0021
1,1,2-Trichloroethane	170,000[f]	< 0.0016	< 0.0016	< 0.0017	< 0.0016	< 0.0016	< 0.0017
1,1-Dichloroethane	4,200[b]	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012
1,1-Dichloroethene (1,1-Dichloroethylene)	1,600[b]	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012
1,2,4-Trichlorobenzene	25[b]	< 0.0022	< 0.0022	< 0.0023	< 0.0022	< 0.0022	< 0.0023
1,2,4-Trimethylbenzene	----	0.02	< 0.0015	0.0035	0.004	0.0039	0.0035
1,2-Dibromoethane	0.048[c]	< 0.0022	< 0.0022	< 0.0023	< 0.0022	< 0.0022	< 0.0023
1,2-Dichlorobenzene	1,700[b]	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018
1,2-Dichloroethane (Ethylene dichloride)	0.81[c]	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012
1,2-Dichloropropane	2.3[c]	< 0.0013	< 0.0013	< 0.0014	< 0.0013	< 0.0013	< 0.0014
1,3,5-Trimethylbenzene	----	0.0072	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
1,3-Butadiene	----	0.0015	0.0027	0.0053	0.0013	0.00093	0.0011
1,3-Dichlorobenzene	----	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018
1,4-Dichlorobenzene	6,800[b]	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018
p-Dioxane (1,4-Dioxane)	2.3[c]	< 0.0027	< 0.0027	< 0.0027	< 0.0027	< 0.0027	< 0.0027
2-Butanone (MEK)	40,000[b]	0.14	0.018	0.02	0.017	0.018	0.019
2-Hexanone	----	< 0.0061	< 0.0061	< 0.0062	< 0.0061	< 0.0061	< 0.0062
4-Ethyltoluene	----	0.007	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
4-Methyl-2-pentanone	----	0.0085	< 0.0061	< 0.0062	< 0.0061	< 0.0061	< 0.0062
Acetone	750,000[f]	0.32	0.081	0.075	0.058	0.065	0.071
Benzene	2.8[c]	0.013	0.0039	0.0034	0.003	0.0035	0.0032
Benzyl chloride	----	< 0.0039	< 0.0039	< 0.0039	< 0.0039	< 0.0039	< 0.0039
Bromodichloromethane (Dichlorobromomethane)	450,000[f]	< 0.0019	< 0.0019	< 0.002	< 0.0019	< 0.0019	< 0.002
Bromoform	52[c]	< 0.0078	< 0.0078	< 0.0078	< 0.0078	< 0.0078	< 0.0078
Bromomethane	----	< 0.0028	< 0.0028	< 0.0029	< 0.0028	< 0.0028	< 0.0029
Carbon disulfide	5,300[b]	0.0059	0.0055	0.0069	0.0041	0.0046	0.0048
Carbon tetrachloride	1.5[c]	< 0.0019	< 0.0019	< 0.002	< 0.0019	< 0.0019	< 0.002
Chlorobenzene (Monochlorobenzene)	420[b]	< 0.0013	< 0.0013	< 0.0014	< 0.0013	< 0.0013	< 0.0014
Chloroethane	----	< 0.00075	< 0.00075	< 0.00075	< 0.00075	< 0.00075	< 0.00075
Chloroform	0.92[c]	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
Chloromethane	----	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	1,100,000[f]	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012
cis-1,3-Dichloropropene (1)	6.2[c]	< 0.0013	< 0.0013	< 0.0014	< 0.0013	< 0.0013	< 0.0014
Cyclohexane	----	0.009	0.0038	0.004	0.0028	0.0041	0.0039
Chlorodibromomethane (Dibromochloromethane)	57,000[f]	< 0.0025	< 0.0025	< 0.0026	< 0.0025	< 0.0025	< 0.0026
Dichlorodifluoromethane	1,700[b]	0.0027	< 0.0015	0.0021	0.0021	0.0021	0.003
Ethyl acetate	----	0.0072	0.0026	0.0015	0.0045	0.0045	0.0038
Ethylbenzene	9.3[c]	0.017	0.0038	0.0038	0.0037	0.0037	0.0036
Freon-113	----	< 0.0022	< 0.0022	< 0.0023	< 0.0022	< 0.0022	< 0.0023
Freon-114	----	< 0.01	< 0.01	< 0.011	< 0.01	< 0.01	< 0.011
Heptane	----	0.021	0.006	0.006	0.0053	0.0069	0.0057
Hexachlorobutadiene	----	< 0.0031	< 0.0031	< 0.0032	< 0.0031	< 0.0031	< 0.0032
Hexane	----	0.042	0.028	0.072	0.036	0.048	0.022
Isopropyl Alcohol	----	0.11	0.02	0.018	0.048	0.035	0.041
m-Xylene*	850[b]	0.048	0.01	0.011	0.01	0.01	0.01
p-Xylene*	820[b]	0.048	0.01	0.011	0.01	0.01	0.01
MTBE (methyl tertiary-butyl ether)	24,000[b]	< 0.001	< 0.001	< 0.0011	< 0.001	< 0.001	< 0.0011
Methylene chloride (Dichloromethane)	45[c]	0.022	0.036	0.035	0.033	0.035	0.034
o-Xylene	790[b]	0.017	0.0035	0.0038	0.0038	0.0038	0.0036
Propene	----	0.014	0.057	0.066	0.0097	< 0.0051	0.0058
Styrene	8,500[b]	< 0.0013	< 0.0013	< 0.0014	< 0.0013	< 0.0013	< 0.0014
Tetrachloroethene (Perchloroethylene)	4.0[c]	0.21	0.06	0.058	0.051	0.05	0.055
Tetrahydrofuran	----	0.064	0.0074	0.0089	0.0066	0.0079	0.008
Toluene	40,000[b]	0.076	0.021	0.02	0.019	0.019	0.017
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	510[b]	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012	< 0.0012
trans-1,3-Dichloropropene (1)	6.2[c]	< 0.0013	< 0.0013	< 0.0014	< 0.0013	< 0.0013	< 0.0014
Trichloroethene (Trichloroethylene)	12[c]	0.0023	0.0055	0.0036	< 0.0016	< 0.0016	0.0042
Trichlorofluoromethane	5,600[b]	0.0025	< 0.0016	< 0.0017	< 0.0016	< 0.0016	< 0.0017
Vinyl Acetate	1,600[b]	< 0.01	< 0.01	< 0.011	< 0.01	< 0.01	< 0.011
Vinyl Chloride	4.8[c]	< 0.00075	< 0.00075	< 0.00075	< 0.00075	< 0.00075	< 0.00075
Xylenes (total)[e]	840[b]	0.065	0.014	0.015	0.014	0.014	0.014

V3 Table Notes:

0.11 Indicates exceedance of Tier 1 remediation objective
(1) indicates value is for (1,3-Dichloropropylene, cis+trans)
--- Indicates chemical not analyzed or no objectives available
* Indicates lab concentrations were analyzed for m,p-xylenes

Prepared by/date KJW 02/28/13
Checked by/date RKB 06/12/13

Chemical Name and Soil Remediation Objective Notations

a	Compliance is determined by meeting either the soil gas remediation objectives (ROs) or the groundwater ROs. See Sections 742.505 & 742.515.
b	Calculated values correspond to a target hazard quotient of 1.
c	Calculated values correspond to a cancer risk level of 1 in 1,000,000.
d	PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired.
e	Groundwater remediation objective calculated at 25 degrees C. For Dalapon and 1,2-Dibromo-3-chloropropane, the critical temperature (Tc) and enthalpy of vaporization at the normal boling point (Hv,b) are not available. For Xylenes (total), the enthalpy of vaporization at the normal boiling point (Hv,b) is not available.
f	The value shown is the Cv^{sat} value of the chemical in soil gas. The Cv^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the Cv^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.
g	The value shown is the solubility of the chemical in water. The solubility of the chemical becomes the remediation objective if the calculated value exceeds the solubility or if there are no toxicity criteria available for the inhalation route of exposure.
h	Value for inhlation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental mercury is a contaminant of concern.
i	The value shown is the Groundwater Remediation Objective listed in Appendix B, Table E.
j	Calculated values for the remediation objectives in this table are based on the assumption that the existing or potential building has a full concrete slab-on grade, though the remediation objectives in this table are also considered protective of occupants of buildings with a full concrete basement floors and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to use remediation objectives in this table. This table does not apply whien the existing or potential building has neither a full concrete slab-on-grade nor a full basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312, meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

TABLE 2.2 - GROUNDWATER ANALYTICAL RESULTS: INDOOR INHALATION (VOCs)
SPARTANS ' SQUARE
ROMEOVILLE, IL

Proposed TACO Amendments [Second Notice 03-07-2013]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	10/11/06 MW-9 mg/L	10/11/06 MW-10 mg/L	11/19/08 MW-10 (Sampled by V3) mg/L	1/28/08 SM-GP-07-GW mg/L	1/28/08 SM-GP-08-GW mg/L	4/11/08 SM-GP-13-GW mg/L	4/11/08 SM-GP-14-GW mg/L	4/11/08 SM-GP-15-GW mg/L	4/11/08 SM-GP-16-GW mg/L	4/11/08 SM-GP-17-GW mg/L	4/11/08 SM-GP-18-GW mg/L	11/18/08 SM-GP-105 G105 mg/L	11/18/08 SM-GP-106 G106 mg/L	11/19/08 SM-GP-108 G108 mg/L	11/19/08 SM-GP-110 G110 mg/L	11/19/08 SM-GP-117 G117 mg/L	5/5/09 SM-MW-01 G101 MS/MSD mg/L
(Method -8260B/8310/8082)																		
Acetone	1,000,000[g]	---	---	<0.002	<0.100	<0.100	<0.100	---	<0.100	<0.100	<0.100	<0.100	<0.002	<0.002	<0.002	0.013	<0.002	<0.002
Benzene	0.41[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bis(2-chloroethyl)ether	0.43[c]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Bromodichloromethane (Dichlorobromomethane)	6,700[g]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bromoform	12[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Butanone (MEK)	48,000[b]	---	---	<0.010	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	210[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride	0.076[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorobenzene (Monochlorobenzene)	82[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorodibromomethane (Dibromochloromethane)	2,600[g]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroform	0.15[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Chlorophenol	22,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
1,2-Dichlorobenzene	160[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
1,4-Dichlorobenzene	79[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
1,1-Dichloroethane	580[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane (Ethylene dichloride)	0.22[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene (1,1-Dichloroethylene)	74[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	3,500[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	51[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloropropane	0.48[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,3-Dichloropropene (1)	0.52[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,3-Dichloropropene (1)	0.52[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	1.4[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Hexachlorobenzene	0.0062[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Hexachlorocyclopentadiene	0.26[b]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Hexachloroethane	50[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Isophorone	12,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Mercury[h]	0.060[g]	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.0002	---	<0.0002	<0.0002
MTBE (methyl tertiary-butyl ether)	6,800[b]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene chloride (Dichloromethane)	8.2[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Methylnaphthalene	25[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
2-Methylphenol (o-cresol)	26,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Naphthalene	0.32[c]	<0.00013	0.000036	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
n-Nitrosodi-n-propylamine	0.27[c]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Phenol	83,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
Polychlorinated biphenyls (PCBs)	---[d]	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.0005	---	<0.0005	<0.0005
Styrene	310[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tetrachloroethene (Perchloroethylene)	0.34[c]	---	---	<0.002	0.128	0.109	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	0.0022	0.079	0.0042	0.026	0.0055
Toluene	530[g]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2,4-Trichlorobenzene	5.9[b]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---	<0.0017	---	<0.0017	<0.0015
1,1,1-Trichloroethane	1,300[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2-Trichloroethane	4,400[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Trichloroethene (Trichloroethylene)	1.3[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Proposed TACO Amendments [Second Notice 03-07-2013]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	10/11/06 MW-9	10/11/06 MW-10	11/19/08 MW-10 (Sampled by V3)	1/28/08 SM-GP-07-GW	1/28/08 SM-GP-08-GW	4/11/08 SM-GP-13-GW	4/11/08 SM-GP-14-GW	4/11/08 SM-GP-15-GW	4/11/08 SM-GP-16-GW	4/11/08 SM-GP-17-GW	4/11/08 SM-GP-18-GW	11/18/08 SM-GP-105 G105	11/18/08 SM-GP-106 G106	11/19/08 SM-GP-108 G108	11/19/08 SM-GP-110 G110	11/19/08 SM-GP-117 G117	5/5/09 SM-MW-01 G101 MS/MSD
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Vinyl Acetate	550[b]	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	0.21[c]	---	---	<0.002	<0.0020	<0.0020	<0.0020	---	<0.0020	<0.0020	<0.0020	<0.0020	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (total)[e]	93[b]	<0.003	<0.003	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0021	<0.002	<0.002	<0.002	<0.002	<0.002

V3 Table Notes:

0.11 Indicates exceedance of Tier 1 remediation objective
(1) indicates value is for (1,3-Dichloropropylene, cis+trans)
--- --- indicates chemical not analyzed or not sampled
* value is for m&p-xylene

Chemical Name and Soil Remediation Objective Notations

a Compliance is determined by meeting either the soil gas remediation objectives or the groundwater remediation objectives. See Sections 742.505 and 742.515.

b Calculated values correspond to a target hazard quotient of 1.

c Calculated values correspond to a cancer risk level of 1 in 1,000,000.
PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site.

d Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired.
Groundwater remediation objective calculated at 25 degrees C. For Dalapon and 1,2-Dibromo-3-chloropropane, the critical temperature (Tc) and enthalpy of vaporization at the normal boiling point (Hv,b) are not available.

e For Xylenes (total), the enthalpy of vaporization at the normal boiling point (Hv,b) is not available.

f The value shown is the Cv^{sat} value of the chemical in soil gas. The Cv^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the Cv^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

g The value shown is the solubility of the chemical in water. The solubility of the chemical becomes the remediation objective if the calculated value exceeds the solubility or if there are no toxicity criteria available for the inhalation route of exposure.

h Value for inhlation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental mercury is a contaminant of concern.

i The value shown is the Groundwater Remediation Objective listed in Appendix B, Table E.

j Calculated values for the remediation objectives in this table are based on the assumption that the existing or potential building has a full concrete slab-on grade, though the remediation objectives in this table are also considered protective of occupants of buildings with a full concrete basement floors and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to use remediation objectives in this table. This table does not apply whien the existing or potential building has neither a full concrete slab-on-grade nor a full basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312, meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

Proposed TACO Amendments [Second Notice 03-07-2013]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	5/5/09 SM-MW-02 G102	5/5/09 SM-MW-02 G102 Field Blank	5/5/09 SM-MW-03 G103	5/5/09 SM-MW-03 G103 Field Blank	5/5/09 SM-MW-04 G151 (G104)
		mg/L	mg/L	mg/L	mg/L	mg/L
(Method -8260B/8310/8082)						
Acetone	1,000,000[g]	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	0.41[c]	<0.002	<0.002	<0.002	<0.002	<0.002
Bis(2-chloroethyl)ether	0.43[c]	<0.0015	---	<0.0015	---	<0.0015
Bromodichloromethane (Dichlorobromomethane)	6,700[g]	0.0056	<0.002	0.004	<0.002	<0.002
Bromoform	12[c]	0.0048	<0.002	<0.002	<0.002	<0.002
2-Butanone (MEK)	48,000[b]	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	210[b]	<0.002	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride	0.076[c]	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorobenzene (Monochlorobenzene)	82[b]	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorodibromomethane (Dibromochloromethane)	2,600[g]	0.0067	<0.002	0.0043	<0.002	<0.002
Chloroform	0.15[c]	0.0032	<0.002	0.0023	<0.002	<0.002
2-Chlorophenol	22,000[g]	<0.0015	---	<0.0015	---	<0.0015
1,2-Dichlorobenzene	160[g]	<0.0015	---	<0.0015	---	<0.0015
1,4-Dichlorobenzene	79[g]	<0.0015	---	<0.0015	---	<0.0015
1,1-Dichloroethane	580[b]	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane (Ethylene dichloride)	0.22[c]	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene (1,1-Dichloroethylene)	74[b]	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	3,500[g]	<0.002	<0.002	0.003	<0.002	<0.002
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	51[b]	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloropropane	0.48[c]	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,3-Dichloropropene (1)	0.52[c]	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,3-Dichloropropene (1)	0.52[c]	<0.002	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	1.4[c]	<0.002	<0.002	<0.002	<0.002	<0.002
Hexachlorobenzene	0.0062[g]	<0.0015	---	<0.0015	---	<0.0015
Hexachlorocyclopentadiene	0.26[b]	<0.0015	---	<0.0015	---	<0.0015
Hexachloroethane	50[g]	<0.0015	---	<0.0015	---	<0.0015
Isophorone	12,000[g]	<0.0015	---	<0.0015	---	<0.0015
Mercury[h]	0.060[g]	<0.0002	---	<0.0002	---	<0.002
MTBE (methyl tertiary-butyl ether)	6,800[b]	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene chloride (Dichloromethane)	8.2[c]	<0.002	<0.002	<0.002	<0.002	<0.002
2-Methylnaphthalene	25[g]	<0.0015	---	<0.0015	---	<0.0015
2-Methylphenol (o-cresol)	26,000[g]	<0.0015	---	<0.0015	---	<0.0015
Naphthalene	0.32[c]	<0.0015	---	<0.0015	---	<0.0015
n-Nitrosodi-n-propylamine	0.27[c]	<0.0015	---	<0.0015	---	<0.0015
Phenol	83,000[g]	<0.0015	---	<0.0015	---	<0.0015
Polychlorinated biphenyls (PCBs)	---[d]	<0.0005	---	<0.0005	---	<0.0005
Styrene	310[g]	<0.002	<0.002	<0.002	<0.002	<0.002
Tetrachloroethene (Perchloroethylene)	0.34[c]	0.015	<0.002	0.053	<0.002	0.0046
Toluene	530[g]	<0.002	<0.002	<0.002	<0.002	<0.002
1,2,4-Trichlorobenzene	5.9[b]	<0.0015	---	<0.0015	---	<0.0015
1,1,1-Trichloroethane	1,300[g]	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2-Trichloroethane	4,400[g]	<0.002	<0.002	<0.002	<0.002	<0.002
Trichloroethene (Trichloroethylene)	1.3[c]	<0.002	<0.002	0.0027	<0.002	<0.002

Proposed TACO Amendments [Second Notice 03-07-2013]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	5/5/09 SM-MW-02 G102	5/5/09 SM-MW-02 G102 Field Blank	5/5/09 SM-MW-03 G103	5/5/09 SM-MW-03 G103 Field Blank	5/5/09 SM-MW-04 G151 (G104)
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Vinyl Acetate	550[b]	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	0.21[c]	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (total)[d]	93[b]	<0.002	<0.002	<0.002	<0.002	<0.002

V3 Table Notes:

0.11	Indicates exceedance of Tier 1 remediation objective
	(1) indicates value is for (1,3-Dichloropropylene, cis+trans)
---	--- indicates chemical not analyzed or not sampled
*	value is for m&p-xylene

Chemical Name and Soil Remediation Objective Notations

	Compliance is determined by meeting either the soil gas remediation objectiv
a	742.505 and 742.515.
b	Calculated values correspond to a target hazard quotient of 1.
c	Calculated values correspond to a cancer risk level of 1 in 1,000,000.
	PCBs are a mixture of different congeners. The appropriate values to use for congeners present at the site.
d	Persons remediating sites should consult with BOL if calculation of Tier 2 or 3
	Groundwater remediation objective calculated at 25 degrees C. For Dalapon and enthalpy of vaporization at the normal boiling point (Hv,b) are not availab
e	For Xylenes (total), the enthalpy of vaporization at the normal boiling point (H
	The value shown is the Cv^{sat} value of the chemical in soil gas. The Cv^{sat} of th
f	value exceeds the Cv^{sat} value or if there are no toxicity criteria available for th
	The value shown is the solubility of the chemical in water. The solubility of th
g	value exceeds the solubility or if there are no toxicity criteria available for the
	Value for inhlation exposure route is based on Reference Concentration for e
h	objectives only apply at sites where elemental mercury is a contaminant of co
i	The value shown is the Groundwater Remediation Objective listed in Append
j	Calculated values for the remediation objectives in this table are based on th concrete slab-on grade, though the remediation objectives in this table are al concrete basement floors and walls. This table applies only when the existin concrete basement floor and walls. Institutional controls under Subpart J are does not apply whien the existing or potential building has neither a full concr building with an earthen crawl space, an earthen floor, a stone foundation, pa have the option of excluding the indoor inhalation exposure route under Sect under Subpart L, or proposing an alternative approach under Tier 3.

Spartans' Square Shopping Center
Active Soil Gas Sampling Event
February 19, 2013

Sample Location		SM-SG-01		
Start Time	1110	**Measured He PPM**		**%He in Sample**
End Time	1140	0		0.0000%

If field reading is in PPM, input Measured Helium PPM reading from soil gas sample tube to get percent Helium in sample due to leakage.
Measured He PPM / 1,000,000 x 100 = %He

%He in Sample	%He in Shroud	DF
0.0000%	13.50%	0.000

Dilution Factor (DF) = Percent *He* in Sample / Percent *He* in Shroud.
Fill in the blanks to calculate the DF.
If DF = 0.05 or less (5% or less) the Measured He PPM is not significant.

Sample Location		SM-SG-02		
Start Time	1145	**Measured He PPM**		**%He in Sample**
End Time	1206	25		0.0025%

%He in Sample	%He in Shroud	DF
0.0025%	2.20%	0.001

Sample Location		SM-SG-03		
Start Time	1215	**Measured He PPM**		**%He in Sample**
End Time	1230	50		0.0050%

%He in Sample	%He in Shroud	DF
0.0050%	2.50%	0.002

Sample Location		SM-SG-04		
Start Time	1240	**Measured He PPM**		**%He in Sample**
End Time	1300	50		0.0050%

%He in Sample	%He in Shroud	DF
0.0050%	2.00%	0.003

Sample Location		SM-SG-05		
Start Time	1308	**Measured He PPM**		**%He in Sample**
End Time	1340	25		0.0025%

%He in Sample	%He in Shroud	DF
0.0025%	2.30%	0.001

Sample Location		SM-SG-06		
Start Time	1400	**Measured He PPM**		**%He in Sample**
End Time	1440	125		0.0125%

%He in Sample	%He in Shroud	DF
0.0125%	3.00%	0.004

TABLE 3.1 - SOIL ANALYTICAL RESULTS (VOCs)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

	Industrial-Commercial					Residential			V3 Soil Samples										
	Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Route Values	Exposure Route-Specific Values for Soils			1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	4/11/08	11/17/2008
	Industrial-Commercial		Construction Worker						SM-GP-01 (0-2)	SM-GP-02 (2-4)	SM-GP-03 (0-2)	SM-GP-03 (6-7)	SM-GP-04 (0-2)	SM-GP-05 (0-2)	SM-GP-05 (2-4)	SM-GP-07 (10-12)	SM-GP-08 (8-10)	SM-GP-09 (0-2)	SM-GP-15 (0-2)	SM-GP-101 X101
Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	ADL (mg/kg)	0-2 ft mg/kg	2-4 ft mg/kg	0-2 ft mg/kg	6-7 ft mg/kg	0-2 ft mg/kg	0-2 ft mg/kg	2-4 ft mg/kg	10-12 ft mg/kg	8-10 ft mg/kg	0-2 ft mg/kg	0-2 ft mg/kg	10-12 ft mg/kg
Volatile Organic Compounds (Method 5035A/8260B)																				
Acetone	----[g]	100000[d]	----[g]	100000[d]	25[b]	70,000[b]	100000[d]	*	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.021
Benzene	100[e]	1.6[e]	2300[e]	2.2[e]	0.03	12[e]	0.8[e]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	10[e]	3000[d]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	81[e]	53[e]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Bromomethane [NT]	---c	44b	1,800b	2.8b	---c	---c	28b,x	**	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0018
2-Butanone [NT]	1,000,000b	25,000d,x	120,000b	730b	17b	47,000b	25,000d,x	**	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.009
Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	7800[b]	720[d, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	5[e]	0.3[e]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	1600[b]	130[b, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	1600[b]	1300[b]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Chloroethane [NT]	---c	1,500d	20,000b	39b	---c	---c	1,500d,x	**	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0018
Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	100[e]	0.3[e]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Chloromethane [NT]	---c	180b	---c	5b	---c,h	---c	110a	**	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0018
1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	130[b]	23[b]	7800[b]	1300[b, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	7[e]	0.4[e]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---
1,1-Dichloroethene (1,1-Dichloroethylene)	100,000[b]	470[d]	10000[b]	3.0[b]	0.06	3900[b]	290[b, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	20000[b]	1200[d]	20000[b]	1200[d]	0.4	780[b]	1200[d]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	1600[b]	3100[d]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	9[e]	15[b, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
cis-1,3-Dichloropropene (1)	57[e]	2.1[e]	1200[e]	0.39[b]	0.004[e]	6.4[e]	1.1[e, x]	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
trans-1,3-Dichloropropene (1)	57[e]	2.1[e]	1200[e]	0.39[b]	0.004[e]	6.4[e]	1.1[e, x]	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Ethylbenzene	200,000[b]	400[d]	20000[b]	58[b]	13	7800[b]	400[d, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
2-Hexanone [NT]	10,000b	720b	1,000b	47b	0.16b	390b	450b,x	**	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0018
4-Methyl-2-pentanone [NT]	160,000b	3,100d	160,000b	340b	2.5b	6,300b	3,100d,x	**	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0018
Methylene chloride (Dichloromethane)	760[e]	24[e]	12,000[b]	34[e]	0.02[e]	85[e]	13[e]	*	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0045
MTBE (methyl tertiary-butyl ether)	20,000[b]	8,800[d]	2,000[b]	140[b]	0.32	780[b]	8,800[d, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Styrene	410,000[b]	1,500[d]	41,000[b]	430[b]	4	16000[b]	1500[d, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
1,1,2,2-Tetrachloroethane [NT]	27e	1.2e	620e	1.7e	0.0035e	3.2e	0.62e,x	**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Tetrachloroethene (Perchloroethylene)	110[e]	20[e]	2,400[e]	28[e]	0.06	12[e]	11[e]	*	0.0159	0.0167	0.100	0.0485	<0.0050	0.0454	0.0492	14.6	76.3	0.0109	0.0492	<0.0018
Toluene	410000[b]	650[d]	410000[b]	42[b]	12	16000[b]	650[d, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
1,1,1-Trichloroethane	---c	1,200[d]	---c	1,200[d]	2	---c	1200[d]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
1,1,2-Trichloroethane	8,200[b]	1,800[d]	8,200[b]	1,800[d]	0.02	310[b]	1800[d]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018
Trichloroethene (Trichloroethylene)	520[e]	8.9[e]	1200[b]	12[e]	0.06	58[e]	5[e]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0164	<0.0050	<0.0050	<0.0018
Vinyl Acetate	1,000,000[b]	1,600[b]	200,000[b]	10[b]	170[b]	78000[b]	1000[b, x]	*	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	---
Vinyl Chloride	7.9[e]	1.1[e]	170[e]	1.1[b]	0.01	0.46[e]	0.28[e]	*	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0018
Xylenes (total)	410000[b]	320[d]	41000[b]	5.6[b]	150	16000[b]	320[d, x]	*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0018

Part 742 Notes

* indicates that the ADL is less than or equal to the specified remediation objective.

** indicates that the value is not listed in TACO, Section 742, Table A or B.

V3 Table Notes:

0.11	Indicates exceedance of Tier 1 remediation objective (RO)
(1)	Indicates RO is for (1,3-Dichloropropylene, cis+trans)
[NT]	[NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007. Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html
---	--- indicates chemical not analyzed or not sampled
	See attached for soil remediation objective notations

TABLE 3.1 - SOIL ANALYTICAL RESULTS (VOCs)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

	Industrial-Commercial					Residential			V3 Soil Samples											
	Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Route Values	Exposure Route-Specific Values for Soils			11/17/2008	11/17/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/18/2008	11/18/2008
	Industrial-Commercial		Construction Worker						SM-GP-102 X102	SM-GP-103 X103	SM-GP-104 X104	SM-GP-105 X105A	SM-GP-105 X105B	SM-GP-06 X106	SM-GP-107 X107A MS/MSD	SM-GP-107 X107B	SM-GP-108 X108A	SM-GP-108 X108B & MS/MSD	SM-GP-110 X110A	SM-GP-110 X110B
Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	ADL (mg/kg)	14-16 ft mg/kg	10-11 ft mg/kg	10-11 ft mg/kg	2-3 ft mg/kg	10-11 ft mg/kg	10-11 ft mg/kg	2-3 ft mg/kg	7-9 ft mg/kg	2-3 ft mg/kg	10-11 ft mg/kg	2-3 ft mg/kg	10-11 ft mg/kg
Volatile Organic Compounds (Method 5035A/8260B)																				
Acetone	----[g]	100000[d]	----[g]	100000[d]	25[b]	70,000[b]	100000[d]	*	0.013	<0.011	<0.0085	<0.0089	<0.0087	0.015	<0.0098	0.018	<0.01	<0.01	<0.011	0.01
Benzene	100[e]	1.6[e]	2300[e]	2.2[e]	0.03	12[e]	0.8[e]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	10[e]	3000[d]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	81[e]	53[e]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Bromomethane [NT]	---c	44b	1,800b	2.8b	---c	---c	28b,x	**	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
2-Butanone [NT]	1,000,000b	25,000d,x	120,000b	730b	17b	47,000b	25,000d,x	**	<0.0094	<0.011	<0.0085	<0.0089	<0.0087	<0.0083	<0.0098	<0.0087	<0.01	<0.01	<0.011	<0.0085
Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	7800[b]	720[d, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	0.0022	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	5[e]	0.3[e]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	1600[b]	130[b, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	0.0061	<0.0021	<0.0017
Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	1600[b]	1300[b]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Chloroethane [NT]	---c	1,500d	20,000b	39b	---c	---c	1,500d,x	**	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	100[e]	0.3[e]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	0.0087	<0.0021	<0.0017
Chloromethane [NT]	---c	180b	---c	5b	---c,h	---c	110a	**	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	130[b]	23[b]	7800[b]	1300[b, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	7[e]	0.4[e]	*	---	---	---	---	---	---	---	---	---	---	---	---
1,1-Dichloroethene (1,1-Dichloroethylene)	100,000[b]	470[d]	10000[b]	3.0[b]	0.06	3900[b]	290[b, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	20000[b]	1200[d]	20000[b]	1200[d]	0.4	780[b]	1200[d]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	0.011	<0.0021	<0.0017
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	1600[b]	3100[d]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	9[e]	15[b, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
cis-1,3-Dichloropropene (1)	57[e]	2.1[e]	1200[e]	0.39[b]	0.004[e]	6.4[e]	1.1[e, x]	0.005	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
trans-1,3-Dichloropropene (1)	57[e]	2.1[e]	1200[e]	0.39[b]	0.004[e]	6.4[e]	1.1[e, x]	0.005	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Ethylbenzene	200,000[b]	400[d]	20000[b]	58[b]	13	7800[b]	400[d, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
2-Hexanone [NT]	10,000b	720b	1,000b	47b	0.16b	390b	450b,x	**	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
4-Methyl-2-pentanone [NT]	160,000b	3,100d	160,000b	340b	2.5b	6,300b	3,100d,x	**	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Methylene chloride (Dichloromethane)	760[e]	24[e]	12,000[b]	34[e]	0.02[e]	85[e]	13[e]	*	<0.0047	<0.0054	<0.0042	<0.0045	<0.0044	<0.0041	<0.0049	<0.0044	<0.0052	<0.0051	<0.0054	<0.0042
MTBE (methyl tertiary-butyl ether)	20,000[b]	8,800[d]	2,000[b]	140[b]	0.32	780[b]	8,800[d, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Styrene	410,000[b]	1,500[d]	41,000[b]	430[b]	4	16000[b]	1500[d, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
1,1,2,2-Tetrachloroethane [NT]	27e	1.2e	620e	1.7e	0.0035e	3.2e	0.62e,x	**	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Tetrachloroethene (Perchloroethylene)	110[e]	20[e]	2,400[e]	28[e]	0.06	12[e]	11[e]	*	<0.0019	0.12	9	<0.0018	0.0087	0.054	3.2	3.3	0.032	800	0.025	0.16
Toluene	410000[b]	650[d]	410000[b]	42[b]	12	16000[b]	650[d, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	0.0035	<0.0021	<0.002	<0.0021	<0.0017
1,1,1-Trichloroethane	---c	1,200[d]	---c	1,200[d]	2	---c	1200[d]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
1,1,2-Trichloroethane	8,200[b]	1,800[d]	8,200[b]	1,800[d]	0.02	310[b]	1800[d]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Trichloroethene (Trichloroethylene)	520[e]	8.9[e]	1200[b]	12[e]	0.06	58[e]	5[e]	*	<0.0019	<0.0022	0.005	<0.0018	<0.0017	0.016	<0.002	<0.0017	<0.0021	0.17	<0.0021	<0.0017
Vinyl Acetate	1,000,000[b]	1,600[b]	200,000[b]	10[b]	170[b]	78000[b]	1000[b, x]	*	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	7.9[e]	1.1[e]	170[e]	1.1[b]	0.01	0.46[e]	0.28[e]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017
Xylenes (total)	410000[b]	320[d]	41000[b]	5.6[b]	150	16000[b]	320[d, x]	*	<0.0019	<0.0022	<0.0017	<0.0018	<0.0017	<0.0017	<0.002	<0.0017	<0.0021	<0.002	<0.0021	<0.0017

Part 742 Notes

* indicates that the ADL is less than or equal to the specified remediation objective.

** indicates that the value is not listed in TACO, Section 742, Table A or B.

V3 Table Notes:

0.11	Indicates exceedance of Tier 1 remediation objective (RO)
(1)	Indicates RO is for (1,3-Dichloropropylene, cis+trans)
[NT]	[NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007. Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html
---	--- indicates chemical not analyzed or not sampled
	See attached for soil remediation objective notations

TABLE 3.1 - SOIL ANALYTICAL RESULTS (VOCs)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

	Industrial-Commercial					Residential			V3 Soil Samples												
	Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Route Values	Exposure Route-Specific Values for Soils			11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/19/2008	11/19/2008	11/19/2008
	Industrial-Commercial		Construction Worker						SM-GP-111 X111A	SM-GP-111 X111B	SM-GP-112 X112A	SM-GP-112 X112B	SM-GP-113 X113A	SM-GP-113 X113B	SM-GP-114 X114A	SM-GP-114 X114B	SM-GP-115 X115	SM-GP-116 X116	SM-GP-117 X117	SM-GP-118 X118A	SM-GP-118 X118B
Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	ADL (mg/kg)	2-3 ft mg/kg	8-9 ft mg/kg	2-3 ft mg/kg	8-9 ft mg/kg	5-6 ft mg/kg	7-8 ft mg/kg	2-3 ft mg/kg	8-9 ft mg/kg	7.5-8.5 ft mg/kg	7.5-8.5 ft mg/kg	10-11 ft mg/kg	2-3 ft mg/kg	9-10 ft mg/kg
Volatile Organic Compounds (Method 5035A/8260B)																					
Acetone	----[g]	100000[d]	----[g]	100000[d]	25[b]	70,000[b]	100000[d]	*	<0.0097	<0.0096	<0.012	<0.011	<0.009	<0.0085	<0.013	<0.0097	<0.011	<0.015	0.018	<0.0091	<0.0093
Benzene	100[e]	1.6[e]	2300[e]	2.2[e]	0.03	12[e]	0.8[e]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	10[e]	3000[d]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	81[e]	53[e]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Bromomethane [NT]	---c	44b	1,800b	2.8b	---c	---c	28b,x	**	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
2-Butanone [NT]	1,000,000b	25,000d,x	120,000b	730b	17b	47,000b	25,000d,x	**	<0.0097	<0.0096	<0.012	<0.011	<0.009	<0.0085	<0.013	<0.0097	<0.011	<0.015	<0.0085	<0.0091	0.011
Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	7800[b]	720[d, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	5[e]	0.3[e]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	1600[b]	130[b, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	1600[b]	1300[b]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Chloroethane [NT]	---c	1,500d	20,000b	39b	---c	---c	1,500d,x	**	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	100[e]	0.3[e]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Chloromethane [NT]	---c	180b	---c	5b	---c,h	---c	110a	**	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	130[b]	23[b]	7800[b]	1300[b, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	7[e]	0.4[e]	*	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1-Dichloroethene (1,1-Dichloroethylene)	100,000[b]	470[d]	10000[b]	3.0[b]	0.06	3900[b]	290[b, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	20000[b]	1200[d]	20000[b]	1200[d]	0.4	780[b]	1200[d]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	1600[b]	3100[d]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	9[e]	15[b, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
cis-1,3-Dichloropropene (1)	57[e]	2.1[e]	1200[e]	0.39[b]	0.004[e]	6.4[e]	1.1[e, x]	0.005	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
trans-1,3-Dichloropropene (1)	57[e]	2.1[e]	1200[e]	0.39[b]	0.004[e]	6.4[e]	1.1[e, x]	0.005	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Ethylbenzene	200,000[b]	400[d]	20000[b]	58[b]	13	7800[b]	400[d, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
2-Hexanone [NT]	10,000b	720b	1,000b	47b	0.16b	390b	450b,x	**	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
4-Methyl-2-pentanone [NT]	160,000b	3,100d	160,000b	340b	2.5b	6,300b	3,100d,x	**	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Methylene chloride (Dichloromethane)	760[e]	24[e]	12,000[b]	34[e]	0.02[e]	85[e]	13[e]	*	<0.0049	<0.0048	<0.006	<0.0054	<0.0045	<0.0043	<0.0064	<0.0048	<0.0054	<0.0073	<0.0043	<0.0046	<0.0046
MTBE (methyl tertiary-butyl ether)	20,000[b]	8,800[d]	2,000[b]	140[b]	0.32	780[b]	8,800[d, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Styrene	410,000[b]	1,500[d]	41,000[b]	430[b]	4	16000[b]	1500[d, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
1,1,2,2-Tetrachloroethane [NT]	27e	1.2e	620e	1.7e	0.0035e	3.2e	0.62e,x	**	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Tetrachloroethene (Perchloroethylene)	110[e]	20[e]	2,400[e]	28[e]	0.06	12[e]	11[e]	*	0.0094	0.19	0.042	0.017	0.018	0.0066	0.016	2.2	0.16	0.13	6.3	0.0025	0.0043
Toluene	410000[b]	650[d]	410000[b]	42[b]	12	16000[b]	650[d, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
1,1,1-Trichloroethane	---c	1,200[d]	--c	1,200[d]	2	---c	1200[d]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
1,1,2-Trichloroethane	8,200[b]	1,800[d]	8,200[b]	1,800[d]	0.02	310[b]	1800[d]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Trichloroethene (Trichloroethylene)	520[e]	8.9[e]	1200[b]	12[e]	0.06	58[e]	5[e]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	0.0045	<0.0018	<0.0019
Vinyl Acetate	1,000,000[b]	1,600[b]	200,000[b]	10[b]	170[b]	78000[b]	1000[b, x]	*	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	7.9[e]	1.1[e]	170[e]	1.1[b]	0.01	0.46[e]	0.28[e]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019
Xylenes (total)	410000[b]	320[d]	41000[b]	5.6[b]	150	16000[b]	320[b, x]	*	<0.0019	<0.0019	<0.0024	<0.0021	<0.0018	<0.0017	<0.0026	<0.0019	<0.0022	<0.0029	<0.0017	<0.0018	<0.0019

Part 742 Notes

* indicates that the ADL is less than or equal to the specified remediation objective.

** indicates that the value is not listed in TACO, Section 742, Table A or B.

	V3 Table Notes:
0.11	Indicates exceedance of Tier 1 remediation objective (RO)
(1)	Indicates RO is for (1,3-Dichloropropylene, cis+trans)
[NT]	[NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007. Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html
---	--- indicates chemical not analyzed or not sampled
	See attached for soil remediation objective notations

TABLE 3.2 - SOIL ANALYTICAL RESULTS (SVOCs)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

	Industrial-Commercial					Residential			V3 Soil Samples						Phase II V3/OSE Supplemental Investigation												
	Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Route Values	Exposure Route-Specific Values for Soils		Background Carcinogenic PAH 95th Percentile Concentrations		1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	1/28/08	11/17/2008	11/17/2008	11/17/2008	11/18/2008	11/19/2008	11/18/2008	11/18/2008	11/18/2008	11/17/2008	11/18/2008	11/18/2008	11/18/2008	11/18/2008	11/19/2008	11/18/2008	11/18/2008
	Industrial-Commercial		Construction Worker							SM-GP-01 (0-2)	SM-GP-02 (2-4)	SM-GP-03 (0-2)	SM-GP-10 (4-6)	SM-GP-11 (6-8)	SM-GP-12 (4-6)	SM-GP-101 X101	SM-GP-101 (10-12) X-101 V3	SM-GP-102 X102	SM-GP-104 X104	SM-GP-108 (10-11) X-108B V3	SM-GP-111 X111A	SM-GP-111 (8-9) X-111B V3	SM-GP-111 X111B	SM-GP-112 (14-16) X-112 V3	SM-GP-114 (2-3) X-114A V3	SM-GP-114 X114A	SM-GP-114 (8-9) X-114B V3	SM-GP-114 X114B	SM-GP-115 (7.5-8.5) X-115 V3	SM-GP-115 X115	SM-GP-116 X116
Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Within MSA (mg/kg)	ADL (mg/kg)	0-2 ft mg/kg	2-4 ft mg/kg	0-2 ft mg/kg	4-6 ft mg/kg	6-8 ft mg/kg	4-6 ft mg/kg	10-12 ft mg/kg	10-12 ft mg/kg	14-16 ft mg/kg	10-11 ft mg/kg	10-11 ft mg/kg	2-3 ft mg/kg	8-9 ft mg/kg	8-9 ft mg/kg	14-16 ft mg/kg	2-3 ft mg/kg	2-3 ft mg/kg	8-9 ft mg/kg	8-9 ft mg/kg	7.5-8.5 ft mg/kg	7.5-8.5 ft mg/kg	7.5-8.5 ft mg/kg
Base Neutral/Acid Compounds (Includes Polynuclear Aromatics)									*																					
Acenaphthene	120000[b]	-----c	120000[b]	-----c	570[b]	4,700[b]	-----c	0.13	*	<0.050	<0.050	<0.050	---	---	---	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Acenaphthylene [NT]	61,000b	-----c	61,000b	-----c	85b	2,300b	-----c	0.07	**	<0.050	<0.050	<0.050	---	---	---	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Anthracene	610000[b]	-----c	610000[b]	-----c	12,000[b]	23,000[b]	-----c	0.4	*	<0.050	<0.050	<0.050	---	---	---	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Benzidine [NT]	0.02e	0.02e	0.54e	0.02e	2.2E-06e	0.003e	0.009e	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Benzo(*a*)anthracene	8[e]	-----c	170[e]	-----c	2	0.9[e, w]	-----c	1.8	*	<0.087	<0.087	<0.087	---	---	---	<0.059	<0.33	<0.059	<0.055	<0.0087	<0.058	<0.0087	<0.054	<0.0087	<0.33	<0.055	<0.0087	<0.053	<0.0087	<0.055	<0.054
Benzo(*b*)fluoranthene	8[e]	-----c	170[e]	-----c	5	0.9[e, w]	-----c	2.1	*	<0.011	<0.011	<0.011	---	---	---	<0.059	<0.33	<0.059	<0.055	<0.011	<0.058	<0.011	<0.054	<0.011	<0.33	<0.055	<0.011	<0.053	<0.011	<0.055	<0.054
Benzo(*k*) fluoranthene	78[e]	-----c	1700[e]	-----c	49	9[e]	-----c	1.7	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Benzo(*g,h,i*)perylene [NT]	61,000b	-----c	61,000b	-----c	27,000b	2,300b	-----c	1.7	**	<0.050	<0.050	<0.050	---	---	---	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Benzo(*a*) pyrene	0.8[e, x]	-----c	17[e]	-----c	8	0.09[e,w]	-----c	2.1	*	<0.015	<0.015	<0.015	---	---	---	<0.059	<0.09	<0.059	<0.055	<0.015	<0.058	<0.015	<0.054	<0.015	<0.09	<0.055	<0.015	<0.053	<0.015	<0.055	<0.054
Benzoic Acid	1000000[b]	-----c	820000[b]	-----c	400[f,b]	31000[b]	-----c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Benzyl alcohol [NT]	200,000b	-----c	61,000b	-----c	3b	61,000b	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
bis (2-Chloroethoxy)methane	**	**	**	**	**	**	**	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
bis (2-Chloroethyl)ether	5[e]	0.47[e]	75[e]	0.66[e]	0.0004[e]	0.6[e]	0.2[e]	**	0.66	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
bis (2-chloroisopropyl)ether [NT]	82,000b	-----c	200b	-----c	2.4b	3,100b	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
bis (2-Ethylhexyl)phthalate	410[e]	31000[d]	4100[b]	31000[d]	3600	46[e]	31000[d]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
4-Bromophenyl-phenylether	**	**	**	**	**	**	**	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Butyl benzyl phthalate	410,000[b]	930[d]	410,000[b]	930[d]	930[d]	16000[b]	930[d]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
4-Chloroaniline	8,200[b]	-----c	820[b]	-----c	0.7[b]	310[b]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
4-Chloro-3-methylphenol	**	**	**	**	**	**	**	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
2-Chloronaphthalene [NT]	160,000b	-----c	41,000b	-----c	49b	6,300b	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Chrysene	780[e]	-----c	17000[e]	-----c	160	88[e]	---c	2.7	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Dibenzo(*a,h*)anthracene	0.8[e]	-----c	17[e]	-----c	2	0.09[e,w]	---c	0.42	*	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.059	<0.09	<0.059	<0.055	<0.02	<0.058	<0.02	<0.054	<0.02	<0.09	<0.055	<0.02	<0.053	<0.02	<0.055	<0.054
Dibenzofuran [NT]	2,000b	-----c	820b	-----c	3b	78b	---c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
1,2-Dichlorobenzene (*o* -Dichlorobenzene)	180,000[b]	560[d]	18,000[b]	310[b]	17	7000[b]	560[d, x]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
1,3-Dichlorobenzene	**	**	**	**	**	**	**	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
1,4-Dichlorobenzene (*p* -Dichlorobenzene)	-----c	17,000[b]	-----c	340[b]	2	---c	11000[b, x]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
3,3'-Dichlorobenzidine	13[e]	-----c	280[e]	-----c	0.007[e]	1[e]	---c	**	1.3	---	---	---	---	---	---	<0.059	<0.66	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.66	<0.055	---	<0.053	---	<0.055	<0.054
2,4-Dichlorophenol	6100[b]	-----c	610[b]	-----c	1[f,b]	230[b]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Diethyl phthalate	1000000[b]	2000[d]	1000000[b]	2000[d]	470[b]	63000[b]	2000[d]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
2,4-Dimethylphenol	41000[b]	-----c	41000[b]	-----c	9[b]	1600[b]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Dimethylphthalate [NT]	-----c	-----c	20000b	-----c	-----c	-----c	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Di-n-butylphthalate	200000[b]	2300[d]	200000[b]	2300[d]	2300[d]	7800[b]	2300[d]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
4,6-Dinitro-2-methylphenol [NT]	160b	-----c	160b	-----c	pH-based	6.3b	---c	**	**	---	---	---	---	---	---	<0.36	<1.6	<0.36	<0.36	---	<0.36	---	<0.36	---	<1.6	<0.055	---	<0.053	---	<0.36	<0.36
2,4-Dinitrophenol	4100[b]	-----c	410[b]	-----c	0.2[b,f]	160[b]	---c	**	3.3	---	---	---	---	---	---	<0.19	<1.6	<0.19	<0.19	---	<0.19	---	<0.19	---	<1.6	<0.055	---	<0.053	---	<0.19	<0.19
2,4-Dinitrotoluene	8.4[e]	-----c	180[e]	-----c	0.0008[e]	0.9[e]	---c	**	0.25	---	---	---	---	---	---	<0.059	<0.25	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.25	<0.055	---	<0.053	---	<0.055	<0.054
2,6-Dinitrotoluene	8.4[e]	-----c	180[e]	-----c	0.0007[e]	0.9[e]	---c	**	0.26	---	---	---	---	---	---	<0.059	<0.26	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.26	<0.055	---	<0.053	---	<0.055	<0.054
Di-n-octylphthalate	41,000[e]	10,000[d]	4,100[b]	10,000[d]	10000[d]	1600[b]	10000[d]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Fluoranthene	82000[b]	-----c	82000[b]	-----c	4300[b]	3100[b]	---c	4.1	*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Fluorene	82000[b]	-----c	82000[b]	-----c	560[b]	3100[b]	---c	0.18	*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Hexachlorobenzene	4[e]	1.8[e]	78[e]	2.6[e]	2	0.4[e]	1[e]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Hexachlorobutadiene [NT]	2,000b	-----c	200b	-----c	2.2b	78b	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Hexachlorocyclopentadiene	14,000[b]	16[b]	14,000[b]	1.1[b]	400	550[b]	10[b, x]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Hexachloroethane	2,000[b]	-----c	2,000[b]	-----c	0.5[b]	78[b]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Indeno(1,2,3-*c,d*)pyrene	8[e]	-----c	170[e]	-----c	14	0.9[e, w]	---c	1.6	*	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.059	<0.33	<0.059	<0.055	<0.029	<0.058	<0.029	<0.054	<0.029	<0.33	<0.055	<0.029	<0.053	<0.029	<0.055	<0.054
Isophorone	410,000[b]	4,600[d]	410,000[b]	4,600[d]	8[b]	15600[b]	4600[d]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	0.067	---	<0.33	<0.055	---	<0.053	---	<0.055	0.067
2-Methylnaphthalene [NT]	8,200b	-----c	820b	-----c	1.9b	310b	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
2-Methylphenol (o-cresol)	100000b	-----c	100000b	-----c	15b	3900b	-----c	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
4-Methylphenol (p-cresol) [NT]	200,000b	170,000b	4,100b	3,300b	3.9b	7,800b	100,000b,x	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Naphthalene	41000[b]	270[b]	4100[b]	1.8[b]	12[b]	1600[b]	170[b, x]	0.2	*	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.059	<0.33	<0.059	<0.055	<0.025	<0.058	<0.025	<0.054	<0.025	<0.33	<0.055	<0.025	<0.053	<0.025	<0.055	<0.054
2-Nitroaniline [NT]	31,000b	28b	31,000b	1.5b	0.7b	1,200b	18b,x	**	**	---	---	---	---	---	---	<0.059	<1.6	<0.059	<0.055	---	<0.058	---	<0.054	---	<1.6	<0.055	---	<0.053	---	<0.055	<0.054
3-Nitroaniline [NT]	-----c	-----c	200b	-----c	-----c	-----c	-----c	**	**	---	---	---	---	---	---	<0.059	<1.6	<0.059	<0.055	---	<0.058	---	<0.054	---	<1.6	<0.055	---	<0.053	---	<0.055	<0.054
4-Nitroanilne [NT]	8,200b	2,400b	2,000b	52b	0.14b	310b	1,500b,x	**	**	---	---	---	---	---	---	<0.059	<1.6	<0.059	<0.055	---	<0.058	---	<0.054	---	<1.6	<0.055	---	<0.053	---	<0.055	<0.054
Nitrobenzene	1,000[b]	140[b]	1,000[b]	9.4[b]	0.1[b]	39[b]	92[b, x]	**	0.26	---	---	---	---	---	---	<0.059	<0.26	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.26	<0.055	---	<0.053	---	<0.055	<0.054
2-Nitrophenol	**	**	**	**	**	**	**	**	**	---	---	---	---	---	---	<0.059	<1.6	<0.059	<0.055	---	<0.058	---	<0.054	---	<1.6	<0.055	---	<0.053	---	<0.055	<0.054
4-Nitrophenol	**	**	**	**	**	**	**	**	**	---	---	---	---	---	---	<0.059	<1.6	<0.059	<0.055	---	<0.058	---	<0.054	---	<1.6	<0.055	---	<0.053	---	<0.055	<0.054
N-Nitrosodimethylamine [NT]	0.11e	0.023[e]	1.6b	2	7E-06e	0.013e	0.012e	**	**	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
N-Nitroso-di-n-propylamine	0.8[e]	-----c	18[e]	-----c	0.00005[e]	0.09[e]	---c	**	0.0018	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
N-Nitrosodiphenylamine	1,200[e]	-----c	25,000[e]	-----c	1[e]	130[e]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Pentachlorophenol	24[e,j]	-----c	520[e,j]	-----c	0.03[f]	3[e,j]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Phenanthrene [NT]	61,000b	-----c	61,000b	-----c	200b	2,300b	---c	2.5	**	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
Phenol	610000[b]	-----c	61000[b]	-----c	100[b]	23000[b]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
Pyrene	61000[b]	-----c	61000[b]	-----c	4200[b]	2300[b]	---c	3	*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.059	<0.33	<0.059	<0.055	<0.05	<0.058	<0.05	<0.054	<0.05	<0.33	<0.055	<0.05	<0.053	<0.05	<0.055	<0.054
1,2,4-Trichlorobenzene	20,000[b]	3,200[d]	2,000[b]	920[b]	5	780[b]	3200[b, x]	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
2,4,5-Trichlorophenol	200000[b]	-----c	200000[b]	---c	270[f,b]	7800[b]	---c	**	*	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054
2,4,6-Trichlorophenol	520[e]	390[e]	11000[e]	540[e]	0.2[e,f]	58[e]	200[e]	**	0.66	---	---	---	---	---	---	<0.059	<0.33	<0.059	<0.055	---	<0.058	---	<0.054	---	<0.33	<0.055	---	<0.053	---	<0.055	<0.054

Part 742 Notes
* indicates that the ADL is less than or equal to the specified remediation objective.
** indicates that the value is not listed in TACO, Section 742, Table A or B.

V3 Table Notes:

0.11	Indicates laboratory reporting limit exceeds Tier 1 RO
[NT]	[NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007. Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html
---	--- indicates chemical not analyzed or not sampled
	See attached for notations

TABLE 3.3 - SOIL ANALYTICAL RESULTS (METALS)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

Chemical Name	Industrial-Commerical: Exposure Route-Specific Values for Soils: Industrial-Commerical: Ingestion (mg/kg)	Industrial-Commerical: Exposure Route-Specific Values for Soils: Industrial-Commerical: Inhalation (mg/kg)	Industrial-Commerical: Exposure Route-Specific Values for Soils: Construction Worker: Ingestion (mg/kg)	Industrial-Commerical: Exposure Route-Specific Values for Soils: Construction Worker: Inhalation (mg/kg)	Residential: Exposure Route-Specific Values for Soils: Ingestion (mg/kg)	Residential: Exposure Route-Specific Values for Soils: Inhalation (mg/kg)	[A'] Counties Within Metropolitan Statistical Areas[B'] (For Inorganic Chem.in Background Soils) (mg/kg)	Soil Component of the Groundwater Ingestion Exposure Route Values ([C']): [C'] pH 7.25-7.74 for Groundwater Ingestion Class I Groundwater (mg/kg)	[C'] pH 7.75 - 8.24 for Groundwater Ingestion Class I Groundwater (mg/kg)	[C'] pH 8.25 - 8.74 for Groundwater Ingestion Class I Groundwater (mg/kg)	V3 Soil Samples: 11/17/2008 SM-GP-101 X101 10-12 ft mg/kg	11/17/2008 SM-GP-102 X102 14-16 ft mg/kg	11/18/2008 SM-GP-111 X111A 2-3 ft mg/kg	11/18/2008 SM-GP-111 X111B 8-9 ft mg/kg	11/18/2008 SM-GP-114 X114A 2-3 ft mg/kg	11/18/2008 SM-GP-114 X114B 8-9 ft mg/kg	11/19/2008 SM-GP-117 X117 10-11 ft mg/kg
INORGANICS (Method - 6010B/7000A)																	
Metals (Totals)																	
Aluminum [NT]	1,000,000b	1,000,000b	410,000b	870,000[b]	78,000b	1,000,000b	9500	N/A	N/A	N/A	13400	13000	3780	4410	4060	2440	4720
Antimony	820[b]	-----c	82[b]	-----c	31[b]	-----c	4	5.0	5	5	<1.16	<1.18	<1.05	<1.03	<1.01	<1.01	<1.10
Arsenic[l,n]	13[t]	1200[e]	61[b]	25000[e]	13[t]	750[e]	13	30	31	32	5.49	5.75	4.57	7.81	9.29	4.59	5.03
Barium	140000[b]	910000[b]	14000[b]	870000[b]	5500[b]	690000[b]	110	1800	2100	---a	39.9	39.9	19.8	17.4	31	8.55	28
Beryllium	4100[b]	2100[e]	410[b]	44000[e]	160[b]	1300[e]	0.59	1000	8000	---a	<0.580	<0.580	<0.524	<0.517	<0.503	<0.504	<0.550
Boron	410,000[b]	-----c	41000[b]	-----c	16000[b]	----c	-	N/A	N/A	N/A	<11.6	<11.8	<10.5	<10.3	<10.1	<10.1	<11
Cadmium[l,n]	2000[b,r]	2800[e]	200[b,r]	59000[e]	78[b,r]	1800[e]	0.6	59	430	---a	<0.580	<0.592	<0.524	<0.517	<0.503	<0.504	<0.550
Calcium[n]	-----g	-----c	-----g	-----c	----g	-----c	9300	N/A	N/A	N/A	45000	4740	123000	123000	127000	130000	142000
Chromium, total	6100[b]	420[e]	4100[b]	690[e]	230[b]	270[e]	16.2	N/A	N/A	N/A	21.2	18.5	8.82	8.75	10.7	8.15	10.7
Cobalt	120000[b]	-----c	12000[b]	-----c	4700[b]	-----c	8.9	N/A	N/A	N/A	10.8	10.4	3.73	4.1	4.38	2.5	4.49
Copper[n]	82000[b]	-----c	8200[b]	-----c	2900[b]	-----c	19.6	330000	330000	---a	15	15.4	6.76	10.2	8.95	6.25	7.74
Cyanide (amenable)	41000[b]	-----c	4100[b]	-----c	1600[b]	-----c	0.51	40	40	40	<0.544	<0.536	<0.549	<0.489	<0.458	<0.506	<0.544
Iron	-----c	-----c	-----c	-----c	-----c	-----c	15900	N/A	N/A	N/A	24500	23700	11400	17600	21500	12900	12700
Lead	800[y]	-----c	700[y]	-----c	400[k]	-----c	36	107	107	107	12.3	12.2	7.5	9.35	12.1	7.29	7.58
Magnesium[n]	-----g	-----c	730,000	-----c	325,000	-----c	4820	N/A	N/A	N/A	23300	25100	70600	72300	71600	77700	84200
Manganese	41,000[b, w]	91000[b]	4100[b, w]	8700[b]	1600[b, v]	69000[b, x]	636	N/A	N/A	N/A	424	413	294	284	530	247	406
Mercury[l,n,s]	610[b]	16[b]	61[b]	0.1[b]	23[b]	10[b, x]	0.06	6.4	8.0	---a	<0.116	<0.118	<0.105	<0.103	<0.101	<0.101	<0.110
Nickel[l]	41000[b]	21000[e]	4100[b]	440000[e]	1600[b]	13000[e]	18	700	3800	---a	27.4	25.3	8.41	10.2	10.3	7.68	10.3
Potassium[n]	-----g	-----c	-----g	-----c	-----g	-----c	1268	N/A	N/A	N/A	3570	3620	1170	887	1830	1010	1810
Selenium[l,n]	10000[b]	-----c	1000[b]	-----c	390[b]	-----c	0.48	3.3	2.4	1.8	<0.580	<0.592	0.629	0.953	0.795	1.11	1.05
Silver	10000[b]	-----c	1000[b]	-----c	390[b]	-----c	0.55	39	110	---a	<0.580	<0.592	<0.524	<0.517	<0.503	<0.504	<0.550
Sodium[n]	-----g	-----c	-----g	-----c	-----g	-----c	130	N/A	N/A	N/A	70.8	76.6	121	111	113	<229	538
Thallium	160[b,u]	-----c	160[b,u]	-----c	6.3[b,u]	-----c	0.32	3.4	3.8	4.4	<0.580	<0.592	<0.524	<0.517	<0.503	<0.504	<0.550
Vanadium	14000[b]	-----c	1400[b]	-----c	550[b]	-----c	25.2	980	980	980	23.3	19	12.3	10.7	13.2	9.34	13.3
Zinc[l]	610000[b]	-----c	61000[b]	-----c	23000[b]	-----c	95	16000	53000	---a	41	41.7	19.2	22.5	30.6	21.4	25.9
pH@ 25°C (1:10)	---	---	---	---	---	---	---	---	---	---	7.7	7.7	7.6	8.7	7.6	8.3	---

Part 742 Notes

* indicates that the ADL is less than or equal to the specified remediation objective.

** indicates that the value is not listed in TACO, Section 742, Table A or B.

V3 Table Notes:

0.1 Indicates laboratory reporting limit exceeds Tier 1 RO

[NT] [NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007.

Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html

--- --- indicates chemical not analyzed or not sampled

[A'] Section 742, Appendix A, Table G: Concentrations of Inorganic Chemicals in Background Soils

[B'] Counties within Metropolitan Statistical Areas: Boone, Champaign, Clinton, Cook, DuPage, Grundy, Henry, Jersey, Kane, Kankakee, Kendall, Lake, Macon, Madison, McHenry, McLean, Mendard, Monroe, Peoria, Rock Island, Sangamon, St. Clair, Tazewelll, Will, Winnebago and Woodford.

[C'] Section 742, Appendix B, Table C: pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Soil Component of the Groundwater Ingestion Route (Class I Groundwater)

See attached for notations

TABLE 3.4 - SOIL ANALYTICAL RESULTS (Pesticides/PCBs)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

	Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Route Values		Exposure Route-Specific Values for Soils Residential			11/17/2008	11/18/2008	11/18/2008	11/18/2008
	Industrial-Commercial		Construction Worker							SM-GP-102 X102	SM-GP-111 X111A	SM-GP-111 X111B	SM-GP-114 X114A
Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	ADL (mg/kg)	14-16 ft mg/kg	2-3 ft mg/kg	8-9 ft mg/kg	2-3 ft mg/kg
Pesticides\Insecticides\Herbicide (Method - 8081/8082)													
Aldicarb[o]	2000[b]	-----[c]	200[b]	-----[c]	0.013	0.07	78[b]	---[c]	NA	<0.0054	<0.0054	<0.0064	<0.0064
Chlordane	16[e]	140[e]	100[b]	22[b]	10	48	1.8[e]	72[e, x]	*	<0.011	<0.011	<0.013	<0.013
gamma-Chlordane	**	**	**	**	**	**	**	**	**	<0.011	<0.011	<0.013	<0.013
alpha-Chlordane	**	**	**	**	**	**	**	**	**	<0.011	<0.011	<0.013	<0.013
DDD	24[e]	-----[c]	520[e]	-----[c]	16[e]	80	3[e]	---[c]	*	<0.0054	<0.0054	<0.0064	<0.0064
DDT	17[e]	1500[e]	100[b]	2100[e]	32[e]	160	2[e]	---[g, x]	*	<0.0054	<0.0054	<0.0064	<0.0064
Dieldrin[n]	0.4[e]	2.2[e]	7.8[e]	3.1[e]	0.004[e]	0.02	0.04[e]	1[e]	0.603	<0.0054	<0.0054	<0.0064	<0.0064
Endosulfan[o]	12000[b]	-----[c]	1200[b]	-----[c]	18[b]	90	470[b]	---[c]	*	<0.0054	<0.0054	<0.0064	<0.0064
Endrin	610[b]	-----[c]	61[b]	-----[c]	1	5	23[b]	---[c]	*	<0.0054	<0.0054	<0.0064	<0.0064
Heptachlor	1[e]	11[e]	28[e]	16[e]	23	110	0.1[e]	0.1[e]	0.871	<0.0054	<0.0054	<0.0064	<0.0064
Heptachlor epoxide	0.6[e]	9.2[e]	2.7[b]	13[e]	0.7	3.3	0.07[e]	5[e]	1.005	<0.0054	<0.0054	<0.0064	<0.0064
Alpha -HCH (*alpha* -BHC)	0.9[e]	1.5[e]	20[e]	2.1[e]	0.0005[e]	0.003	0.1[e]	0.8[e]	0.0074	<0.0054	<0.0054	<0.0064	<0.0064
Methoxychlor[o]	10000[b]	-----[c]	1000[b]	-----[c]	160	780	390[b]	---c	*	<0.027	<0.027	<0.032	<0.032
Toxaphene[n]	5.2[e]	170[e]	110[e]	240[e]	31	150	0.6[e]	89[e]	*	<0.11	<0.11	<0.13	<0.13
PCBs (Method - 8081/8082)													
Aroclor 1016 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013
Aroclor 1221 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013
Aroclor 1232 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013
Aroclor 1242 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013
Aroclor 1248 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013
Aroclor 1254 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013
Aroclor 1260 (Using value for PCBs)[n]	1[h]	--[c,h]	1[h]	--[c,h]	--[h]	--[h]	1[h]	--[c,h]	*	<0.011	<0.011	<0.013	<0.013

Part 742 Notes
* indicates that the ADL is less than or equal to the specified remediation objective.
** indicates that the value is not listed in TACO, Section 742, Table A or B.
NA means Not Available; no PQL or EQL available in USEPA analytical methods.

	V3 Table Notes:
[NT]	[NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007. Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html
---	--- indicates chemical not analyzed or not sampled
	See attached for notations

TABLE 3.5 - SOIL ANALYTICAL RESULTS (ORGANIC MATTER)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

	SM-GP-101 X101	SM-GP-108 X108A	SM-GP-114 X114A
	Clayey Silt	Silty Clay Fill	Silty Clay Fill
	10-12 feet	2-3 feet	2-3 feet
Chemical Name	(mg/kg)	(mg/kg)	(mg/kg)
Organic Matter [%]	1.40	1.70	3.38

TABLE 4.1 - GROUNDWATER ANALYTICAL RESULTS (VOCS)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

		ERS Monitoring Wells			V3 Groundwater Samples												
		10/11/06	10/11/06	11/19/08	1/28/08	1/28/08	4/11/08	4/11/08	4/11/08	4/11/08	4/11/08	4/11/08	11/18/08	11/18/08	11/19/08	11/19/08	11/19/08
Chemical Name	Groundwater Remediation Objective Class I (mg/L)	MW-9 mg/L	MW-10 mg/L	MW-10 (Sampled by V3) mgL	SM-GP-07-GW mg/L	SM-GP-08-GW mgL	SM-GP-13-GW mgL	SM-GP-14-GW mgL	SM-GP-15-GW mgL	SM-GP-16-GW mgL	SM-GP-17-GW mgL	SM-GP-18-GW mgL	SM-GP-105 G105 mgL	SM-GP-106 G106 mgL	SM-GP-108 G108 mgL	SM-GP-110 G110 mgL	SM-GP-117 G117 mg/L
Volatile Organic Compounds (Method - 5030B/8260B)																	
Acetone	6.3	---	---	<0.002	<0.100	<0.100	<0.100	---	<0.100	<0.100	<0.100	<0.100	<0.002	<0.002	<0.002	0.013	<0.002
Benzene	0.005[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Bromodichloromethane (Dichlorobromomethane)	0.0002[a]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002
Bromoform	0.001[a]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002
Bromomethane	**	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
2-Butanone	**	---	---	<0.010	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	0.7	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride	0.005[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorobenzene (Monochlorobenzene)	0.1[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorodibromomethane (Dibromochloromethane)	0.14	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroethane [NT]	2.8	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroform	0.0002[a]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002
Chloromethane [NT]	0.028	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	0.7	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene (1,1-Dichloroethylene)[b]	0.007[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	0.07[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	0.1[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloropropane	0.005[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,3-Dichloropropene***	0.001[a]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,2-Dichloropropene***	0.001[a]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	0.7[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
2-Hexanone [NT]	0.28	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002	<0.002	<0.002	<0.002
4-Methyl-2-pentanone	**	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene chloride (Dichloromethane)	0.005[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Methyl tertiary-butyl ether (MTBE)	0.07	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Styrene	0.1[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2,2-Tetrachloroethane [NT]	0.42	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Tetrachloroethene (Perchloroethylene)	0.005[c]	---	---	<0.002	0.128	0.109	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	0.0022	0.079	0.0042	0.026
Toluene	1.0[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,1-Trichloroethane[b]	0.2[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2-Trichloroethane	0.005[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Trichloroethene (Trichloroethylene)	0.005[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Acetate	7.0	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	0.002[c]	---	---	<0.002	<0.0020	<0.0020	<0.0020	---	<0.0020	<0.0020	<0.0020	<0.0020	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (total)	10.0[c]	<0.003	<0.003	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0021	<0.002	<0.002	<0.002	<0.002

Part 742 Notes:

**indicates that the value is not listed in TACO, Section 742, Table E.

Chemical Name and Groundwater Remediation Objective Notations

a The groundwater remediation objective is equal to ADL for carcinogens according to the proecedures specified in 35 Ill. Adm. Code 620.

b Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed values subject to change.

c Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

V3 Table Notes:

0.1	Indicates exceedance of Tier 1 Class I objectives
0.1	Indicates laboratory detection limit exceeds Tier 1 RO
---	-- indicates chemical not analyzed or not sampled
***	***indicates value is for (1,3-Dichloropropylene, cis+trans)

		V3 Groundwater Samples						
		11/18/08	5/5/09	5/5/09	5/5/09	5/5/09	5/5/09	5/5/09
	Groundwater Remediation Objective	**VOC Trip Blank**	**SM-MW-01 G101 MS/MSD**	**SM-MW-02 G102**	**SM-MW-02 G102 Field Blank**	**SM-MW-03 G103**	**SM-MW-03 G103 Field Blank**	**SM-MW-04 G151 (G104)**
Chemical Name	Class I (mg/L)	mg/L	mgL	mgL	mgL	mgL	mgL	mg/L
Volatile Organic Compounds (Method - 5030B/8260B)								
Acetone	6.3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	0.005[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bromodichloromethane (Dichlorobromomethane)	0.0002[a]	<0.002	<0.002	0.0056	<0.002	0.004	<0.002	<0.002
Bromoform	0.001[a]	<0.002	<0.002	0.0048	<0.002	<0.002	<0.002	<0.002
Bromomethane	**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Butanone	**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	0.7	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride	0.005[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorobenzene (Monochlorobenzene)	0.1[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorodibromomethane (Dibromochloromethane)	0.14	<0.002	<0.002	0.0067	<0.002	0.0043	<0.002	<0.002
Chloroethane [NT]	2.8	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroform	0.0002[a]	<0.002	<0.002	0.0032	<0.002	0.0023	<0.002	<0.002
Chloromethane [NT]	0.028	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	0.7	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene (1,1-Dichloroethylene)[b]	0.007[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	0.07[c]	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	0.1[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloropropane	0.005[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,3-Dichloropropene***	0.001[a]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,2-Dichloropropene***	0.001[a]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	0.7[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Hexanone [NT]	0.28	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
4-Methyl-2-pentanone	**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene chloride (Dichloromethane)	0.005[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methyl tertiary-butyl ether (MTBE)	0.07	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Styrene	0.1[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2,2-Tetrachloroethane [NT]	0.42	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tetrachloroethene (Perchloroethylene)	0.005[c]	<0.002	0.0055	0.015	<0.002	0.053	<0.002	0.0046
Toluene	1.0[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,1-Trichloroethane[b]	0.2[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2-Trichloroethane	0.005[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Trichloroethene (Trichloroethylene)	0.005[c]	<0.002	<0.002	<0.002	<0.002	0.0027	<0.002	<0.002
Vinyl Acetate	7.0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	0.002[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (total)	10.0[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Part 742 Notes:

**indicates that the value is not listed in TACO, Section 742, Table E.

Chemical Name and Groundwater Remediation Objective Notations

a The groundwater remediation objective is equal to ADL for carcinogens according to the

b Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed

c Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 I
Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

V3 Table Notes:

0.1	Indicates exceedance of Tier 1 Class I objectives
0.1	Indicates laboratory detection limit exceeds Tier 1 RO
---	-- indicates chemical not analyzed or not sampled
***	***indicates value is for (1,3-Dichloropropylene, cis+trans)

TABLE 4.2 - GROUNDWATER ANALYTICAL RESULTS (SVOCS, Pest/PCBs, Inorganics)
SPARTANS' SQUARE SHOPPING CENTER
ROMEOVILLE, IL

		ERS GW Samples		V3 Groundwater Samples								
		10/11/06	10/11/06	11/19/08	11/19/08	11/19/08	11/19/08	11/19/08	5/5/09	5/5/09	5/5/09	5/5/09
	Groundwater Remediation Objective	**MW-9**	**MW-10**	**MW-10 (Sampled by V3)**	**SM-GP-108 G108**	**SM-GP-117 G117**	**MW-10**	**MW-10 V3**	**SM-MW-01 G101 MS/MSD**	**SM-MW-02 G102**	**SM-MW-03 G103**	**SM-MW-04 G151 (G104)**
Chemical Name	Class I (mg/L)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Base-Neutral/Acid Compounds (Includes Polynuclear Aromatics)												
Acenaphthene	0.42	0.00025	0.000028	<0.0017	<0.0017	<0.0017	<0.0017	<0.01	<0.0015	<0.0015	<0.0015	<0.0015
Acenaphthylene [NT]	0.21	<0.000083	<0.000017	<0.0017	<0.0017	<0.0017	<0.0017	<0.01	<0.0015	<0.0015	<0.0015	<0.0015
Anthracene	2.1	0.00085	0.00009	<0.0017	<0.0017	<0.0017	<0.0017	<0.005	<0.0015	<0.0015	<0.0015	<0.0015
Benzo(*a*)anthracene	0.00013[a]	**0.00084**	0.00021	<0.0017	<0.0017	<0.0017	<0.0017	<0.00013	<0.0015	<0.0015	<0.0015	<0.0015
Benzo(*b*)fluoranthene	0.00018[a]	0.00072	0.00047	<0.0017	<0.0017	<0.0017	<0.0017	<0.0002	<0.0015	<0.0015	<0.0015	<0.0015
Benzo(*k*) fluroanthene	0.00017[a]	0.00064	0.00035	<0.0017	<0.0017	<0.0017	<0.0017	<0.00018	<0.0015	<0.0015	<0.0015	<0.0015
Benzo(*g,h,i*)perylene [NT]	0.21	0.00065	0.00053	<0.0017	<0.0017	<0.0017	<0.0017	<0.00017	<0.0015	<0.0015	<0.0015	<0.0015
Benzo(*a*) pyrene	0.0002[a,c]	0.00071	0.00043	<0.0017	<0.0017	<0.0017	<0.0017	<0.0002	<0.0015	<0.0015	<0.0015	<0.0015
Benzoic Acid	28	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Benzyl alcohol [NT]	3.5	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
bis (2-Chloroethoxy)methane	**	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
bis (2-Chloroethyl)ether	0.01[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
bis (2-chloroisopropyl)ether [NT]	0.28	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
bis (2-Ethylhexyl)phthalate	0.006[c]	---	---	0.0029	<0.0017	<0.0017	0.0029	---	0.0017	<0.0015	<0.0015	<0.0015
Butyl benzyl phthalate	1.4	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
4-Chloroaniline (p-Chloroaniline)	0.028	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
4-Chloro-3-methylphenol	**	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2-Chloronaphthalene	**	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2-Chlorophenol (pH dependent)	0.035	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
4-Chlorophenyl-phenylether	**	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Chrysene	0.0015[a]	0.001	0.0003	<0.0017	<0.0017	<0.0017	<0.0017	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015
Dibenzo(*a,h*)anthracene	0.0003[a]	0.00019	0.00012	<0.0017	<0.0017	<0.0017	<0.0017	<0.0003	<0.0015	<0.0015	<0.0015	<0.0015
Dibenzofuran [NT]	0.014	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
1,2-Dichlorobenzene (*o*-Dichlorobenzene)	0.6[c]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
1,3-Dichlorobenzene [NT]	0.0063	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
1,4-Dichlorobenzene (*p*-Dichlorobenzene)	0.075[c]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
3,3'-Dichlorobenzidine	0.02[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2,4-Dichlorophenol	0.021	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Diethyl phthalate	5.6	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2,4-Dimethylphenol	0.14	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Dimethylphthalate [NT]	70	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Di-n-butylphthalate	0.7	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
4,6-Dinitro-2-methylphenol [NT]	0.0007	---	---	<0.0056	<0.0056	<0.0056	<0.0056	---	<0.0050	<0.0050	<0.0050	<0.0050
2,4-Dinitrophenol	0.014	---	---	<0.0056	<0.0056	<0.0056	<0.0056	---	<0.0050	<0.0050	<0.0050	<0.0050
2,4-Dinitrotoluene	0.00002[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2,6-Dinitrotoluene	0.00031[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Di-n-octylphthalate	0.14	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Fluoranthene	0.28	0.00360	0.00038	<0.0017	<0.0017	<0.0017	<0.0017	<0.002	<0.0015	<0.0015	<0.0015	<0.0015
Fluorene	0.28	0.00045	0.00004	<0.0017	<0.0017	<0.0017	<0.0017	<0.002	<0.0015	<0.0015	<0.0015	<0.0015
Hexachlorobenzene	0.00006[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Hexachlorobutadiene [NT]	0.0014	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Hexachlorocyclopentadiene	0.05[c]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Hexachloroethane	0.007	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Indeno(1,2,3-*c,d*)pyrene	0.00043[a]	0.00044	0.0004	<0.0017	<0.0017	<0.0017	<0.0017	<0.0003	<0.0015	<0.0015	<0.0015	<0.0015
Isophorone	1.4	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2-Methylnaphthalene [NT]	0.028	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2-Methylphenol (o-cresol)	0.35	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
3&4-Methylphenol [NT]	0.385	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Naphthalene	0.14	<0.00013	0.000036	<0.0017	<0.0017	<0.0017	<0.0017	<0.01	<0.0015	<0.0015	<0.0015	<0.0015
2-Nitroaniline [NT]	0.021	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
3-Nitroaniline [NT]	0.0021	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
4-Nitroanilne [NT]	0.021	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Nitrobenzene[b]	0.0035	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2-Nitrophenol	**	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
4-Nitrophenol [NT]	0.056	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
N-Nitrosodimethylamine [NT]	0.0006	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
N-Nitroso-di-n-propylamine	0.0018[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
N-Nitrosodiphenylamine	0.0032[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Pentachlorophenol	0.001[c]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Phenanthrene [NT]	0.21	0.00350	0.00027	<0.0017	<0.0017	<0.0017	<0.0017	<0.005	<0.0015	<0.0015	<0.0015	<0.0015
Phenol	0.1[c]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
Pyrene	0.21	0.00230	0.00033	<0.0017	<0.0017	<0.0017	<0.0017	<0.002	<0.0015	<0.0015	<0.0015	<0.0015
1,2,4-Trichlorobenzene	0.07[c]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2,4,5-Trichlorophenol (pH dependant)	0.7	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
2,4,6-Trichlorophenol (pH dependant)	0.01[a]	---	---	<0.0017	<0.0017	<0.0017	<0.0017	---	<0.0015	<0.0015	<0.0015	<0.0015
PCBs												
PCBs	0.0005[c]	---	---	---	<0.0005	<0.0005	---	---	<0.0005	<0.0005	<0.0005	<0.0005
Pesticides\Insecticides\Herbicides												
Alachlor	0.002[c]	---	---	---	<0.00005	<0.00005	---	---	<0.00005	<0.00005	<0.00005	<0.00005
Aldrin	0.014[a]	---	---	---	<0.00005	<0.00005	---	---	<0.00005	<0.00005	<0.00005	<0.00005
Chlordane	0.002[c]	---	---	---	<0.00005	<0.00005	---	---	<0.00005	<0.00005	<0.00005	<0.00005
DDE	0.01[a]	---	---	---	<0.0001	<0.0001	---	---	<0.0001	<0.0001	<0.0001	<0.0001
DDT	0.006[a]	---	---	---	<0.0001	<0.0001	---	---	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	0.009[a]	---	---	---	<0.0001	<0.0001	---	---	<0.0001	<0.0001	<0.0001	<0.0001
Endosulfan	0.042	---	---	---	<0.0001	<0.0001	---	---	<0.0001	<0.0001	<0.0001	<0.0001
Endrin	0.002[c]	---	---	---	<0.0001	<0.0001	---	---	<0.0001	<0.0001	<0.0001	<0.0001
Heptachlor	0.0004[c]	---	---	---	<0.0001	<0.0001	---	---	<0.0001	<0.0001	<0.0001	<0.0001
Heptachlor epoxide	0.0002[c]	---	---	---	<0.00005	<0.00005	---	---	<0.00005	<0.00005	<0.00005	<0.00005
Alpha-HCH (*alpha*-BHC)	0.00011[a]	---	---	---	<0.00005	<0.00005	---	---	<0.00005	<0.00005	<0.00005	<0.00005
Gamma-HCH (Lindane)	0.0002[c]	---	---	---	<0.00005	<0.00005	---	---	<0.00005	<0.00005	<0.00005	<0.00005
Methoxychlor	0.04[c]	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	<0.001	<0.001
Toxaphene	0.003[c]	---	---	---	<0.003	<0.003	---	---	<0.003	<0.003	<0.003	<0.003
INORGANICS												
Aluminum [NT]	3.5	---	---	---	0.257	1.22	---	---	**5.58**	0.0949	0.93	**6.74**
Antimony	0.006[c]	---	---	---	<0.002	<0.002	---	---	<0.002	<0.002	<0.002	<0.002
Arsenic	0.05[c]	---	---	---	<0.005	<0.005	---	---	<0.005	<0.005	<0.005	<0.005
Barium	2.0[c]	---	---	---	0.0847	0.0899	---	---	0.091	0.0416	0.0449	0.0928
Beryllium	0.004[c]	---	---	---	<0.002	<0.002	---	---	<0.002	<0.002	<0.002	<0.002
Boron	2.0[c]	---	---	---	0.0824	0.0805	---	---	0.202	0.292	0.269	0.196
Cadmium	0.005[c]	---	---	---	<0.002	<0.002	---	---	<0.002	<0.002	<0.002	<0.002
Calcium	----d	---	---	---	135	142	---	---	192	78.8	92.4	184
Chromium, total	0.1[c]	---	---	---	<0.002	0.00373	---	---	0.0124	<0.002	<0.002	0.0144
Cobalt	1.0[c]	---	---	---	<0.002	<0.002	---	---	<0.002	<0.002	<0.002	<0.002
Copper	0.65[c]	---	---	---	<0.002	0.00406	---	---	0.0201	<0.002	<0.002	0.0211
Cyanide	0.2[c]	---	---	---	<0.005	<0.005	---	---	<0.005	<0.005	<0.005	<0.005
Iron	5.0[c]	---	---	---	0.687	3.51	---	---	**16.2**	0.327	4.42	**18.1**
Lead	0.0075[c]	---	---	---	<0.002	0.00278	---	---	**0.0115**	<0.002	<0.002	0.0101
Magnesium	----d	---	---	---	64.4	70.4	---	---	105	37.8	46.6	101
Manganese	0.15[c]	---	---	---	0.0166	0.0654	---	---	0.397	0.0272	0.112	0.386
Mercury	0.002[c]	---	---	---	<0.0002	<0.0002	---	---	<0.0002	<0.0002	<0.0002	<0.002
Nickel	0.1[c]	---	---	---	0.0022	0.00633	---	---	0.0171	<0.0002	<0.0002	0.0181
Potassium	----d	---	---	---	6.97	7	---	---	6.25	3.72	4.77	6.67
Selenium	0.05[c]	---	---	---	<0.005	<0.005	---	---	<0.005	<0.005	<0.005	<0.005
Silver	0.05[c]	---	---	---	<0.002	<0.002	---	---	<0.002	<0.002	<0.002	<0.002
Sodium	----d	---	---	---	138	141	---	---	<0.002	<0.002	<0.002	<0.002
Thallium	0.002[c]	---	---	---	<0.002	<0.002	---	---	<0.002	<0.002	<0.002	<0.002
Vanadium[b]	0.049[c]	---	---	---	<0.002	0.00245	---	---	0.0119	<0.002	<0.002	0.0141
Zinc	5.0[c]	---	---	---	0.0053	0.0195	---	---	0.0462	<0.002	<0.002	0.0529

Chemical Name and Groundwater Remediation Objective Notations

a The groundwater remediation objective is equal to ADL for carcinogens according to the proecedures specified in 35 Ill. Adm. Code 620.

b Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed values subject to change.

c Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

V3 Table Notes:

0.1	Indicates exceedance of Tier 1 Class I objectives
0.1	Indicates exceedance of Tier 1 Class II objectives
	Indicates laboratory reporting limit is greater than Tier 1 remediation objectives
---	-- indicates chemical not analyzed or not sampled
***	***indicates value is for (1,3-Dichloropropylene, cis+trans)
[NT]	[NT] indicates Non-TACO Chemical, some values are provisional objectives and are subject to change. Non-TACO Chemical Remediation Objectives are prepared by the IEPA Toxicity Assessment Unit, May 1, 2007.
	Non-TACO values from http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html

Chemical Name and Soil Remediation Objective Notations (For INDUSTRIAL-COMMERCIAL and CONSTRUCTION WORKER Remediation Objectives)

a. Soil remediation objectives based on human health criteria only.
b. Calculated values correspond to a target hazard quotient of 1.
c. No toxicity criteria available for this route of exposure.
d. Soil saturation concentration (C[sat]) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.
e. Calculated values correspond to a cancer risk level of 1 in 1,000,000.
f. Deleted from 742.
g. Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.
h. 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Request for approval of a Tier 3 evaluation must address the applicablity of 40 CFR 761.
i. Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D in this Part.
j. Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.
k. Deleted from 742.
l. Potential for soil-plant-human exposure.
m. The person conducting the remediation has the option to use: (1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; (2) the total amount of contaminant in the soil sample results to compare with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510); or (3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentration, this should be done in accordance with Subpart D of this Part.
n. The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.
o. For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.
p. For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.
q. The TCLP extraction must be done using water at a pH of 7.0.
r. Value based on dietary Reference Dose.
s. Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.
t. For the ingestion route for arsenic for industrial/commercial, see 742, Appendix A, Table G.
u. Value based on Reference Dose for thallium sulfate (CAS No. 7446-18-6).
v. Deleted from 742.
w. Value based on Reference Dose adjusted for dietary intake.
x. For any populated areas as defined in Section 742.200, Appendix A, Table H may be used.
y. Value based on maintaining fetal blood lead below 10 ug/dl, using the USEPA adults Blood Lead Model.

Chemical Name and Soil Remediation Objective Notations (For RESIDENTIAL REMEDIATION OBJECTIVES)

a. Soil remediation objectives based on human health criteria only.
b. Calculated values correspond to a target hazard quotient of 1.
c. No toxicity criteria available for this route of exposure.
d. Soil saturation concentration (C[sat]) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.
e. Calculated values correspond to a cancer risk level of 1 in 1,000,000.
f. Deleted from 742.
g. Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.
h. 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Request for approval of a Tier 3 evaluation must address the applicablity of 40 CFR 761.
i. Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D in this Part.
j. Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.
k. A preliminary remediation goal of 400 mg/kg has been set for lead based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* , OSWER Directive #9355.4-12.
l. Potential for soil-plant-human exposure.
m. The person conducting the remediation has the option to use: (1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; (2) where applicable, the total amount of contaminant in the soil sample results to with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510): or (3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentration, this should be done in accordance with Subpart D of this Part.
n. The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.
o. For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.
p. For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.
q. The TCLP extraction must be done using water at a pH of 7.0.
r. Value based on dietary Reference Dose.
s. Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.
t. For the ingestion route for arsenic, see 742, Appendix A, Table G.
u. Value based on Reference Dose for thallium sulfate (CAS No. 7446-18-6).
v. Value based on Reference Dose adjusted for dietary intake.
w. For sites located in any populated area as defined in Section 742.200, Appendix A, Table H may be used.
x. The remediation objectives for these chemicals must also include the construction worker inhalation objective in Appendix B, Table B.

APPENDIX A

SOIL GAS ASSESSMENT WORK PLAN

ILLINOIS SITE REMEDIATION PROGRAM

SOIL GAS ASSESSMENT WORK PLAN

Spartans' Square Sampling Work Plan
IEPA BOL Site No. 1970905180
NWC Illinois Route 53 & Alexander Circle
(3-23 Terrace Lane, 615-625 Access Drive)
Romeoville, Illinois

PREPARED FOR:

VILLAGE OF ROMEOVILLE
13 MONTROSE DRIVE
ROMEOVILLE, ILLINOIS 60446

PREPARED BY:

V3 COMPANIES OF ILLINOIS, LTD.
7365 JANES AVENUE
WOODRIDGE, ILLINOIS 60517
630.724.9200

AUGUST 2012

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APPENDICES

1.0 INTRODUCTION

This Work Plan (WP) was prepared by V3 Companies of Illinois, Ltd. (V3) on behalf of the Village of Romeoville to summarize the general scope and work requirements for soil gas sampling activities at the Spartans' Square Shopping Center property (Site). The WP focuses on the collection of six soil gas samples via use of the Geoprobe® Post Run Tubing (PRT) system. The active soil gas collection points have been selected to evaluate the subsurface below the existing and potential future building foundations at the Site. The evaluation of prior passive sampling results did identify potential indoor inhalation concerns for dry cleaning solvents. This active soil gas collection is intended to evaluate indoor inhalation risks within interior and exterior areas of the Site and determine if indoor inhalation issues need to be addressed within the future Remedial Action Plan. The existing building is planned to be demolished and a new building will likely be built at this location.

The Site is located at the northwest corner of Illinois Route 53 and Alexander Circle, in Romeoville, Illinois. Previous Site investigations were completed from January 2008 to May 2009. The investigations consisted of the installation of soil borings and monitoring wells, and the collection of passive soil gas samples. Figures and tables summarizing the results of the 2008-2009 site investigations were presented in the May 21, 2010, Comprehensive Site Investigation and Remediation Objectives Report (CSI/ROR), and the subsequent Supplemental Comprehensive Site Investigation and Remediation Objectives Report (CSI/ROR).

See **Table 1.0** (attached) for existing groundwater data compared to the Tier 1 industrial/commercial groundwater ROs for the inhalation exposure pathway provided within *Appendix B, Table H* of the proposed amendments to *Part 742*. The Tier 1 ROs within *Appendix B, Table H* consider both diffusion and advection, are the most stringent, and are required to be used within 5 feet of a building. [Note: In using Table H, compliance with the Tier 1 ROs for the indoor inhalation route is achieved by meeting either the soil gas ROs or the groundwater ROs.]

The following scope of work is based on results of the prior investigations and discussions with the IEPA. Results of soil gas sampling proposed herein will be formally provided to IEPA for review within the pending Remedial Action Plan (RAP), or as an addendum to prior reporting.

2.0 FIELD PROGRAM

Work will be conducted in general accordance with the *Interim Protocol for Active Soil Gas Sampling* guidance document prepared by the Illinois EPA (IEPA) in January 2010 (presented in **Appendix A**). The field activities will include:

- Advancing active soil gas sampling probes using the Geoprobe® Post-Run Tubing (PRT) system direct push methods
- Collecting leak detection samples for quality control
- Collecting soil gas samples
- Equipment Decontamination
- Transport of samples to the laboratory
- Documentation of Field Activities

The following sections describe media to be sampled, number and location of samples, general sampling methods and field and laboratory methods. Documentation of field activities is

discussed in **Section 5.0**. Proposed sampling locations are shown on **Figure 1.0**. Suggested soil gas assessment methods and equipment are presented in **Appendix A**.

2.1 Soil Gas Sample Locations

Based on a review of existing groundwater data for the Site and the prior passive soil gas sampling results (see Appendix A.4 of the approved CSI/ROR for this site), and informal discussions with IEPA, soil gas sample collection locations are proposed as shown on **Figure 1.0**. The objectives of the samples are as follows:

- Inside existing building: The proposed interior sample location is intended to evaluate conditions beneath the former dry cleaner location, where groundwater results indicate the presence of tetrachloroethylene (PCE) in excess of the pending Tier 1 groundwater RO for indoor inhalation.
- Outside existing building: These proposed soil gas sampling locations are intended to evaluate the potential for migration of VOC vapors in soil gas in excess of the pending Tier 1 indoor inhalation ROs. These locations are proposed in the Remediation Area, where buildings may be constructed in the future, and also down-gradient of previous groundwater samples, where PCE exceeds the pending Tier 1 groundwater ROs for indoor inhalation.

2.2 Soil Gas Sampling Probes

Soil gas sampling will be conducted using the Geoprobe® PRT (Post Run Tubing) direct push methods and equipment. The soil gas probes will be advanced to an approximate depth of 3 to 5 feet below ground surface. A slide hammer or electric jackhammer will be used to drive the tool string into the ground. Refer to *Soil Gas Sampling – PRT System Operation*, which is presented in **Appendix A**.

2.3 Collecting Soil Gas Samples

Soil gas samples will be collected using equipment and procedures consistent with the IEPA Interim Protocol.

- Either Teflon or Nylaflow 1/8" diameter rigid tubing will be attached to the sampling implant and used to collect soil gas samples.
- Three volumes of soil gas will be purged before obtaining each soil gas sample.
- Soil gas samples will be collected in opaque Tedlar bags via syringe or hand pump, or in 1-Liter (EZ-CAN) preassembled air canisters (see **Appendix A**) fitted with a flow controller limited to a maximum flow rate of 200 milliliters/minute. The EZ-CAN air canisters are batch-certified clean by the laboratory.
- A field quality control (QC) soil gas sample will be collected from each location to determine whether the sampling string is leaking. A rigid containment shroud will be used to cover the entire sampling string, and to contain Helium, which will be used as a tracer gas to detect leaks. The QC sample will be collected into a Tedlar bag, and a Helium detector will be used to measure the concentration of Helium in the soil gas sample. If no Helium is detected, a soil gas sample will be collected into a Tedlar bag or an EZ-CAN. If Helium is detected, the sampling system will be repaired, and the leak detection procedure repeated until no leak is detected.
- Leak evaluation procedure: To evaluate soil gas sample integrity, the proportion of ambient air leakage (ratio of Helium in the sample to the stabilized Helium concentration within the shroud) will be calculated as a percent (X% of Helium in sample divided by

X% of Helium in shroud), thereby providing an estimate of the amount of ambient air leakage in the sample collection process. An allowable percent leakage of ambient air is presumed to be less than 5%, based on the quantitative leak testing procedures / guidance published by California EPA, Department of Toxic Substances Control at: http://dtsc.ca.gov/SiteCleanup/upload/VI_ActiveSoilGasAdvisory_FINAL_043012.pdf (Appendix C of the referenced document).

3.0 ANALYTICAL PROGRAM

Laboratory services will be provided by a NELAC-certified laboratory. Soil gas samples will be analyzed using the upgraded TO-15 method.

3.1 Sample Custody

The following information concerning the sample will be documented on the COC form:

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Analyses required
- Name of field personnel collecting samples
- Pertinent field data
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (e.g. Federal Express)

All samples will be uniquely identified, labeled, and documented in the field at the time of collection.

3.2 Sample Shipment and Transfer of Custody

Samples collected in the field will be transported to the laboratory as expeditiously as possible. Samples will be packed in packaging provided by the laboratory. There are no other special handling requirements for soil gas samples collected in Tedlar bags or EZ-CANS. Samples will either be dropped off or shipped to the laboratory. Samples will be delivered and analyzed within the required 72-hour holding time. Standard chain of custody procedures will be utilized throughout this process.

3.3 Analytical Sampling Results

The laboratory analytical results will be initially evaluated by comparison to the Tier 1 soil gas remediation objectives as described within Section 742.515, and as specified within Appendix B, Table H, of the proposed amendments to Part 742 initially filed in November 2010, and as currently pending before the Illinois Pollution Control Board.

4.0 DECONTAMINATION ACTIVITIES

Decontamination procedures will be employed to prevent cross contamination during the collection of soil gas samples, by purging each sample point as described above, and by using laboratory clean-certified air canisters or Tedlar bags.

All equipment used to install the tool string into the subsurface will be decontaminated prior to each use by following these procedures:

- Scrub the equipment with a brush and a Liquinox® wash,
- Rinse the equipment once with distilled water,
- Air dry the equipment.

New disposable sampling gloves will be donned each time a sample is collected and during the handling of sampling equipment.

5.0 DOCUMENTATION OF FIELD ACTIVITIES

Field logbooks (bound field survey books) will be used to record data collection activities performed on Site. Each logbook will be identified by a V3 project-specific number. The cover of each logbook will contain the following:

- Book Number
- Project Name and Number
- Start Date
- End Date

Data recorded in the field logbooks, sample labels and COC records will be completed in waterproof ink. Entries in the logbook will include the following items, as appropriate to the activity:

- Name and title of author, date and time of entry, and physical/environmental conditions
- Description of sampling and or other field activity location
- Identification of the specific activity or work task being performed
- Name(s) and title(s) of field crew
- Name(s) and title(s) of Site visitors
- Type of media sampled or measured
- Sample collection or measurement method
- Description of measuring point references
- Date and time of collection
- Unique sample identification number
- References to maps and photographs
- Field measurements
- Reference to all pertinent data collection forms
- Sample documentation, including dates and methods of shipment.

If photographs are taken during the sampling activity, then the following identifying information will be entered into the logbook as the photographs are being taken:

- Photograph number
- Site location
- Date and time
- Photographer's name
- A description of the activities being performed or the subject of the photograph
- Personnel included in the photograph

- File number or disposable camera number

After processing, photographs will be numbered and identified according to the logbook descriptions.

6.0 INVESTIGATION DERIVED WASTE

Soil cuttings will not be generated during the field activities, and thus there will be no materials to containerize.

REMEDIATION SITE BOUNDARY

MW-9 ERS (Sampled - 10/11/06):
Groundwater Sample Analyzed for BTEX+MTBE & PNAs
BAA, BBF, BKF, BAP, IP Class I

SM-GP-18(GW):
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-18

SM-GP-15(GW):
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-16(GW):
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-17(GW):
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-17

SM-GP-15

SM-GP-16

MW-10 ERS (Sampled - 10/11/06):
Groundwater Sample Analyzed for BTEX+MTBE & PNAs
BAA, BBF, BKF, BAP Class I
MW-10 V3 (Sampled - 11/19/08):
Groundwater Sample Analyzed for VOCs & PNAs
No Groundwater Exceedances

SM-GP-13(GW):
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-102

SM-GP-13

APPROX. GROUNDWATER FLOW DIRECTION

SM-GP-01
SM-GP-02
SM-GP-111
SM-GP-110
SM-GP-03
SM-GP-109
SM-GP-113
SM-GP-103

SM-GP-110:
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-06
SM-GP-116
SM-GP-115
SM-GP-114

SM-GP-07:
Groundwater Sample Analyzed for VOCs
PCE Class I

SM-MW-03

SM-MW-03:
Groundwater Sample Analyzed for VOCs, SVOCs, TAL Metals, Pest/PCBs
BFM, CF, PCE Class I

SM-GP-101

SM-GP-105:
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-04
SM-GP-05
SM-GP-105
SM-GP-112
SM-GP-09
SM-GP-07
SM-GP-108

SM-GP-108:
Groundwater Sample Analyzed for VOCs
PCE Class I

SM-MW-02:
Groundwater Sample Analyzed for VOCs, SVOCs, TAL Metals, Pest/PCBs
PCE, BDM, BF, CF Class I

SM-MW-02
SM-GP-104
SM-GP-08
SM-GP-106
SM-GP-107

SM-GP-106(GW):
Groundwater Sample Analyzed for VOCs
No Groundwater Exceedances

SM-GP-08:
Groundwater Sample Analyzed for VOCs
PCE Class I

SM-GP-117

SM-GP-117:
Groundwater Sample Analyzed for VOCs
SVOCs, TAL Metals, Pest/PCBs
PCE Class I

General Class I Groundwater Delineation

SM-MW-01

APPROXIMATE GROUNDWATER PCE PLUME

SM-GP-12
SM-GP-11
SM-GP-10
SM-MW-04
SM-GP-118

SM-MW-04:
Groundwater Sample Analyzed for VOCs, SVOCs, TAL Metals, Pest/PCBs
Al, Fe, Pb, Mn Class I

SM-MW-01:
Groundwater Sample Analyzed for VOCs, SVOCs, TAL Metals, Pest/PCBs
Al, Fe, Pb, Mn, PCE Class I

PROPOSED SOIL GAS SAMPLE

1"=40'
40 0 40 80
SCALE FEET

V3 Companies
7325 Janes Avenue
Woodridge, IL 60517
630.724.9200 phone
630.724.9202 fax
www.v3co.com
Visio, Vertere, Virtute "The Vision to Transform with Excellence"

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT NO.:	07292	DESIGNED BY:	RKB
FILE NAME:	Fig1_pSGSsamples	DRAWN BY:	RKB
DATE:	DATE	CHECKED BY:	CAM
SCALE:	SCALE	PROJECT MANAGER:	CAM

SPARTANS' SQUARE SHOPPING CENTER

ROMEOVILLE ILLINOIS

PROPOSED SOIL GAS COLLECTION LOCATIONS

DRAWING NO. 1.0

07292 - PROPOSED SOIL GAS COLLECTION LOCATIONS

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...\SGS\Fig1_pSGSsamples07292.dgn 8/17/2012 4:20:23 PM

TABLE 1 - GROUNDWATER: INDOOR INHALATION EXPOSURE ROUTE ANALYTICAL RESULTS
Spartans Square, Romeoville, IL

Proposed TACO Amendments [First Notice 04-19-2012]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	10/11/06 MW-9 mg/L	10/11/06 MW-10 mg/L	11/19/08 MW-10 (Sampled by V3) mg/L	1/28/08 SM-GP-07-GW mg/L	1/28/08 SM-GP-08-GW mg/L	4/11/08 SM-GP-13-GW mg/L	4/11/08 SM-GP-14-GW mg/L	4/11/08 SM-GP-15-GW mg/L	4/11/08 SM-GP-16-GW mg/L	4/11/08 SM-GP-17-GW mg/L	4/11/08 SM-GP-18-GW mg/L	11/18/08 SM-GP-105 G105 mg/L	11/18/08 SM-GP-106 G106 mg/L
(Method -8260B/8310/8082)														
Acetone	1,000,000[g]	---	---	<0.002	<0.100	<0.100	<0.100	---	<0.100	<0.100	<0.100	<0.100	<0.002	<0.002
Benzene	0.41[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Bis(2-chloroethyl)ether	0.43[c]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane (Dichlorobromomethane)	6,700[g]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002
Bromoform	12[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002
2-Butanone (MEK)	48,000[b]	---	---	<0.010	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.010	<0.010
Carbon disulfide	210[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Carbon tetrachloride	0.076[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Chlorobenzene (Monochlorobenzene)	82[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Chlorodibromomethane (Dibromochloromethane)	2,600[g]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002
Chloroform	0.15[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002
2-Chlorophenol	22,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
1,2-Dichlorobenzene	160[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
1,4-Dichlorobenzene	79[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
1,1-Dichloroethane	580[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
1,2-Dichloroethane (Ethylene dichloride)	0.22[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
1,1-Dichloroethene (1,1-Dichloroethylene)	74[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	3,500[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	51[b]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
1,2-Dichloropropane	0.48[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
cis-1,3-Dichloropropene (1)	0.52[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002
trans-1,3-Dichloropropene (1)	0.52[c]	---	---	<0.002	<0.0010	<0.0010	<0.0010	---	<0.0010	<0.0010	<0.0010	<0.0010	<0.002	<0.002
Ethylbenzene	1.4[c]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Hexachlorobenzene	0.0062[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Hexachlorocyclopentadiene	0.26[b]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Hexachloroethane	50[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Isophorone	12,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Mercury[h]	0.060[g]	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 1 - GROUNDWATER: INDOOR INHALATION EXPOSURE ROUTE ANALYTICAL RESULTS
Spartans Square, Romeoville, IL

Proposed TACO Amendments [First Notice 04-19-2012]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	10/11/06 MW-9 mg/L	10/11/06 MW-10 mg/L	11/19/08 MW-10 (Sampled by V3) mg/L	1/28/08 SM-GP-07-GW mg/L	1/28/08 SM-GP-08-GW mg/L	4/11/08 SM-GP-13-GW mg/L	4/11/08 SM-GP-14-GW mg/L	4/11/08 SM-GP-15-GW mg/L	4/11/08 SM-GP-16-GW mg/L	4/11/08 SM-GP-17-GW mg/L	4/11/08 SM-GP-18-GW mg/L	11/18/08 SM-GP-105 G105 mg/L	11/18/08 SM-GP-106 G106 mg/L
MTBE (methyl tertiary-butyl ether)	6,800[b]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Methylene chloride (Dichloromethane)	8.2[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
2-Methylnaphthalene	25[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
2-Methylphenol (o-cresol)	26,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Naphthalene	0.32[c]	<0.00013	0.000036	<0.0017	---	---	---	---	---	---	---	---	---	---
n-Nitrosodi-n-propylamine	0.27[c]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Phenol	83,000[g]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
Polychlorinated biphenyls (PCBs)	---[d]	---	---	---	---	---	---	---	---	---	---	---	---	---
Styrene	310[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Tetrachloroethene (Perchloroethylene)	0.34[c]	---	---	<0.002	0.128	0.109	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	0.0022
Toluene	530[g]	<0.001	<0.001	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
1,2,4-Trichlorobenzene	5.9[b]	---	---	<0.0017	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	1,300[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
1,1,2-Trichloroethane	4,400[g]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Trichloroethene (Trichloroethylene)	1.3[c]	---	---	<0.002	<0.0050	<0.0050	<0.0050	---	<0.0050	<0.0050	<0.0050	<0.0050	<0.002	<0.002
Vinyl Acetate	550[b]	---	---	<0.002	<0.0100	<0.0100	<0.0100	---	<0.0100	<0.0100	<0.0100	<0.0100	<0.002	<0.002
Vinyl Chloride	0.21[c]	---	---	<0.002	<0.0020	<0.0020	<0.0020	---	<0.0020	<0.0020	<0.0020	<0.0020	<0.002	<0.002
Xylenes (total)[e]	93[b]	<0.003	<0.003	<0.002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0021	<0.002

V3 Table Notes:

0.11 Indicates exceedance of Tier 1 remediation objective

(1) indicates value is for (1,3-Dichloropropylene, cis+trans)

--- --- indicates chemical not analyzed or not sampled

* value is for m&p-xylene

Proposed TACO Amendments [First Notice 04-19-2012]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	11/19/08 SM-GP-108 G108	11/19/08 SM-GP-110 G110	11/19/08 SM-GP-117 G117	5/5/09 SM-MW-01 G101 MS/MSD	5/5/09 SM-MW-02 G102	5/5/09 SM-MW-02 G102 Field Blank	5/5/09 SM-MW-03 G103	5/5/09 SM-MW-03 G103 Field Blank	5/5/09 SM-MW-04 G151 (G104)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
(Method -8260B/8310/8082)										
Acetone	1,000,000[g]	<0.002	0.013	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	0.41[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bis(2-chloroethyl)ether	0.43[c]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Bromodichloromethane (Dichlorobromomethane)	6,700[g]	<0.002	<0.002	<0.002	<0.002	0.0056	<0.002	0.004	<0.002	<0.002
Bromoform	12[c]	<0.002	<0.002	<0.002	<0.002	0.0048	<0.002	<0.002	<0.002	<0.002
2-Butanone (MEK)	48,000[b]	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	210[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride	0.076[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorobenzene (Monochlorobenzene)	82[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorodibromomethane (Dibromochloromethane)	2,600[g]	<0.002	<0.002	<0.002	<0.002	0.0067	<0.002	0.0043	<0.002	<0.002
Chloroform	0.15[c]	<0.002	<0.002	<0.002	<0.002	0.0032	<0.002	0.0023	<0.002	<0.002
2-Chlorophenol	22,000[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
1,2-Dichlorobenzene	160[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
1,4-Dichlorobenzene	79[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
1,1-Dichloroethane	580[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane (Ethylene dichloride)	0.22[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene (1,1-Dichloroethylene)	74[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	3,500[g]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002
trans-1,2-Dichloroethene (trans-1,2-Dichloroethylene)	51[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloropropane	0.48[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
cis-1,3-Dichloropropene (1)	0.52[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
trans-1,3-Dichloropropene (1)	0.52[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	1.4[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Hexachlorobenzene	0.0062[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Hexachlorocyclopentadiene	0.26[b]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Hexachloroethane	50[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Isophorone	12,000[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Mercury[h]	0.060[g]	<0.0002	---	<0.0002	<0.0002	<0.0002	---	<0.0002	---	<0.002

Proposed TACO Amendments [First Notice 04-19-2012]

Appendix B, Table H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route - Diffusion and Advection

Qsoil = 83.33 cm3/sec [a]

Chemical Name	Groundwater Industrial/ Commercial (mg/L)	11/19/08 SM-GP-108 G108	11/19/08 SM-GP-110 G110	11/19/08 SM-GP-117 G117	5/5/09 SM-MW-01 G101 MS/MSD	5/5/09 SM-MW-02 G102	5/5/09 SM-MW-02 G102 Field Blank	5/5/09 SM-MW-03 G103	5/5/09 SM-MW-03 G103 Field Blank	5/5/09 SM-MW-04 G151 (G104)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MTBE (methyl tertiary-butyl ether)	6,800[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene chloride (Dichloromethane)	8.2[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Methylnaphthalene	25[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
2-Methylphenol (o-cresol)	26,000[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Naphthalene	0.32[c]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
n-Nitrosodi-n-propylamine	0.27[c]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Phenol	83,000[g]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
Polychlorinated biphenyls (PCBs)	---[d]	<0.0005	---	<0.0005	<0.0005	<0.0005	---	<0.0005	---	<0.0005
Styrene	310[g]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tetrachloroethene (Perchloroethylene)	0.34[c]	0.079	0.0042	0.026	0.0055	0.015	<0.002	0.053	<0.002	0.0046
Toluene	530[g]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2,4-Trichlorobenzene	5.9[b]	<0.0017	---	<0.0017	<0.0015	<0.0015	---	<0.0015	---	<0.0015
1,1,1-Trichloroethane	1,300[g]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,2-Trichloroethane	4,400[g]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Trichloroethene (Trichloroethylene)	1.3[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0027	<0.002	<0.002
Vinyl Acetate	550[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	0.21[c]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (total)[e]	93[b]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

V3 Table Notes:

0.11 Indicates exceedance of Tier 1 remediation objective
(1) indicates value is for (1,3-Dichloropropylene, cis+trans)
--- --- indicates chemical not analyzed or not sampled
* value is for m&p-xylene

Interim Protocol for Active Soil Gas Sampling

The Bureau of Land's vapor intrusion workgroup has been reviewing and compiling literature on active soil gas sampling. This email contains or links to the best documents we've found so far.

Here is the basic protocol we recommend.

1. Use an active soil gas sampling system, such as the Geoprobe PRT, that consists of withdrawing soil vapor from the subsurface by driving a heavy-gauge steel probe with inert tubing running down the center of the drive rod.
2. Use 1/8" diameter rigid tubing, either Teflon or Nylaflow.
3. Purge three volumes before obtaining each soil gas sample.
4. Limit the flow rate to 200 ml/min.
5. Use a Helium tracer to detect leaks.
6. Collect the sample in 1 L summa canisters that are clean certified by the lab.
7. Analyze the samples using the upgraded TO-15 method that is NELAC certified.

The use of black Tedlar bags and the modified 8260 analytical method are also acceptable substitutes for numbers 6 and 7, respectively.

Subsection 742.227(b)(4) of Illinois EPA's proposed rules specify the use of isopropyl alcohol or other leak compound approved by the Agency when collecting soil gas samples. After further review, we think helium is the better tracer and plan to update the draft amendment before the Illinois Pollution Control Board.

The first two attachments are specific to the PRT system by Geoprobe. The third attachment is the SOP used by BP for soil gas sampling. It contains good information, including SKU#s for tubing and fittings.

Here are our other major references:

How to Collect Reliable Soil-Gas Data for Risk-Based Applications Part 1: Active Soil-Gas Method
http://www.handpmg.com/documents/LustLine42-Active_Soil_Gas_Part_1.pdf

[Part 2 in this series is specific to the surface flux-chamber method and not needed for our purposes.]

How to Collect Reliable Soil-Gas Data for Risk-Based Applications—Specifically Vapor Intrusion Part 3 – Answers to Frequently Asked Questions
http://www.handpmg.com/documents/LustLine-48-FAQ_Part_3.pdf

How to Collect Reliable Soil-Gas Data for Risk-Based Applications—Specifically Vapor Intrusion Part 4 – Updates on Soil-Gas Collection and Analytical Procedures

http://www.handpmg.com/documents/LL53.Blayne.pdf

Review of Best Practices, Knowledge and Data Gaps, and Research Opportunities for the U.S. Department of Navy Vapor Intrusion Focus Areas. In response to the need for future research and development on reducing high costs and uncertainties of VI assessment strategies, the objective of this report is to identify existing best practices, knowledge and data gaps, and future research into new strategies and techniques. This study was supported by the Navy Environmental Sustainability Development to Integration Program (NESDI) Program, as part of the study on Improved Strategies for Assessment of Vapor Intrusion, under direction by the Space and Naval Warfare (SPAWAR) Systems Center Pacific (May 2009, 86 pages). Contributors include Robbie Ettinger and Paul Johnson (the J&E modelers)
http://www.spawar.navy.mil/sti/publications/pubs/tr/1982/tr1982cond.pdf .

Tri-Services Handbook for the Assessment of the Vapor Intrusion Pathway
U.S. Air Force, U.S. Navy and U.S. Army, Feb 2008
http://airforcemedicine.afms.mil/idc/groups/public/documents/afms/ctb_093354.pdf

Comparison of Geoprobe® PRT and AMS GVP Soil-Gas Sampling Systems with Dedicated Vapor Probes in Sandy Soils at the Raymark Superfund Site
http://www.epa.gov/nrmrl/pubs/600R06111/600R06111.pdf

Here's a link to a site with good Tedlar bag recommendations – use black bags for VOCs, don't write on them with marker or use adhesive sampling labels, don't fill beyond 50 percent to prevent bursting, etc.: http://www.keikaventures.com/s_tedlar.php

Attachments:

Geoprobe PRT.pdf

Geoprobe SG Tech Bulletin MK3098.pdf

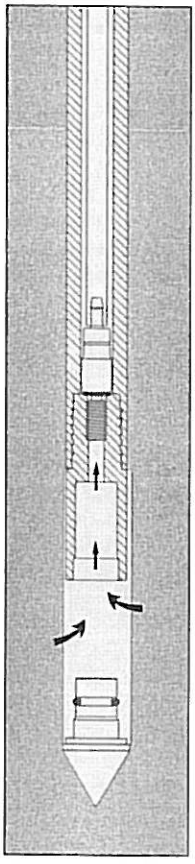
BP VI Basics and Sampling Methods.pdf

Prepared by Heather Nifong and Tracey Hurley
January 2010

Soil Gas Sampling – PRT System Operation

from Geoprobe Systems®

www.geoprobe.com
1-800-436-7762



Soil Gas Sampling using the Post-Run Tubing (PRT) System.

Soil Gas Sampling — PRT System Operation

Basics

Using the Post-Run Tubing System, one can drive probe rods to the desired sampling depth, then insert and seal an internal tubing for soil gas sampling. The usual Geoprobe probe rods and driving accessories and the following tools are required:

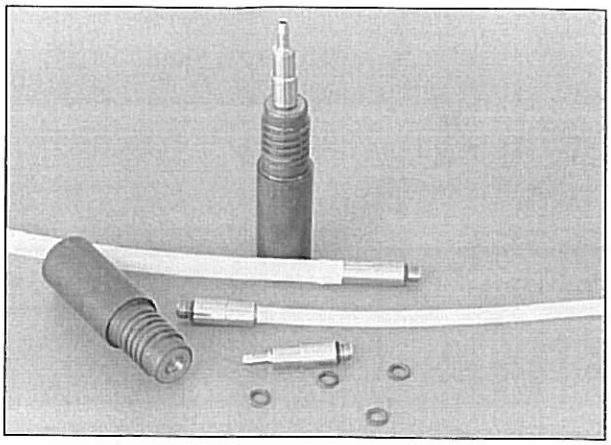
- PRT Expendable Point Holder
- PRT Adapter
- Selected PRT Tubing

Preparation

1. Clean all parts prior to use. Install O-rings on the PRT Expendable Point Holder and the PRT adapter.
2. Inspect the probe rods and clear them of all obstructions.
3. TEST FIT the adapter with the PRT fitting on the expendable point holder to assure that the threads are compatible and fit together smoothly.

   NOTE: PRT fittings are left-hand threaded.
4. Push the adapter into the end of the selected tubing. Tape may be used on the outside of the adapter and tubing to prevent the tubing from spinning freely around the adapter during connection – especially when using Teflon tubing **(Figure 1)**.

   REMEMBER: The sample will not contact the outside of the tubing or adapter.



PRT SYSTEM PARTS
PRT Expendable Point Holder, PRT Adapters, Tubing, and O-rings.

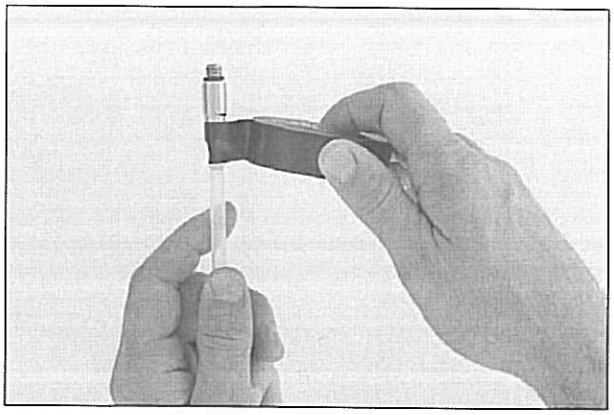


Figure 1. Securing adapter to tubing with tape. NOTE: Tape does not contact soil gas sample.

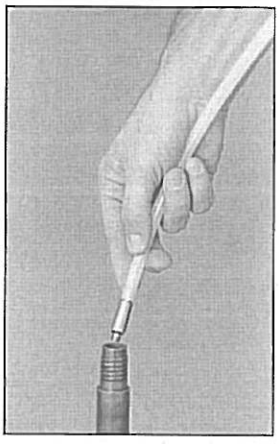


Figure 2. Insertion of tubing and PRT adapter.

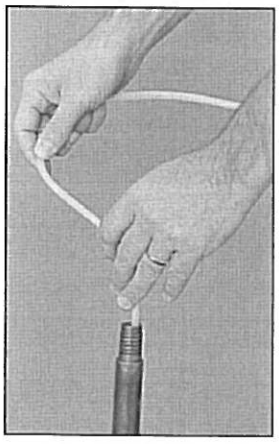
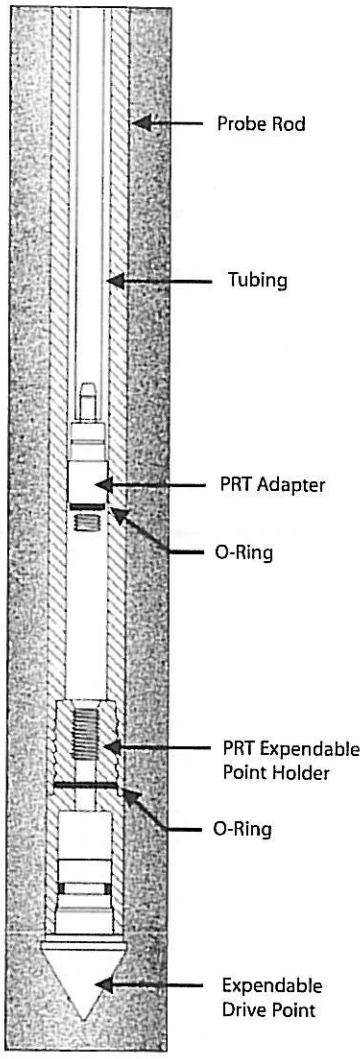


Figure 3. Engaging threads by rotating tubing.



A cross section of probe rods driven to depth and then retracted to allow for soil gas sampling. The PRT adapter and tubing are now fed through the rods and rotated to form a vacuum-tight connection at the point holder. The result is a continuous run of tubing from the sample level to the surface.

Probing

Drive the PRT tip configuration into the ground. Connect probe rods as necessary to reach the desired depth. After depth has been reached, disengage the expendable point by pulling up on the probe rods. Remove the pull cap from the top probe rod, and position the Geoprobe unit to allow room to work.

Connection

1. Insert the adapter end of the tubing down the inside diameter of the probe rods **(Figure 2)**.

2. Feed the tubing down the rod bore until it hits bottom on the expendable point holder. Allow about 2 ft. (610 mm) of tubing to extend out of the hole before cutting it.

3. Grasp the excess tubing and apply some downward pressure while turning it in a counterclockwise motion to engage the adapter threads with the expendable point holder **(Figure 3)**.

4. Pull up lightly on the tubing to test engagement of the threads. (Failure of adapter to thread could mean that intrusion of soil may have occurred during driving of probe rods or disengagement of drive point.)

Sampling

1. Connect the outer end of the tubing to the Silicone Tubing Adapter and vacuum hose (or other sampling apparatus).

2. Follow the appropriate sampling procedure for collecting a soil gas sample **(Figure 1)**.

Removal

1. After collecting a sample, disconnect the tubing from the vacuum hose or sampling system.

2. Pull up firmly on the tubing until it releases from the adapter at the bottom of the hole. (Taped tubing requires a stronger pull.)

3. Remove the tubing from the probe rods. Dispose of polyethylene tubing or decontaminate Teflon tubing as protocol dictates.

4. Retrieve the probe rods from the ground and recover the expendable point holder with the attached PRT adapter.

5. Inspect the O-ring at the base of the PRT adapter to verify that proper sealing was achieved during sampling. The O-ring should be compressed. This seal can be tested by capping the open end of the point holder applying vacuum to the PRT adapter.

6. Prepare for the next sample.

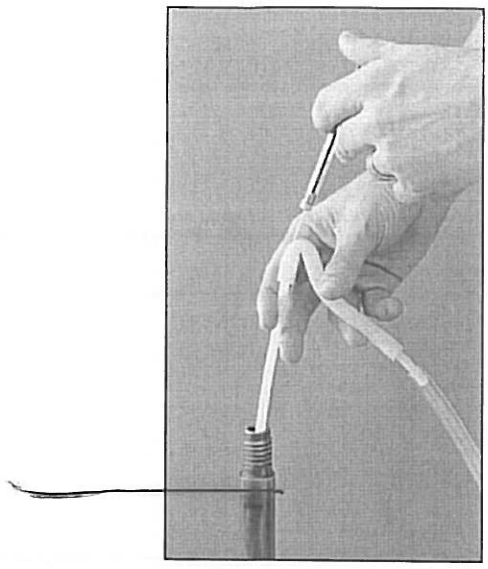


Figure 1. Taking a soil gas sample for direct injection into a GC with the PRT system.

Pace Analytical®

EZ-CANS

PREASSEMBLED CANISTERS

Sampling Instructions for EZ-CANS

Preassembled Air Canisters

Unpack EZ-CANS

1. Remove the protective EZ-CANS foam insert from the box and retain it for return shipping.
2. To remove from the box, lift and carry EZ-CANS by the frame ring near the top of the canister. Avoid lifting by the flow controller or any part of the sampling assembly.
3. EZ-CANS are completely preassembled, leak-checked and ready to go.

Prepare to Sample

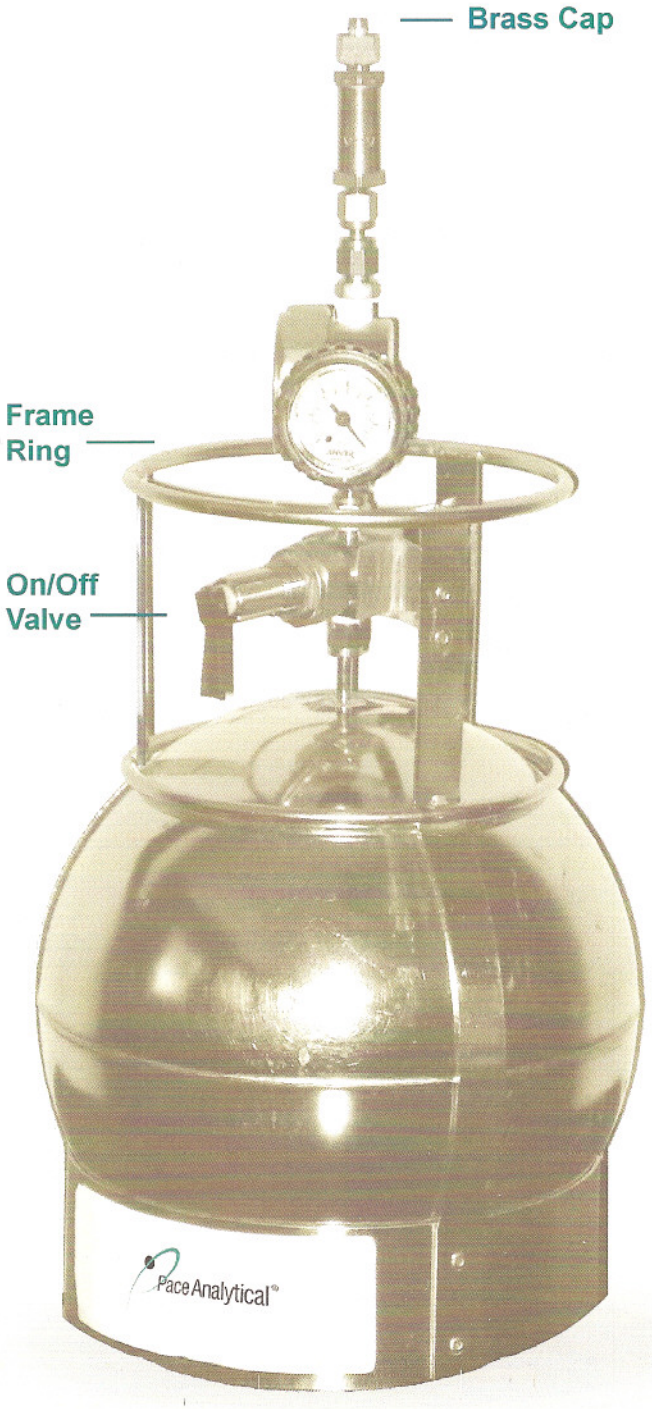
1. Review the contents of the package to ensure you have everything you need.
2. Remove the brass cap from the top of the sampling assembly by turning counter clockwise. It should be finger tight, if necessary use a 9/16" wrench.
3. Position the EZ-CANS for sampling. NOTE: If tubing and fittings are needed to sample subsurface or a hard to reach area, you will find these items and all instructions in an enclosed plastic bag.

Begin Sampling

1. Open the canister valve to begin sampling. Pace uses two valve styles:
   a. Rotary: One full turn counter clockwise
   b. Toggle: Flip the valve upward
2. The decline in vacuum should be directly proportional to the collection time.
3. Record initial vacuum on the Chain Of Custody. *Initial Field reading (-inches of Hg)

End Sampling

1. Close the canister valve and record the vacuum gauge reading on the Chain of Custody. *Final Field reading (-inches of Hg)
2. Reattach the brass cap to the top of the sampling assembly.
3. Repack the canister using the protective foam insert to ensure the integrity of your sample.
4. Complete the shipping and COC documents and call the carrier for pickup.



Questions? Call 612-607-6386

www.pacelabs.com

Return to Pace Analytical @ 1700 Elm Street, Minneapolis MN 55414
Questions? Please call the Air Technical phone number 612-607-6386

CABENO

Environmental Field Services, LLC

16714 Cherry Creek Ct.
Joliet IL 60433

STANDARD OPERATING PROCEDURE

Sub-Slab and Soil Vapor Point Installation

April 18, 2012

TABLE OF CONTENTS

1 DISCLAIMER

This Standard Operating Procedure (SOP) was developed by CABENO Environmental Field Services, LLC (CABENO) based on a compilation of best available information, knowledge, field experience, and general industry practices to provide guidance to CABENO staff and Clients in performing the activities defined herein, in a consistent and standardized manner. This document does not reflect any specific regulatory or statutory requirements unless specified.

CABENO has made every attempt to present the information in a clear and concise manner for a variety of users. However, CABENO is not responsible for the misuse or misinterpretation of the information presented herein. Under no circumstances shall CABENO be liable for any actions taken or omissions by non-CABENO users of this document.

In general this document should be used as a reference. Differences may exist between the procedures presented in this document and what is required under project or site specific regulatory conditions.

2 Introduction

The objective of this SOP is to describe the equipment, procedures and protocols for installation of sub-slab vapor points and soil vapor points. Sub-slab vapor points are most appropriate and suggested if sampling/monitoring for potential vapor intrusion inside a building or structure. Soil vapor points are more appropriate outside and at depth for assessment of the potential for vapor intrusion if a structure were placed over that area and/or for identifying potential contaminant sources in the subsurface. There is a distinction made here between the two because equipment required and what the data reflects can be different.

A sub-slab vapor point only penetrates thru a concrete, asphalt or relatively impermeable floor/barrier/slab but no deeper than three or so inches below the bottom of the barrier. A sample collected from directly beneath the slab will most accurately reflect the chemicals of concern potentially available for vapor intrusion into the open space above the slab.

A soil vapor point is installed at depth below the bottom of the slab and below the aggregate sub-base (if any) of the slab. Typically the points consist of a metal tip (though plastic and ceramic are available) that is fitted with tubing, driven to depth and a granular filter is placed around the porous opening with a bentonite or portland cement is placed in the remaining annulus to the ground surface. Some soil vapor points (non-permanent) can also be operated thru the direct push rods: sample is collected and then rods and tubing are removed. The sample collected will reflect soil/groundwater chemicals of concern at or below that sampling point.

Both the sub-slab and soil vapor point can be either temporary or permanent. Permanent points have various surface terminations available, including flush options.

2.1 Materials

Tubing: Nylon (Nylaflow), Teflon or Teflon lined polyethylene. Nylon tubing is preferred over Teflon tubing due to lower adsorption. Diameters are typically 1/8" ID, ¼" ID or 5/16ths" ID based on size of hose barb fitting on end of vapor pins/points/implants.

Sub-slab Vapor Point: Brass or stainless vapor pin can be used. The vapor pin is 5/8" OD, approximately 3-inches in total length and comes with a silicone sleeve. The silicone sleeve with the pin creates the seal along the annulus between the pin and the slab.

Soil Vapor Points: Stainless steel, ceramic or plastic. Stainless steel mesh screens can also be used if a longer screen interval is desired. When installing soil vapor points a granular material is placed/tremied around outside porous portion of point and remainder of annulus to surface is backfilled with either bentonite or Portland cement.

2.2 Decontamination

Metal vapor points are to be washed thoroughly in an alconox and water solution, baked in an oven at 350-degrees for a minimum of 1-hour, cooled and then wrapped in aluminum foil until used. This procedure is to be used each time vapor points are used; especially when they are new from the factory.

3 Sub-Slab Vapor Point Installation

3.1 Vapor Pin

1. Ensure all sub-slab utilities (public and private) are marked prior to installation.
2. Setup wet/dry vacuum to collect drill cuttings.
3. If a flush mount installation is required, drill a 1.5-inch diameter hole at least 1.75-inches into the slab.
4. Drill a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void.
5. Remove the drill bit, brush the hole out and remove loose cuttings with vacuum from around surface of hole only.
6. Place lower end of vapor pin into the drilled hole. Drive pin into place with a dead blow hammer. Make sure the extraction/installation tool is aligned parallel to the vapor pin to avoid damaging the barb fitting. During installation, the silicone sleeve will form a slight bulge between the slab and pin shoulder. Place the protective cap on the vapor pin to prevent vapor loss prior to sampling.
7. For flush mount installations, cover the vapor pin with plastic flush cover.
8. Allow 20-minutes or more for the sub-slab soil-gas conditions to re-equilibrate prior to sampling.
9. Remove protective cap and connect sample tubing to the barb fitting of the vapor pin.
10. Conduct leak tests.
11. Collect sample. When, finished sampling, replace protective cap and flush mount cover until next sampling event. If sampling is complete, extract the vapor pin and seal the hole.

4 Soil Vapor Point (permanent)

1. Ensure all underground utilities (public and private) are marked prior to installation.
2. Direct push rods are driven to depth. In cohesive soil conditions the soil vapor point and tubing can be left in place and the rods removed. Cohesive soils will predominantly remain open allowing for the filter pack to be placed around the porous portion of the point and then the remainder of the annulus is backfilled with either bentonite or Portland cement. If soils are granular in nature and subject to collapse after rods are removed it is suggested to use larger diameter direct push rods (2.25" OD or 3.25" OD). The soil vapor point can be placed down thru the larger diameter rods post run, filter material tremied in as well as the sealing material as the rods are removed. Essentially construction the soil vapor point like a monitoring well. If plastic or ceramic soil vapor points were being used they cannot be driven real-time like a metal based implant and would have to be installed post run in either an open borehole or inside the larger diameter direct push rods.
3. Conduct leak testing.
4. Collect sample.
5. Install surface finish as desired by client: flush or above ground cover.

Soil Vapor Point (non-permanent)

1. Ensure all underground utilities (public and private) are marked prior to installation.
2. Direct push rods are driven to depth.
3. Tubing is placed down center of the rods and attached to a barbed/threaded tip at the bottom of the rods.
4. Direct push rods are retracted/pulled back towards the surface several inches exposing the porous portion of the special soil vapor point.
5. Conduct leak testing.
6. Collect sample.
7. Remove rods and tip, backfill/seal boring.

APPENDIX B

FIELD INVESTIGATION PHOTOGRAPHS

PHOTO 1

Date: 2/19/2013

Cabeno Environmental drilling soil gas location SM-SG-01 inside the Laundromat (former dry cleaners), facing south.

PHOTO 2

Cabeno Environmental drilling soil gas location SM-SG-02 in front of the Laundromat (former dry cleaners), facing west.

PHOTO 3

Soil gas location SM-SG-06, located east of Subway/retail shops, sealed with modeling clay and ready for helium testing, facing north.

APPENDIX C

LABORATORY ANALYTICAL REPORTS

APPENDIX C.1

LAB ACCREDITATIONS AND CERTIFICATIONS

OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

STAT Analysis Corporation

IL300001

2242 West Harrison Street

Chicago,IL 60612

IS GRANTED APPROVAL BY ORELAP UNDER THE 2009 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	*Drinking Water*	*Non Potable Water*	*Solids and Chem. Waste*	*Tissue*
Chemistry				

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Gary K. Ward, MS

Oregon State Public Health Laboratory

ORELAP Administrator

3150 NW. 229th Ave, Suite 100

Hillsboro, OR 97124

ISSUE DATE: 06/06/2012

EXPIRATION DATE: 06/05/2013

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Oregon

Environmental Laboratory Accreditation Program

Department of Agriculture, Laboratory Division
Department of Environmental Quality, Laboratory Division
Oregon Health Authority, Public Health Division

NELAP Recognized

ORELAP Fields of Accreditation

ORELAP ID: IL300001
EPA CODE: IL00086
Certificate: IL300001 - 008

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MATRIX : Air

Reference	Code	Description
40 CFR Part 50 Appendix J	**10000507**	**Determination of Particulate Matter as PM10 PARTICULATE MATTER AS PM10 IN THE ATMOSPHERE**

Analyte Code	*Analyte*
3950	Particulates <10 um

EPA 3C	**10247708**	**Fixed Gasses by GC/TCD**

Analyte Code	*Analyte*
3755	Carbon dioxide
4926	Methane
1843	Nitrogen
3895	Oxygen

EPA IO-3.1	**10246001**	**SPM - Selection, Preparation, Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation
3915	Particulates

EPA IO-3.2	**10246205**	**SPM - Metals in Ambient Air by AAS**

Analyte Code	*Analyte*
1075	Lead

EPA IO-3.5	**10246603**	**SPM - Metals in Ambient Air by ICP/MS**

Analyte Code	*Analyte*
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium

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Analyte Code	*Analyte*
1150	Silver
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA TO-13A **10248405** **Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS**

Analyte Code	*Analyte*
6380	1-Methylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5855	Chrysene
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6615	Phenanthrene
6665	Pyrene

EPA TO-14A **10248609** **Volatile Organic Compounds with SUMMA canister and GC/MS**

Analyte Code	*Analyte*
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4836	1-Propene
4410	2-Butanone (Methyl ethyl ketone, MEK)
4860	2-Hexanone
4542	4-Ethyltoluene
4995	4-Methyl-2-pentanone (MIBK)
4375	Benzene
5635	Benzyl chloride
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide

ORELAP Fields of Accreditation

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Issue Date: 06/06/2012 ***Expiration Date:*** 06/05/2013

As of 06/06/2012 ***this list supercedes all previous lists for this certificate number. Customers. Please verify the current accreditation standing with ORELAP.***

Analyte Code	*Analyte*
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4555	Cyclohexane
4625	Dichlorodifluoromethane (Freon-12)
4755	Ethyl acetate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4825	n-Heptane
4855	n-Hexane
5250	o-Xylene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5120	Tetrahydrofuran (THF)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA TO-15 **10248803** **VOCs collected in Canisters by GC/MS**

Analyte Code	*Analyte*
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4836	1-Propene
4410	2-Butanone (Methyl ethyl ketone, MEK)
4860	2-Hexanone
4542	4-Ethyltoluene
4995	4-Methyl-2-pentanone (MIBK)
4375	Benzene

ORELAP Fields of Accreditation

ORELAP ID: IL300001
EPA CODE: IL00086
Certificate: IL300001 - 008

STAT Analysis Corporation

2242 West Harrison Street
Chicago IL 60612

Issue Date: 06/06/2012 ***Expiration Date:*** 06/05/2013

As of 06/06/2012 ***this list supercedes all previous lists for this certificate number.***
Customers. Please verify the current accreditation standing with ORELAP.

Analyte Code	*Analyte*
5635	Benzyl chloride
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4555	Cyclohexane
4625	Dichlorodifluoromethane (Freon-12)
4755	Ethyl acetate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4825	n-Heptane
4855	n-Hexane
5250	o-Xylene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5120	Tetrahydrofuran (THF)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

APPENDIX C.2

LAB REPORTS

STAT Analysis Corporation
2242 West Harrison St., Suite 200, Chicago, IL 60612-3766
Tel: (312) 733-0551 Fax: (312) 733-2386 STATinfo@STATAnalysis.com
Accreditation Numbers: IEPA ELAP 100445; ORELAP IL300001;AIHA 101160; NVLAP LabCode 101202-

February 27, 2013

V3 Companies of Illinois
7325 Janes Avenue
Woodridge, IL 60517
Telephone: (312) 924-3545
Fax: (630) 724-9202

RE: 07292, Spartan Square, Romeoville, IL STAT Project No: 13020460

Dear Craig McCammack:

STAT Analysis received 6 samples for the referenced project on 2/20/2013 2:30:00 PM. The analytical results are presented in the following report.

This report is revised to reflect changes made after the initial report was issued.

All analyses were performed in accordance with the requirements of 35 IAC part 186 / NELAC standards. Analyses were performed in accordance with methods as referenced on the analytical report. Those analytical results expressed on a dry weight basis are also noted on the analytical report.

All analyses were performed within established holding time criteria, and all Quality Control criteria met EPA or laboratory specifications except when noted in the Case Narrative or Analytical Report. If required, an estimate of uncertainty for the analyses can be provided. A listing of accredited methods/parameters can also be provided.

Thank you for the opportunity to serve you and I look forward to working with you in the future. If you have any questions regarding the enclosed materials, please contact me at (312) 733-0551.

Sincerely,

Catia Giannini
Project Manager

STAT Analysis Corporation

Date: February 27, 2013

Client: V3 Companies of Illinois
Project: 07292, Spartan Square, Romeoville, IL
Lab Order: 13020460

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
13020460-001A	SM-SG-01		2/19/2013 11:40:00 AM	2/20/2013
13020460-002A	SM-SG-02		2/19/2013 12:06:00 PM	2/20/2013
13020460-003A	SM-SG-03		2/19/2013 12:30:00 PM	2/20/2013
13020460-004A	SM-SG-04		2/19/2013 1:00:00 PM	2/20/2013
13020460-005A	SM-SG-05		2/19/2013 1:40:00 PM	2/20/2013
13020460-006A	SM-SG-06		2/19/2013 2:00:00 PM	2/20/2013

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Accreditation Numbers: IEPA ELAP 100445; ORELAP IL300001; AIHA 101160; NVLAP LabCode 101202-

Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-01
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 11:40:00 AM
Lab ID:	13020460-001A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.3		ppbv	1	2/21/2013
1,1,2,2-Tetrachloroethane	ND	0.3		ppbv	1	2/21/2013
1,1,2-Trichloroethane	ND	0.3		ppbv	1	2/21/2013
1,1-Dichloroethane	ND	0.3		ppbv	1	2/21/2013
1,1-Dichloroethene	ND	0.3		ppbv	1	2/21/2013
1,2,4-Trichlorobenzene	ND	0.3		ppbv	1	2/21/2013
1,2,4-Trimethylbenzene	4.1	0.3		ppbv	1	2/21/2013
1,2-Dibromoethane	ND	0.3		ppbv	1	2/21/2013
1,2-Dichlorobenzene	ND	0.3		ppbv	1	2/21/2013
1,2-Dichloroethane	ND	0.3		ppbv	1	2/21/2013
1,2-Dichloropropane	ND	0.3		ppbv	1	2/21/2013
1,3,5-Trimethylbenzene	1.5	0.3		ppbv	1	2/21/2013
1,3-Butadiene	0.67	0.3		ppbv	1	2/21/2013
1,3-Dichlorobenzene	ND	0.3		ppbv	1	2/21/2013
1,4-Dichlorobenzene	ND	0.3		ppbv	1	2/21/2013
1,4-Dioxane	ND	0.75		ppbv	1	2/21/2013
2-Butanone	46	0.75		ppbv	1	2/21/2013
2-Hexanone	ND	1.5		ppbv	1	2/21/2013
4-Ethyltoluene	1.4	0.3		ppbv	1	2/21/2013
4-Methyl-2-pentanone	2.1	1.5		ppbv	1	2/21/2013
Acetone	140	30	*	ppbv	10	2/22/2013
Benzene	4.1	0.3		ppbv	1	2/21/2013
Benzyl chloride	ND	0.75		ppbv	1	2/21/2013
Bromodichloromethane	ND	0.3		ppbv	1	2/21/2013
Bromoform	ND	0.75		ppbv	1	2/21/2013
Bromomethane	ND	0.75		ppbv	1	2/21/2013
Carbon disulfide	1.9	0.3		ppbv	1	2/21/2013
Carbon tetrachloride	ND	0.3		ppbv	1	2/21/2013
Chlorobenzene	ND	0.3		ppbv	1	2/21/2013
Chloroethane	ND	0.3		ppbv	1	2/21/2013
Chloroform	ND	0.3		ppbv	1	2/21/2013
Chloromethane	ND	0.75		ppbv	1	2/21/2013
cis-1,2-Dichloroethene	ND	0.3		ppbv	1	2/21/2013
cis-1,3-Dichloropropene	ND	0.3		ppbv	1	2/21/2013
Cyclohexane	2.6	0.3		ppbv	1	2/21/2013
Dibromochloromethane	ND	0.3		ppbv	1	2/21/2013
Dichlorodifluoromethane	0.55	0.3		ppbv	1	2/21/2013
Ethyl acetate	2	0.3		ppbv	1	2/21/2013

Qualifiers:
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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-01
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 11:40:00 AM
Lab ID:	13020460-001A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Ethylbenzene	4	0.3		ppbv	1	2/21/2013
Freon-113	ND	0.3		ppbv	1	2/21/2013
Freon-114	ND	1.5		ppbv	1	2/21/2013
Heptane	5.2	0.3		ppbv	1	2/21/2013
Hexachlorobutadiene	ND	0.3		ppbv	1	2/21/2013
Hexane	12	0.75		ppbv	1	2/21/2013
Isopropyl Alcohol	45	1.5		ppbv	1	2/21/2013
m,p-Xylene	11	0.6		ppbv	1	2/21/2013
Methyl tert-butyl ether	ND	0.3		ppbv	1	2/21/2013
Methylene chloride	6.4	3		ppbv	1	2/21/2013
o-Xylene	4	0.3		ppbv	1	2/21/2013
Propene	8.3	3		ppbv	1	2/21/2013
Styrene	ND	0.3		ppbv	1	2/21/2013
Tetrachloroethene	30	0.3		ppbv	1	2/21/2013
Tetrahydrofuran	22	0.75		ppbv	1	2/21/2013
Toluene	20	0.3		ppbv	1	2/21/2013
trans-1,2-Dichloroethene	ND	0.3		ppbv	1	2/21/2013
trans-1,3-Dichloropropene	ND	0.3		ppbv	1	2/21/2013
Trichloroethene	0.43	0.3		ppbv	1	2/21/2013
Trichlorofluoromethane	0.45	0.3		ppbv	1	2/21/2013
Vinyl acetate	ND	3		ppbv	1	2/21/2013
Vinyl chloride	ND	0.3		ppbv	1	2/21/2013
Xylenes, Total	15	0.9		ppbv	1	2/21/2013
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.0016		mg/m³	1	2/21/2013
1,1,2,2-Tetrachloroethane	ND	0.0021		mg/m³	1	2/21/2013
1,1,2-Trichloroethane	ND	0.0016		mg/m³	1	2/21/2013
1,1-Dichloroethane	ND	0.0012		mg/m³	1	2/21/2013
1,1-Dichloroethene	ND	0.0012		mg/m³	1	2/21/2013
1,2,4-Trichlorobenzene	ND	0.0022		mg/m³	1	2/21/2013
1,2,4-Trimethylbenzene	0.02	0.0015		mg/m³	1	2/21/2013
1,2-Dibromoethane	ND	0.0022		mg/m³	1	2/21/2013
1,2-Dichlorobenzene	ND	0.0018		mg/m³	1	2/21/2013
1,2-Dichloroethane	ND	0.0012		mg/m³	1	2/21/2013
1,2-Dichloropropane	ND	0.0013		mg/m³	1	2/21/2013
1,3,5-Trimethylbenzene	0.0072	0.0015		mg/m³	1	2/21/2013
1,3-Butadiene	0.0015	0.0006		mg/m³	1	2/21/2013
1,3-Dichlorobenzene	ND	0.0018		mg/m³	1	2/21/2013

Qualifiers:
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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-01
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 11:40:00 AM
Lab ID:	13020460-001A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,4-Dichlorobenzene	ND	0.0018		mg/m³	1	2/21/2013
1,4-Dioxane	ND	0.0027		mg/m³	1	2/21/2013
2-Butanone	0.14	0.0022		mg/m³	1	2/21/2013
2-Hexanone	ND	0.0061		mg/m³	1	2/21/2013
4-Ethyltoluene	0.007	0.0015		mg/m³	1	2/21/2013
4-Methyl-2-pentanone	0.0085	0.0061		mg/m³	1	2/21/2013
Acetone	0.32	0.072	*	mg/m³	10	2/22/2013
Benzene	0.013	0.0009		mg/m³	1	2/21/2013
Benzyl chloride	ND	0.0039		mg/m³	1	2/21/2013
Bromodichloromethane	ND	0.0019		mg/m³	1	2/21/2013
Bromoform	ND	0.0078		mg/m³	1	2/21/2013
Bromomethane	ND	0.0028		mg/m³	1	2/21/2013
Carbon disulfide	0.0059	0.00093		mg/m³	1	2/21/2013
Carbon tetrachloride	ND	0.0019		mg/m³	1	2/21/2013
Chlorobenzene	ND	0.0013		mg/m³	1	2/21/2013
Chloroethane	ND	0.00075		mg/m³	1	2/21/2013
Chloroform	ND	0.0015		mg/m³	1	2/21/2013
Chloromethane	ND	0.0015		mg/m³	1	2/21/2013
cis-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/21/2013
cis-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/21/2013
Cyclohexane	0.009	0.001		mg/m³	1	2/21/2013
Dibromochloromethane	ND	0.0025		mg/m³	1	2/21/2013
Dichlorodifluoromethane	0.0027	0.0015		mg/m³	1	2/21/2013
Ethyl acetate	0.0072	0.001		mg/m³	1	2/21/2013
Ethylbenzene	0.017	0.0013		mg/m³	1	2/21/2013
Freon-113	ND	0.0022		mg/m³	1	2/21/2013
Freon-114	ND	0.01		mg/m³	1	2/21/2013
Heptane	0.021	0.0012		mg/m³	1	2/21/2013
Hexachlorobutadiene	ND	0.0031		mg/m³	1	2/21/2013
Hexane	0.042	0.0027		mg/m³	1	2/21/2013
Isopropyl Alcohol	0.11	0.0037		mg/m³	1	2/21/2013
m,p-Xylene	0.048	0.0025		mg/m³	1	2/21/2013
Methyl tert-butyl ether	ND	0.001		mg/m³	1	2/21/2013
Methylene chloride	0.022	0.01		mg/m³	1	2/21/2013
o-Xylene	0.017	0.0013		mg/m³	1	2/21/2013
Propene	0.014	0.0051		mg/m³	1	2/21/2013
Styrene	ND	0.0013		mg/m³	1	2/21/2013
Tetrachloroethene	0.21	0.0021		mg/m³	1	2/21/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-01
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 11:40:00 AM
Lab ID:	13020460-001A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Tetrahydrofuran	0.064	0.0022		mg/m³	1	2/21/2013
Toluene	0.076	0.0012		mg/m³	1	2/21/2013
trans-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/21/2013
trans-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/21/2013
Trichloroethene	0.0023	0.0016		mg/m³	1	2/21/2013
Trichlorofluoromethane	0.0025	0.0016		mg/m³	1	2/21/2013
Vinyl acetate	ND	0.01		mg/m³	1	2/21/2013
Vinyl chloride	ND	0.00075		mg/m³	1	2/21/2013
Xylenes, Total	0.065	0.0039		mg/m³	1	2/21/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-02
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:06:00 PM
Lab ID:	13020460-002A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trimethylbenzene	ND	0.3		ppbv	1	2/22/2013
1,2-Dibromoethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloropropane	ND	0.3		ppbv	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.3		ppbv	1	2/22/2013
1,3-Butadiene	1.2	0.3		ppbv	1	2/22/2013
1,3-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dioxane	ND	0.75		ppbv	1	2/22/2013
2-Butanone	6.2	0.75		ppbv	1	2/22/2013
2-Hexanone	ND	1.5		ppbv	1	2/22/2013
4-Ethyltoluene	ND	0.3		ppbv	1	2/22/2013
4-Methyl-2-pentanone	ND	1.5		ppbv	1	2/22/2013
Acetone	34	3	*	ppbv	1	2/22/2013
Benzene	1.2	0.3		ppbv	1	2/22/2013
Benzyl chloride	ND	0.75		ppbv	1	2/22/2013
Bromodichloromethane	ND	0.3		ppbv	1	2/22/2013
Bromoform	ND	0.75		ppbv	1	2/22/2013
Bromomethane	ND	0.75		ppbv	1	2/22/2013
Carbon disulfide	1.8	0.3		ppbv	1	2/22/2013
Carbon tetrachloride	ND	0.3		ppbv	1	2/22/2013
Chlorobenzene	ND	0.3		ppbv	1	2/22/2013
Chloroethane	ND	0.3		ppbv	1	2/22/2013
Chloroform	ND	0.3		ppbv	1	2/22/2013
Chloromethane	ND	0.75		ppbv	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Cyclohexane	1.1	0.3		ppbv	1	2/22/2013
Dibromochloromethane	ND	0.3		ppbv	1	2/22/2013
Dichlorodifluoromethane	ND	0.3		ppbv	1	2/22/2013
Ethyl acetate	0.72	0.3		ppbv	1	2/22/2013

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
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HT - Sample received past holding time
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Accreditation Numbers: IEPA ELAP 100445; ORELAP IL300001; AIHA 101160; NVLAP LabCode 101202-

Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-02
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:06:00 PM
Lab ID:	13020460-002A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Ethylbenzene	0.88	0.3		ppbv	1	2/22/2013
Freon-113	ND	0.3		ppbv	1	2/22/2013
Freon-114	ND	1.5		ppbv	1	2/22/2013
Heptane	1.5	0.3		ppbv	1	2/22/2013
Hexachlorobutadiene	ND	0.3		ppbv	1	2/22/2013
Hexane	7.8	0.75		ppbv	1	2/22/2013
Isopropyl Alcohol	8	1.5		ppbv	1	2/22/2013
m,p-Xylene	2.3	0.6		ppbv	1	2/22/2013
Methyl tert-butyl ether	ND	0.3		ppbv	1	2/22/2013
Methylene chloride	10	3		ppbv	1	2/22/2013
o-Xylene	0.81	0.3		ppbv	1	2/22/2013
Propene	33	3		ppbv	1	2/22/2013
Styrene	ND	0.3		ppbv	1	2/22/2013
Tetrachloroethene	8.9	0.3		ppbv	1	2/22/2013
Tetrahydrofuran	2.5	0.75		ppbv	1	2/22/2013
Toluene	5.6	0.3		ppbv	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Trichloroethene	1	0.3		ppbv	1	2/22/2013
Trichlorofluoromethane	ND	0.3		ppbv	1	2/22/2013
Vinyl acetate	ND	3		ppbv	1	2/22/2013
Vinyl chloride	ND	0.3		ppbv	1	2/22/2013
Xylenes, Total	3.1	0.9		ppbv	1	2/22/2013
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.0016		mg/m³	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.0021		mg/m³	1	2/22/2013
1,1,2-Trichloroethane	ND	0.0016		mg/m³	1	2/22/2013
1,1-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,1-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.0022		mg/m³	1	2/22/2013
1,2,4-Trimethylbenzene	ND	0.0015		mg/m³	1	2/22/2013
1,2-Dibromoethane	ND	0.0022		mg/m³	1	2/22/2013
1,2-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,2-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,2-Dichloropropane	ND	0.0013		mg/m³	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.0015		mg/m³	1	2/22/2013
1,3-Butadiene	0.0027	0.0006		mg/m³	1	2/22/2013
1,3-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013

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Accreditation Numbers: IEPA ELAP 100445; ORELAP IL300001; AIHA 101160; NVLAP LabCode 101202-

Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-02
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:06:00 PM
Lab ID:	13020460-002A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,4-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,4-Dioxane	ND	0.0027		mg/m³	1	2/22/2013
2-Butanone	0.018	0.0022		mg/m³	1	2/22/2013
2-Hexanone	ND	0.0061		mg/m³	1	2/22/2013
4-Ethyltoluene	ND	0.0015		mg/m³	1	2/22/2013
4-Methyl-2-pentanone	ND	0.0061		mg/m³	1	2/22/2013
Acetone	0.081	0.0072	*	mg/m³	1	2/22/2013
Benzene	0.0039	0.0009		mg/m³	1	2/22/2013
Benzyl chloride	ND	0.0039		mg/m³	1	2/22/2013
Bromodichloromethane	ND	0.0019		mg/m³	1	2/22/2013
Bromoform	ND	0.0078		mg/m³	1	2/22/2013
Bromomethane	ND	0.0028		mg/m³	1	2/22/2013
Carbon disulfide	0.0055	0.00093		mg/m³	1	2/22/2013
Carbon tetrachloride	ND	0.0019		mg/m³	1	2/22/2013
Chlorobenzene	ND	0.0013		mg/m³	1	2/22/2013
Chloroethane	ND	0.00075		mg/m³	1	2/22/2013
Chloroform	ND	0.0015		mg/m³	1	2/22/2013
Chloromethane	ND	0.0015		mg/m³	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/22/2013
Cyclohexane	0.0038	0.001		mg/m³	1	2/22/2013
Dibromochloromethane	ND	0.0025		mg/m³	1	2/22/2013
Dichlorodifluoromethane	ND	0.0015		mg/m³	1	2/22/2013
Ethyl acetate	0.0026	0.001		mg/m³	1	2/22/2013
Ethylbenzene	0.0038	0.0013		mg/m³	1	2/22/2013
Freon-113	ND	0.0022		mg/m³	1	2/22/2013
Freon-114	ND	0.01		mg/m³	1	2/22/2013
Heptane	0.006	0.0012		mg/m³	1	2/22/2013
Hexachlorobutadiene	ND	0.0031		mg/m³	1	2/22/2013
Hexane	0.028	0.0027		mg/m³	1	2/22/2013
Isopropyl Alcohol	0.02	0.0037		mg/m³	1	2/22/2013
m,p-Xylene	0.01	0.0025		mg/m³	1	2/22/2013
Methyl tert-butyl ether	ND	0.001		mg/m³	1	2/22/2013
Methylene chloride	0.036	0.01		mg/m³	1	2/22/2013
o-Xylene	0.0035	0.0013		mg/m³	1	2/22/2013
Propene	0.057	0.0051		mg/m³	1	2/22/2013
Styrene	ND	0.0013		mg/m³	1	2/22/2013
Tetrachloroethene	0.06	0.0021		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-02
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:06:00 PM
Lab ID:	13020460-002A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS **TO-15**				Prep Date: **2/21/2013**		Analyst: **VP**
Tetrahydrofuran	0.0074	0.0022		mg/m³	1	2/22/2013
Toluene	0.021	0.0012		mg/m³	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/22/2013
Trichloroethene	0.0055	0.0016		mg/m³	1	2/22/2013
Trichlorofluoromethane	ND	0.0016		mg/m³	1	2/22/2013
Vinyl acetate	ND	0.01		mg/m³	1	2/22/2013
Vinyl chloride	ND	0.00075		mg/m³	1	2/22/2013
Xylenes, Total	0.014	0.0039		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-03
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:30:00 PM
Lab ID:	13020460-003A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trimethylbenzene	0.72	0.3		ppbv	1	2/22/2013
1,2-Dibromoethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloropropane	ND	0.3		ppbv	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.3		ppbv	1	2/22/2013
1,3-Butadiene	2.4	0.3		ppbv	1	2/22/2013
1,3-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dioxane	ND	0.75		ppbv	1	2/22/2013
2-Butanone	6.7	0.75		ppbv	1	2/22/2013
2-Hexanone	ND	1.5		ppbv	1	2/22/2013
4-Ethyltoluene	ND	0.3		ppbv	1	2/22/2013
4-Methyl-2-pentanone	ND	1.5		ppbv	1	2/22/2013
Acetone	32	3	*	ppbv	1	2/22/2013
Benzene	1.1	0.3		ppbv	1	2/22/2013
Benzyl chloride	ND	0.75		ppbv	1	2/22/2013
Bromodichloromethane	ND	0.3		ppbv	1	2/22/2013
Bromoform	ND	0.75		ppbv	1	2/22/2013
Bromomethane	ND	0.75		ppbv	1	2/22/2013
Carbon disulfide	2.2	0.3		ppbv	1	2/22/2013
Carbon tetrachloride	ND	0.3		ppbv	1	2/22/2013
Chlorobenzene	ND	0.3		ppbv	1	2/22/2013
Chloroethane	ND	0.3		ppbv	1	2/22/2013
Chloroform	ND	0.3		ppbv	1	2/22/2013
Chloromethane	ND	0.75		ppbv	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Cyclohexane	1.2	0.3		ppbv	1	2/22/2013
Dibromochloromethane	ND	0.3		ppbv	1	2/22/2013
Dichlorodifluoromethane	0.42	0.3		ppbv	1	2/22/2013
Ethyl acetate	0.42	0.3		ppbv	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-03
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:30:00 PM
Lab ID:	13020460-003A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Ethylbenzene	0.89	0.3		ppbv	1	2/22/2013
Freon-113	ND	0.3		ppbv	1	2/22/2013
Freon-114	ND	1.5		ppbv	1	2/22/2013
Heptane	1.5	0.3		ppbv	1	2/22/2013
Hexachlorobutadiene	ND	0.3		ppbv	1	2/22/2013
Hexane	20	0.75		ppbv	1	2/22/2013
Isopropyl Alcohol	7.5	1.5		ppbv	1	2/22/2013
m,p-Xylene	2.5	0.6		ppbv	1	2/22/2013
Methyl tert-butyl ether	ND	0.3		ppbv	1	2/22/2013
Methylene chloride	10	3		ppbv	1	2/22/2013
o-Xylene	0.89	0.3		ppbv	1	2/22/2013
Propene	38	3		ppbv	1	2/22/2013
Styrene	ND	0.3		ppbv	1	2/22/2013
Tetrachloroethene	8.6	0.3		ppbv	1	2/22/2013
Tetrahydrofuran	3	0.75		ppbv	1	2/22/2013
Toluene	5.2	0.3		ppbv	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Trichloroethene	0.68	0.3		ppbv	1	2/22/2013
Trichlorofluoromethane	ND	0.3		ppbv	1	2/22/2013
Vinyl acetate	ND	3		ppbv	1	2/22/2013
Vinyl chloride	ND	0.3		ppbv	1	2/22/2013
Xylenes, Total	3.4	0.9		ppbv	1	2/22/2013
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.0017		mg/m³	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.0021		mg/m³	1	2/22/2013
1,1,2-Trichloroethane	ND	0.0017		mg/m³	1	2/22/2013
1,1-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,1-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.0023		mg/m³	1	2/22/2013
1,2,4-Trimethylbenzene	0.0035	0.0015		mg/m³	1	2/22/2013
1,2-Dibromoethane	ND	0.0023		mg/m³	1	2/22/2013
1,2-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,2-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,2-Dichloropropane	ND	0.0014		mg/m³	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.0015		mg/m³	1	2/22/2013
1,3-Butadiene	0.0053	0.0006		mg/m³	1	2/22/2013
1,3-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-03
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:30:00 PM
Lab ID:	13020460-003A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,4-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,4-Dioxane	ND	0.0027		mg/m³	1	2/22/2013
2-Butanone	0.02	0.0023		mg/m³	1	2/22/2013
2-Hexanone	ND	0.0062		mg/m³	1	2/22/2013
4-Ethyltoluene	ND	0.0015		mg/m³	1	2/22/2013
4-Methyl-2-pentanone	ND	0.0062		mg/m³	1	2/22/2013
Acetone	0.075	0.0072	*	mg/m³	1	2/22/2013
Benzene	0.0034	0.0009		mg/m³	1	2/22/2013
Benzyl chloride	ND	0.0039		mg/m³	1	2/22/2013
Bromodichloromethane	ND	0.002		mg/m³	1	2/22/2013
Bromoform	ND	0.0078		mg/m³	1	2/22/2013
Bromomethane	ND	0.0029		mg/m³	1	2/22/2013
Carbon disulfide	0.0069	0.00094		mg/m³	1	2/22/2013
Carbon tetrachloride	ND	0.002		mg/m³	1	2/22/2013
Chlorobenzene	ND	0.0014		mg/m³	1	2/22/2013
Chloroethane	ND	0.00075		mg/m³	1	2/22/2013
Chloroform	ND	0.0015		mg/m³	1	2/22/2013
Chloromethane	ND	0.0015		mg/m³	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.0014		mg/m³	1	2/22/2013
Cyclohexane	0.004	0.0011		mg/m³	1	2/22/2013
Dibromochloromethane	ND	0.0026		mg/m³	1	2/22/2013
Dichlorodifluoromethane	0.0021	0.0015		mg/m³	1	2/22/2013
Ethyl acetate	0.0015	0.0011		mg/m³	1	2/22/2013
Ethylbenzene	0.0038	0.0014		mg/m³	1	2/22/2013
Freon-113	ND	0.0023		mg/m³	1	2/22/2013
Freon-114	ND	0.011		mg/m³	1	2/22/2013
Heptane	0.006	0.0012		mg/m³	1	2/22/2013
Hexachlorobutadiene	ND	0.0032		mg/m³	1	2/22/2013
Hexane	0.072	0.0027		mg/m³	1	2/22/2013
Isopropyl Alcohol	0.018	0.0038		mg/m³	1	2/22/2013
m,p-Xylene	0.011	0.0026		mg/m³	1	2/22/2013
Methyl tert-butyl ether	ND	0.0011		mg/m³	1	2/22/2013
Methylene chloride	0.035	0.01		mg/m³	1	2/22/2013
o-Xylene	0.0038	0.0014		mg/m³	1	2/22/2013
Propene	0.066	0.0051		mg/m³	1	2/22/2013
Styrene	ND	0.0014		mg/m³	1	2/22/2013
Tetrachloroethene	0.058	0.0021		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-03
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 12:30:00 PM
Lab ID:	13020460-003A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS **TO-15**				Prep Date: **2/21/2013**		Analyst: **VP**
Tetrahydrofuran	0.0089	0.0023		mg/m³	1	2/22/2013
Toluene	0.02	0.0012		mg/m³	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.0014		mg/m³	1	2/22/2013
Trichloroethene	0.0036	0.0017		mg/m³	1	2/22/2013
Trichlorofluoromethane	ND	0.0017		mg/m³	1	2/22/2013
Vinyl acetate	ND	0.011		mg/m³	1	2/22/2013
Vinyl chloride	ND	0.00075		mg/m³	1	2/22/2013
Xylenes, Total	0.015	0.0039		mg/m³	1	2/22/2013

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
HT - Sample received past holding time
* - Non-accredited parameter
RL - Reporting / Quantitation Limit for the analysis
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R - RPD outside accepted recovery limits
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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-04
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:00:00 PM
Lab ID:	13020460-004A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trimethylbenzene	0.81	0.3		ppbv	1	2/22/2013
1,2-Dibromoethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloropropane	ND	0.3		ppbv	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.3		ppbv	1	2/22/2013
1,3-Butadiene	0.58	0.3		ppbv	1	2/22/2013
1,3-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dioxane	ND	0.75		ppbv	1	2/22/2013
2-Butanone	5.6	0.75		ppbv	1	2/22/2013
2-Hexanone	ND	1.5		ppbv	1	2/22/2013
4-Ethyltoluene	ND	0.3		ppbv	1	2/22/2013
4-Methyl-2-pentanone	ND	1.5		ppbv	1	2/22/2013
Acetone	25	3	*	ppbv	1	2/22/2013
Benzene	0.93	0.3		ppbv	1	2/22/2013
Benzyl chloride	ND	0.75		ppbv	1	2/22/2013
Bromodichloromethane	ND	0.3		ppbv	1	2/22/2013
Bromoform	ND	0.75		ppbv	1	2/22/2013
Bromomethane	ND	0.75		ppbv	1	2/22/2013
Carbon disulfide	1.3	0.3		ppbv	1	2/22/2013
Carbon tetrachloride	ND	0.3		ppbv	1	2/22/2013
Chlorobenzene	ND	0.3		ppbv	1	2/22/2013
Chloroethane	ND	0.3		ppbv	1	2/22/2013
Chloroform	ND	0.3		ppbv	1	2/22/2013
Chloromethane	ND	0.75		ppbv	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Cyclohexane	0.81	0.3		ppbv	1	2/22/2013
Dibromochloromethane	ND	0.3		ppbv	1	2/22/2013
Dichlorodifluoromethane	0.42	0.3		ppbv	1	2/22/2013
Ethyl acetate	1.3	0.3		ppbv	1	2/22/2013

Qualifiers:
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Accreditation Numbers: IEPA ELAP 100445; ORELAP IL300001; AIHA 101160; NVLAP LabCode 101202-

Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-04
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:00:00 PM
Lab ID:	13020460-004A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Ethylbenzene	0.85	0.3		ppbv	1	2/22/2013
Freon-113	ND	0.3		ppbv	1	2/22/2013
Freon-114	ND	1.5		ppbv	1	2/22/2013
Heptane	1.3	0.3		ppbv	1	2/22/2013
Hexachlorobutadiene	ND	0.3		ppbv	1	2/22/2013
Hexane	10	0.75		ppbv	1	2/22/2013
Isopropyl Alcohol	20	1.5		ppbv	1	2/22/2013
m,p-Xylene	2.3	0.6		ppbv	1	2/22/2013
Methyl tert-butyl ether	ND	0.3		ppbv	1	2/22/2013
Methylene chloride	9.5	3		ppbv	1	2/22/2013
o-Xylene	0.87	0.3		ppbv	1	2/22/2013
Propene	5.6	3		ppbv	1	2/22/2013
Styrene	ND	0.3		ppbv	1	2/22/2013
Tetrachloroethene	7.5	0.3		ppbv	1	2/22/2013
Tetrahydrofuran	2.2	0.75		ppbv	1	2/22/2013
Toluene	5	0.3		ppbv	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Trichloroethene	ND	0.3		ppbv	1	2/22/2013
Trichlorofluoromethane	ND	0.3		ppbv	1	2/22/2013
Vinyl acetate	ND	3		ppbv	1	2/22/2013
Vinyl chloride	ND	0.3		ppbv	1	2/22/2013
Xylenes, Total	3.2	0.9		ppbv	1	2/22/2013
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.0016		mg/m³	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.0021		mg/m³	1	2/22/2013
1,1,2-Trichloroethane	ND	0.0016		mg/m³	1	2/22/2013
1,1-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,1-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.0022		mg/m³	1	2/22/2013
1,2,4-Trimethylbenzene	0.004	0.0015		mg/m³	1	2/22/2013
1,2-Dibromoethane	ND	0.0022		mg/m³	1	2/22/2013
1,2-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,2-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,2-Dichloropropane	ND	0.0013		mg/m³	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.0015		mg/m³	1	2/22/2013
1,3-Butadiene	0.0013	0.0006		mg/m³	1	2/22/2013
1,3-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-04
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:00:00 PM
Lab ID:	13020460-004A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,4-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,4-Dioxane	ND	0.0027		mg/m³	1	2/22/2013
2-Butanone	0.017	0.0022		mg/m³	1	2/22/2013
2-Hexanone	ND	0.0061		mg/m³	1	2/22/2013
4-Ethyltoluene	ND	0.0015		mg/m³	1	2/22/2013
4-Methyl-2-pentanone	ND	0.0061		mg/m³	1	2/22/2013
Acetone	0.058	0.0072	*	mg/m³	1	2/22/2013
Benzene	0.003	0.0009		mg/m³	1	2/22/2013
Benzyl chloride	ND	0.0039		mg/m³	1	2/22/2013
Bromodichloromethane	ND	0.0019		mg/m³	1	2/22/2013
Bromoform	ND	0.0078		mg/m³	1	2/22/2013
Bromomethane	ND	0.0028		mg/m³	1	2/22/2013
Carbon disulfide	0.0041	0.00093		mg/m³	1	2/22/2013
Carbon tetrachloride	ND	0.0019		mg/m³	1	2/22/2013
Chlorobenzene	ND	0.0013		mg/m³	1	2/22/2013
Chloroethane	ND	0.00075		mg/m³	1	2/22/2013
Chloroform	ND	0.0015		mg/m³	1	2/22/2013
Chloromethane	ND	0.0015		mg/m³	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/22/2013
Cyclohexane	0.0028	0.001		mg/m³	1	2/22/2013
Dibromochloromethane	ND	0.0025		mg/m³	1	2/22/2013
Dichlorodifluoromethane	0.0021	0.0015		mg/m³	1	2/22/2013
Ethyl acetate	0.0045	0.001		mg/m³	1	2/22/2013
Ethylbenzene	0.0037	0.0013		mg/m³	1	2/22/2013
Freon-113	ND	0.0022		mg/m³	1	2/22/2013
Freon-114	ND	0.01		mg/m³	1	2/22/2013
Heptane	0.0053	0.0012		mg/m³	1	2/22/2013
Hexachlorobutadiene	ND	0.0031		mg/m³	1	2/22/2013
Hexane	0.036	0.0027		mg/m³	1	2/22/2013
Isopropyl Alcohol	0.048	0.0037		mg/m³	1	2/22/2013
m,p-Xylene	0.01	0.0025		mg/m³	1	2/22/2013
Methyl tert-butyl ether	ND	0.001		mg/m³	1	2/22/2013
Methylene chloride	0.033	0.01		mg/m³	1	2/22/2013
o-Xylene	0.0038	0.0013		mg/m³	1	2/22/2013
Propene	0.0097	0.0051		mg/m³	1	2/22/2013
Styrene	ND	0.0013		mg/m³	1	2/22/2013
Tetrachloroethene	0.051	0.0021		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-04
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:00:00 PM
Lab ID:	13020460-004A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Tetrahydrofuran	0.0066	0.0022		mg/m³	1	2/22/2013
Toluene	0.019	0.0012		mg/m³	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/22/2013
Trichloroethene	ND	0.0016		mg/m³	1	2/22/2013
Trichlorofluoromethane	ND	0.0016		mg/m³	1	2/22/2013
Vinyl acetate	ND	0.01		mg/m³	1	2/22/2013
Vinyl chloride	ND	0.00075		mg/m³	1	2/22/2013
Xylenes, Total	0.014	0.0039		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-05
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:40:00 PM
Lab ID:	13020460-005A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trimethylbenzene	0.79	0.3		ppbv	1	2/22/2013
1,2-Dibromoethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloropropane	ND	0.3		ppbv	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.3		ppbv	1	2/22/2013
1,3-Butadiene	0.42	0.3		ppbv	1	2/22/2013
1,3-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dioxane	ND	0.75		ppbv	1	2/22/2013
2-Butanone	6.1	0.75		ppbv	1	2/22/2013
2-Hexanone	ND	1.5		ppbv	1	2/22/2013
4-Ethyltoluene	ND	0.3		ppbv	1	2/22/2013
4-Methyl-2-pentanone	ND	1.5		ppbv	1	2/22/2013
Acetone	27	3	*	ppbv	1	2/22/2013
Benzene	1.1	0.3		ppbv	1	2/22/2013
Benzyl chloride	ND	0.75		ppbv	1	2/22/2013
Bromodichloromethane	ND	0.3		ppbv	1	2/22/2013
Bromoform	ND	0.75		ppbv	1	2/22/2013
Bromomethane	ND	0.75		ppbv	1	2/22/2013
Carbon disulfide	1.5	0.3		ppbv	1	2/22/2013
Carbon tetrachloride	ND	0.3		ppbv	1	2/22/2013
Chlorobenzene	ND	0.3		ppbv	1	2/22/2013
Chloroethane	ND	0.3		ppbv	1	2/22/2013
Chloroform	ND	0.3		ppbv	1	2/22/2013
Chloromethane	ND	0.75		ppbv	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Cyclohexane	1.2	0.3		ppbv	1	2/22/2013
Dibromochloromethane	ND	0.3		ppbv	1	2/22/2013
Dichlorodifluoromethane	0.42	0.3		ppbv	1	2/22/2013
Ethyl acetate	1.2	0.3		ppbv	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-05
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:40:00 PM
Lab ID:	13020460-005A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Ethylbenzene	0.85	0.3		ppbv	1	2/22/2013
Freon-113	ND	0.3		ppbv	1	2/22/2013
Freon-114	ND	1.5		ppbv	1	2/22/2013
Heptane	1.7	0.3		ppbv	1	2/22/2013
Hexachlorobutadiene	ND	0.3		ppbv	1	2/22/2013
Hexane	14	0.75		ppbv	1	2/22/2013
Isopropyl Alcohol	14	1.5		ppbv	1	2/22/2013
m,p-Xylene	2.3	0.6		ppbv	1	2/22/2013
Methyl tert-butyl ether	ND	0.3		ppbv	1	2/22/2013
Methylene chloride	10	3		ppbv	1	2/22/2013
o-Xylene	0.87	0.3		ppbv	1	2/22/2013
Propene	ND	3		ppbv	1	2/22/2013
Styrene	ND	0.3		ppbv	1	2/22/2013
Tetrachloroethene	7.4	0.3		ppbv	1	2/22/2013
Tetrahydrofuran	2.7	0.75		ppbv	1	2/22/2013
Toluene	4.9	0.3		ppbv	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Trichloroethene	ND	0.3		ppbv	1	2/22/2013
Trichlorofluoromethane	ND	0.3		ppbv	1	2/22/2013
Vinyl acetate	ND	3		ppbv	1	2/22/2013
Vinyl chloride	ND	0.3		ppbv	1	2/22/2013
Xylenes, Total	3.2	0.9		ppbv	1	2/22/2013
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.0016		mg/m³	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.0021		mg/m³	1	2/22/2013
1,1,2-Trichloroethane	ND	0.0016		mg/m³	1	2/22/2013
1,1-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,1-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.0022		mg/m³	1	2/22/2013
1,2,4-Trimethylbenzene	0.0039	0.0015		mg/m³	1	2/22/2013
1,2-Dibromoethane	ND	0.0022		mg/m³	1	2/22/2013
1,2-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,2-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,2-Dichloropropane	ND	0.0013		mg/m³	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.0015		mg/m³	1	2/22/2013
1,3-Butadiene	0.00093	0.0006		mg/m³	1	2/22/2013
1,3-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
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Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-05
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:40:00 PM
Lab ID:	13020460-005A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,4-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,4-Dioxane	ND	0.0027		mg/m³	1	2/22/2013
2-Butanone	0.018	0.0022		mg/m³	1	2/22/2013
2-Hexanone	ND	0.0061		mg/m³	1	2/22/2013
4-Ethyltoluene	ND	0.0015		mg/m³	1	2/22/2013
4-Methyl-2-pentanone	ND	0.0061		mg/m³	1	2/22/2013
Acetone	0.065	0.0072	*	mg/m³	1	2/22/2013
Benzene	0.0035	0.0009		mg/m³	1	2/22/2013
Benzyl chloride	ND	0.0039		mg/m³	1	2/22/2013
Bromodichloromethane	ND	0.0019		mg/m³	1	2/22/2013
Bromoform	ND	0.0078		mg/m³	1	2/22/2013
Bromomethane	ND	0.0028		mg/m³	1	2/22/2013
Carbon disulfide	0.0046	0.00093		mg/m³	1	2/22/2013
Carbon tetrachloride	ND	0.0019		mg/m³	1	2/22/2013
Chlorobenzene	ND	0.0013		mg/m³	1	2/22/2013
Chloroethane	ND	0.00075		mg/m³	1	2/22/2013
Chloroform	ND	0.0015		mg/m³	1	2/22/2013
Chloromethane	ND	0.0015		mg/m³	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/22/2013
Cyclohexane	0.0041	0.001		mg/m³	1	2/22/2013
Dibromochloromethane	ND	0.0025		mg/m³	1	2/22/2013
Dichlorodifluoromethane	0.0021	0.0015		mg/m³	1	2/22/2013
Ethyl acetate	0.0045	0.001		mg/m³	1	2/22/2013
Ethylbenzene	0.0037	0.0013		mg/m³	1	2/22/2013
Freon-113	ND	0.0022		mg/m³	1	2/22/2013
Freon-114	ND	0.01		mg/m³	1	2/22/2013
Heptane	0.0069	0.0012		mg/m³	1	2/22/2013
Hexachlorobutadiene	ND	0.0031		mg/m³	1	2/22/2013
Hexane	0.048	0.0027		mg/m³	1	2/22/2013
Isopropyl Alcohol	0.035	0.0037		mg/m³	1	2/22/2013
m,p-Xylene	0.01	0.0025		mg/m³	1	2/22/2013
Methyl tert-butyl ether	ND	0.001		mg/m³	1	2/22/2013
Methylene chloride	0.035	0.01		mg/m³	1	2/22/2013
o-Xylene	0.0038	0.0013		mg/m³	1	2/22/2013
Propene	ND	0.0051		mg/m³	1	2/22/2013
Styrene	ND	0.0013		mg/m³	1	2/22/2013
Tetrachloroethene	0.05	0.0021		mg/m³	1	2/22/2013

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Accreditation Numbers: IEPA ELAP 100445; ORELAP IL300001; AIHA 101160; NVLAP LabCode 101202-

Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-05
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 1:40:00 PM
Lab ID:	13020460-005A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Tetrahydrofuran	0.0079	0.0022		mg/m³	1	2/22/2013
Toluene	0.019	0.0012		mg/m³	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.0013		mg/m³	1	2/22/2013
Trichloroethene	ND	0.0016		mg/m³	1	2/22/2013
Trichlorofluoromethane	ND	0.0016		mg/m³	1	2/22/2013
Vinyl acetate	ND	0.01		mg/m³	1	2/22/2013
Vinyl chloride	ND	0.00075		mg/m³	1	2/22/2013
Xylenes, Total	0.014	0.0039		mg/m³	1	2/22/2013

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HT - Sample received past holding time
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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-06
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 2:00:00 PM
Lab ID:	13020460-006A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.3		ppbv	1	2/22/2013
1,1,2-Trichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,1-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2,4-Trimethylbenzene	0.72	0.3		ppbv	1	2/22/2013
1,2-Dibromoethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloroethane	ND	0.3		ppbv	1	2/22/2013
1,2-Dichloropropane	ND	0.3		ppbv	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.3		ppbv	1	2/22/2013
1,3-Butadiene	0.48	0.3		ppbv	1	2/22/2013
1,3-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dichlorobenzene	ND	0.3		ppbv	1	2/22/2013
1,4-Dioxane	ND	0.75		ppbv	1	2/22/2013
2-Butanone	6.4	0.75		ppbv	1	2/22/2013
2-Hexanone	ND	1.5		ppbv	1	2/22/2013
4-Ethyltoluene	ND	0.3		ppbv	1	2/22/2013
4-Methyl-2-pentanone	ND	1.5		ppbv	1	2/22/2013
Acetone	30	3	*	ppbv	1	2/22/2013
Benzene	1	0.3		ppbv	1	2/22/2013
Benzyl chloride	ND	0.75		ppbv	1	2/22/2013
Bromodichloromethane	ND	0.3		ppbv	1	2/22/2013
Bromoform	ND	0.75		ppbv	1	2/22/2013
Bromomethane	ND	0.75		ppbv	1	2/22/2013
Carbon disulfide	1.5	0.3		ppbv	1	2/22/2013
Carbon tetrachloride	ND	0.3		ppbv	1	2/22/2013
Chlorobenzene	ND	0.3		ppbv	1	2/22/2013
Chloroethane	ND	0.3		ppbv	1	2/22/2013
Chloroform	ND	0.3		ppbv	1	2/22/2013
Chloromethane	ND	0.75		ppbv	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Cyclohexane	1.1	0.3		ppbv	1	2/22/2013
Dibromochloromethane	ND	0.3		ppbv	1	2/22/2013
Dichlorodifluoromethane	0.6	0.3		ppbv	1	2/22/2013
Ethyl acetate	1.1	0.3		ppbv	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-06
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 2:00:00 PM
Lab ID:	13020460-006A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Ethylbenzene	0.83	0.3		ppbv	1	2/22/2013
Freon-113	ND	0.3		ppbv	1	2/22/2013
Freon-114	ND	1.5		ppbv	1	2/22/2013
Heptane	1.4	0.3		ppbv	1	2/22/2013
Hexachlorobutadiene	ND	0.3		ppbv	1	2/22/2013
Hexane	6.3	0.75		ppbv	1	2/22/2013
Isopropyl Alcohol	17	1.5		ppbv	1	2/22/2013
m,p-Xylene	2.3	0.6		ppbv	1	2/22/2013
Methyl tert-butyl ether	ND	0.3		ppbv	1	2/22/2013
Methylene chloride	9.7	3		ppbv	1	2/22/2013
o-Xylene	0.84	0.3		ppbv	1	2/22/2013
Propene	3.3	3		ppbv	1	2/22/2013
Styrene	ND	0.3		ppbv	1	2/22/2013
Tetrachloroethene	8.2	0.3		ppbv	1	2/22/2013
Tetrahydrofuran	2.7	0.75		ppbv	1	2/22/2013
Toluene	4.5	0.3		ppbv	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.3		ppbv	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.3		ppbv	1	2/22/2013
Trichloroethene	0.78	0.3		ppbv	1	2/22/2013
Trichlorofluoromethane	ND	0.3		ppbv	1	2/22/2013
Vinyl acetate	ND	3		ppbv	1	2/22/2013
Vinyl chloride	ND	0.3		ppbv	1	2/22/2013
Xylenes, Total	3.1	0.9		ppbv	1	2/22/2013
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,1,1-Trichloroethane	ND	0.0017		mg/m³	1	2/22/2013
1,1,2,2-Tetrachloroethane	ND	0.0021		mg/m³	1	2/22/2013
1,1,2-Trichloroethane	ND	0.0017		mg/m³	1	2/22/2013
1,1-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,1-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
1,2,4-Trichlorobenzene	ND	0.0023		mg/m³	1	2/22/2013
1,2,4-Trimethylbenzene	0.0035	0.0015		mg/m³	1	2/22/2013
1,2-Dibromoethane	ND	0.0023		mg/m³	1	2/22/2013
1,2-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,2-Dichloroethane	ND	0.0012		mg/m³	1	2/22/2013
1,2-Dichloropropane	ND	0.0014		mg/m³	1	2/22/2013
1,3,5-Trimethylbenzene	ND	0.0015		mg/m³	1	2/22/2013
1,3-Butadiene	0.0011	0.0006		mg/m³	1	2/22/2013
1,3-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013

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Report Date: February 27, 2013
Print Date: February 27, 2013

Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-06
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 2:00:00 PM
Lab ID:	13020460-006A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
1,4-Dichlorobenzene	ND	0.0018		mg/m³	1	2/22/2013
1,4-Dioxane	ND	0.0027		mg/m³	1	2/22/2013
2-Butanone	0.019	0.0023		mg/m³	1	2/22/2013
2-Hexanone	ND	0.0062		mg/m³	1	2/22/2013
4-Ethyltoluene	ND	0.0015		mg/m³	1	2/22/2013
4-Methyl-2-pentanone	ND	0.0062		mg/m³	1	2/22/2013
Acetone	0.071	0.0072	*	mg/m³	1	2/22/2013
Benzene	0.0032	0.0009		mg/m³	1	2/22/2013
Benzyl chloride	ND	0.0039		mg/m³	1	2/22/2013
Bromodichloromethane	ND	0.002		mg/m³	1	2/22/2013
Bromoform	ND	0.0078		mg/m³	1	2/22/2013
Bromomethane	ND	0.0029		mg/m³	1	2/22/2013
Carbon disulfide	0.0048	0.00093		mg/m³	1	2/22/2013
Carbon tetrachloride	ND	0.002		mg/m³	1	2/22/2013
Chlorobenzene	ND	0.0014		mg/m³	1	2/22/2013
Chloroethane	ND	0.00075		mg/m³	1	2/22/2013
Chloroform	ND	0.0015		mg/m³	1	2/22/2013
Chloromethane	ND	0.0015		mg/m³	1	2/22/2013
cis-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
cis-1,3-Dichloropropene	ND	0.0014		mg/m³	1	2/22/2013
Cyclohexane	0.0039	0.0011		mg/m³	1	2/22/2013
Dibromochloromethane	ND	0.0026		mg/m³	1	2/22/2013
Dichlorodifluoromethane	0.003	0.0015		mg/m³	1	2/22/2013
Ethyl acetate	0.0038	0.0011		mg/m³	1	2/22/2013
Ethylbenzene	0.0036	0.0014		mg/m³	1	2/22/2013
Freon-113	ND	0.0023		mg/m³	1	2/22/2013
Freon-114	ND	0.011		mg/m³	1	2/22/2013
Heptane	0.0057	0.0012		mg/m³	1	2/22/2013
Hexachlorobutadiene	ND	0.0032		mg/m³	1	2/22/2013
Hexane	0.022	0.0027		mg/m³	1	2/22/2013
Isopropyl Alcohol	0.041	0.0038		mg/m³	1	2/22/2013
m,p-Xylene	0.01	0.0026		mg/m³	1	2/22/2013
Methyl tert-butyl ether	ND	0.0011		mg/m³	1	2/22/2013
Methylene chloride	0.034	0.01		mg/m³	1	2/22/2013
o-Xylene	0.0036	0.0014		mg/m³	1	2/22/2013
Propene	0.0058	0.0051		mg/m³	1	2/22/2013
Styrene	ND	0.0014		mg/m³	1	2/22/2013
Tetrachloroethene	0.055	0.0021		mg/m³	1	2/22/2013

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Client:	V3 Companies of Illinois	**Client Sample ID:**	SM-SG-06
Lab Order:	13020460	**Tag Number:**	
Project:	07292, Spartan Square, Romeoville, IL	**Collection Date:**	2/19/2013 2:00:00 PM
Lab ID:	13020460-006A	**Matrix:**	Air

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **2/21/2013**		Analyst: **VP**
Tetrahydrofuran	0.008	0.0023		mg/m³	1	2/22/2013
Toluene	0.017	0.0012		mg/m³	1	2/22/2013
trans-1,2-Dichloroethene	ND	0.0012		mg/m³	1	2/22/2013
trans-1,3-Dichloropropene	ND	0.0014		mg/m³	1	2/22/2013
Trichloroethene	0.0042	0.0017		mg/m³	1	2/22/2013
Trichlorofluoromethane	ND	0.0017		mg/m³	1	2/22/2013
Vinyl acetate	ND	0.011		mg/m³	1	2/22/2013
Vinyl chloride	ND	0.00075		mg/m³	1	2/22/2013
Xylenes, Total	0.014	0.0039		mg/m³	1	2/22/2013

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Catia Giannini

From: Kristine Wright [kwright@v3co.com]
Sent: Wednesday, February 27, 2013 3:43 PM
To: Catia Giannini; Craig McCammack
Subject: RE: 07292, Spartan Square, Romeoville, IL 13020460

Thanks Catia but we need the results in mg/m^3
Can you modify the table and resend the results?

Thanks,
Kristine

From: Catia Giannini [mailto:CGiannini@STATAnalysis.com]
Sent: Wednesday, February 27, 2013 3:28 PM
To: Craig McCammack
Cc: Kristine Wright
Subject: 07292, Spartan Square, Romeoville, IL 13020460

Attached are the report and invoice for project 07292, Spartan Square, Romeoville, IL received 2/20/13.

Catia Giannini
STAT Analysis Corporation
2242 W. Harrison, Suite 200
Chicago, IL 60612
(312)733-0551

<<13020460(V3).pdf>> <<13020460(V3).xls>> <<13020460(V3)Invoice.pdf>>

APPENDIX D

TIER 2 DOCUMENTATION

Supporting Information for Tier 2 RO Determination
Romeoville – Spartan Square RBCA MODEL

COC chemical and physical properties
The COCs' chemical and physical properties that influence migration and exposure pathways are TACO default, unless otherwise stated.

Soil physical properties
Average of the TACO Default Values for Gravel.

Fraction Organic Carbon (f_{oc})
A site-specific value for organic carbon content (f_{oc}) of 0.81% for the native soil sample SM-GP-101 (10-12 ft) was used in the simulations.

Horizontal Gradient (i)
Site-specific data were obtained from field investigations. The gradient was determined by the groundwater elevation at the well subtracted from the groundwater elevation at a downgradient well, divided by the distance from one well to the other.

Hydraulic Conductivity (K)
A site-specific hydraulic conductivity test on well SM-MW-04 was performed. The resulting K value calculated is 1.786×10^{-4} cm/s.

Source Width - Horizontal (Sw)
To determine the source width (Sw) for each well or boring, the following guidelines and hierarchy were used as applicable:

1. For each REC, measure Sw for each boring and/or well modeled.
2. Use actual groundwater data points (wells) as available to define Sw
3. Use actual soil data as available to define Sw
4. Use simulations from up gradient sources to define Sw
5. Check calculated groundwater contours (width perpendicular to flow to define Sw)
6. Divide Sw into "cells" where soil borings or wells are near one another
7. The widest Sw for a group of compounds from a single boring or well will govern what is used.
8. If guiding groundwater or soil data is absent on one side of a well or boring, the distance measured on the opposite side will be mirrored to the other side to complete the source width (Sw).
9. Once an Sw has been determined, if actual downgradient data is available, the downgradient data will be used for a model calibration. In this case, Sw may be modified as part of model calibration.
10. As necessary, an Sw value is measured separately for organics and inorganics at each modeled boring or well.

Source Width - Parallel (W)
Set equal to Sw

Source Concentration (Csource)
The COC concentrations from soil / groundwater sampling were used as source concentrations in the simulations.

Compliance Point (X)
The compliance point for each respective simulation was measured from the well/boring to the property boundary in the direction of groundwater flow.

SOIL DATA-For Soil to Groundwater Route									
Boring Name:	SM-GP-03	SM-GP-07	SM-GP-08	SM-GP-103 / X103	SM-GP-104 / X104	SM-GP-107 / X107B	SM-GP-108 / X108B		SM-GP-110 / X110B
Chemical Consitituant:	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	trichloroethylene (TCE)	tetrachloroethylene (PCE)
Receptor	property bndry	property bndry	property bndry	property bndry	property bndry	property bndry	property bndry	property bndry	property bndry
Site-Specific Parameters									
Source length parallel to GW flow [feet]	17	10	10	19	15	19	10	10	10
Source width perpendicular to GW flow [feet]	17	10	10	19	15	19	10	10	10
Fractional Organic Carbon (FOC) [%]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hydraulic Gradient	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Hydraulic Conductivity - shallow [cm/s]	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04
Distance to Receptor [feet]	156	122	105	155	102	90	118	118	166
Constituant concentration [mg/kg]	0.1	14.6	76.3	0.12	9	3.3	800 (above Csat)	0.17	0.16
		have GW sample	have GW sample				have GW sample		
TACO Plus! Results									
Calculated maximum allowable soil concentration (mg/kg) at borehole to meet Tier 1 groundwater RO at Receptor	15.55 mg/kg	14.9 mg/kg	8.81 mg/kg	12.7 mg/kg	4.03 mg/kg	1.84 mg/kg	13.23 mg/kg	8.16 mg/kg	48.9 mg/kg
Meets modeled Soil Migration to GW Class I RO? / Distance to Compliance?	Y, 15.6 ft	Y, 121.3 ft	N, 184.7 ft	Y, 23.8 ft	N, 128.3 ft	N, 107.6 ft	N, 303.1 ft	Y, 61.4 ft	Y, 13.8 ft

Notes:
Soil Type = Gravel

How Sw cells were calculated for each:

SM-GP-03 = 1/2 distance between SM-GP-03 and SM-GP-103 and 1/2 distance between SM-GP-03 and SM-GP-111
SM-GP-07 = 1/2 distance between SM-GP-07 and SM-GP-108 and 1/2 distance between SM-GP-07 and SM-MW-02
SM-GP-08 = 1/2 distance between SM-GP-08 and SM-GP-07 and 1/2 distance between SM-GP-08 and SM-GP-107
SM-GP-103 = 1/2 distance between SM-GP-103 and SM-GP-113 and 1/2 distance between SM-GP-103 and SM-GP-105
SM-GP-104 = 1/2 distance between SM-GP-104 and SM-GP-08 and 1/2 distance between SM-GP-104 and SM-GP-114
SM-GP-107= 1/2 distance between SM-GP-107 and SM-GP-08 and 1/2 distance between SM-GP-107 and SM-GP-106
SM-GP-108 = 1/2 distance between SM-GP-108 and SM-GP-114 and 1/2 distance between SM-GP-108 and SM-GP-07
SM-GP-110 = 1/2 distance between SM-GP-110 and SM-GP-111 and 1/2 distance between SM-GP-110 and SM-GP-03
SM-GP-111 = 1/2 distance between SM-GP-111 and SM-GP-103 and 1/2 distance between SM-GP-111 and SM-GP-116
SM-GP-114 = 1/2 distance between SM-GP-114 and SM-GP-108 and 1/2 distance between SM-GP-114 and SM-GP-115
SM-GP-115 = 1/2 distance between SM-GP-115 and SM-GP-114 plus distance mirrored to the northeast
SM-GP-116 = 1/2 distance between SM-GP-116 and SM-GP-06 and 1/2 distance between SM-GP-116 and SM-GP-115
SM-GP-117 = 1/2 distance between SM-GP-117 and SM-GP-07 and 1/2 distance between SM-GP-117 and SM-GP-104

SOIL DATA-For Soil to Groundwater Route					
Boring Name:	SM-GP-111 / X111B	SM-GP-114 / X114B	SM-GP-115 / X115	SM-GP-116 / X116	SM-GP-117 / X117
Chemical Consitituant:	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)
Receptor	property bndry	property bndry	property bndry	property bndry	property bndry
Site-Specific Parameters					
Source length parallel to GW flow [feet]	10	10	10	10	15
Source width perpendicular to GW flow [feet]	10	10	10	10	15
Fractional Organic Carbon (FOC) [%]	0.81	0.81	0.81	0.81	0.81
Hydraulic Gradient	0.024	0.024	0.024	0.024	0.024
Hydraulic Conductivity - shallow [cm/s]	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04
Distance to Receptor [feet]	156	132	145	153	66
Constituant concentration [mg/kg]	0.19	2.2	0.16	0.13	6.3
					have GW sample
TACO Plus! Results					
Calculated maximum allowable soil concentration (mg/kg) at borehole to meet Tier 1 groundwater RO at Receptor	38.01 mg/kg	19.92 mg/kg	28.5 mg/kg	35.18 mg/kg	1.08 mg/kg
Meets modeled Soil Migration to GW Class I RO? / Distance to Compliance?	Y, 16.8 ft	Y, 67 ft	Y, 13.8 ft	Y, 9.6 ft	N, 116.2 ft

Notes:
Soil Type = Gravel

How Sw cells were calculated for each:
SM-GP-03 = 1/2 distance between SM-GP-03 a
SM-GP-07 = 1/2 distance between SM-GP-07 a
SM-GP-08 = 1/2 distance between SM-GP-08 a
SM-GP-103 = 1/2 distance between SM-GP-10
SM-GP-104 = 1/2 distance between SM-GP-10
SM-GP-107= 1/2 distance between SM-GP-107
SM-GP-108 = 1/2 distance between SM-GP-10
SM-GP-110 = 1/2 distance between SM-GP-11
SM-GP-111 = 1/2 distance between SM-GP-11
SM-GP-114 = 1/2 distance between SM-GP-11
SM-GP-115 = 1/2 distance between SM-GP-11
SM-GP-116 = 1/2 distance between SM-GP-11
SM-GP-117 = 1/2 distance between SM-GP-11

GROUNDWATER DATA-SHALLOW WELLS

Monitoring Well:	SM-GP-07-GW	SM-GP-08-GW	SM-GP-108 / G018	SM-GP-117 / G117	SM-MW-01 / G101					SM-MW-02 / G102			
Chemical Consitituant:	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	tetrachloroethylene (PCE)	Aluminum	Iron	Lead	Manganese	Bromodichloromethane	Bromoform	Chloroform	tetrachloroethylene (PCE)
Receptor	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy
Site-Specific Parameters													
Source length parallel to GW flow [feet] W	10	32	43	38	41	41	41	41	41	32	32	32	32
Source width perpendicular to GW flow [feet] S_w	10	32	43	38	41	41	41	41	41	32	32	32	32
Fractional Organic Carbon (FOC) [%]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hydraulic Gradient - (I)	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Hydraulic Conductivity - shallow [cm/s]	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04
Distance to Receptor [feet]	120	105	118	66	36	36	36	36	36	110	110	110	110
Constituant concentration [mg/L]	0.128	0.109	0.079	0.026	0.0055	5.58	16.2	0.0115	0.397	0.0056	0.0048	0.0032	0.015
TACO Plus! Results													
Meet Class I objectives at Receptor? /Distance to meet compliance?	Y, 71.5 ft	Y, 97.2 ft	Y, 94.8 ft	Y, 60.3 ft	Y, 4.9 ft	N, 64.8 ft	N, 94.2 ft	N, 55.1 ft	N, 83 ft	N, 378.9 ft	Y, 39.2 ft	N, 123.7 ft	Y, 43.4 ft
Modeled concentration at property boundary C(X) [mg/L]	9.43E-04	3.89E-03	2.46E-03	4.04E-03	2.56E-03	5.06	14.6	1.04E-02	3.60E-01	1.07E-03	3.58E-05	2.71E-04	4.59E-04

Notes:
met=initial concentration meets objective prior to modeling

Soil Type = gravel

How Sw cells were calculated for each:
SM-GP-07-GW = 1/2 distance between SM-GP-07 and SM-GP-108 and 1/2 distance between SM-GP-07 and SM-MW-02
SM-GP-08-GW = 1/2 distance between SM-GP-08 and SM-GP-07 and 1/2 distance between SM-GP-08 and SM-MW-04
SM-GP-108-GW = 1/2 distance between SM-GP-108 and SM-GP-07 and 1/2 distance between SM-GP-108 and SM-MW-03
SM-GP-117 = 1/2 distance between SM-GP-117 and SM-GP-07 and 1/2 distance between SM-GP-117 and SM-MW-04
SM-MW-01 = 1/2 distance between SM-MW-01 and SM-GP-117 and 1/2 distance between SM-MW-01 and SM-MW-03
SM-MW-02 = 1/2 distance between SM-MW-02 and SM-GP-07 and 1/2 distance between SM-MW-02 and SM-MW-04
SM-MW-03 = 1/2 distance between SM-MW-03 and MW-10 and 1/2 distance between SM-MW-03 and SM-GP-108
SM-MW-04 = 1/2 distance between SM-MW-04 and SM-GP-117 plus the distance mirrored to the southwest.

GROUNDWATER DATA-SHALLOW WELLS

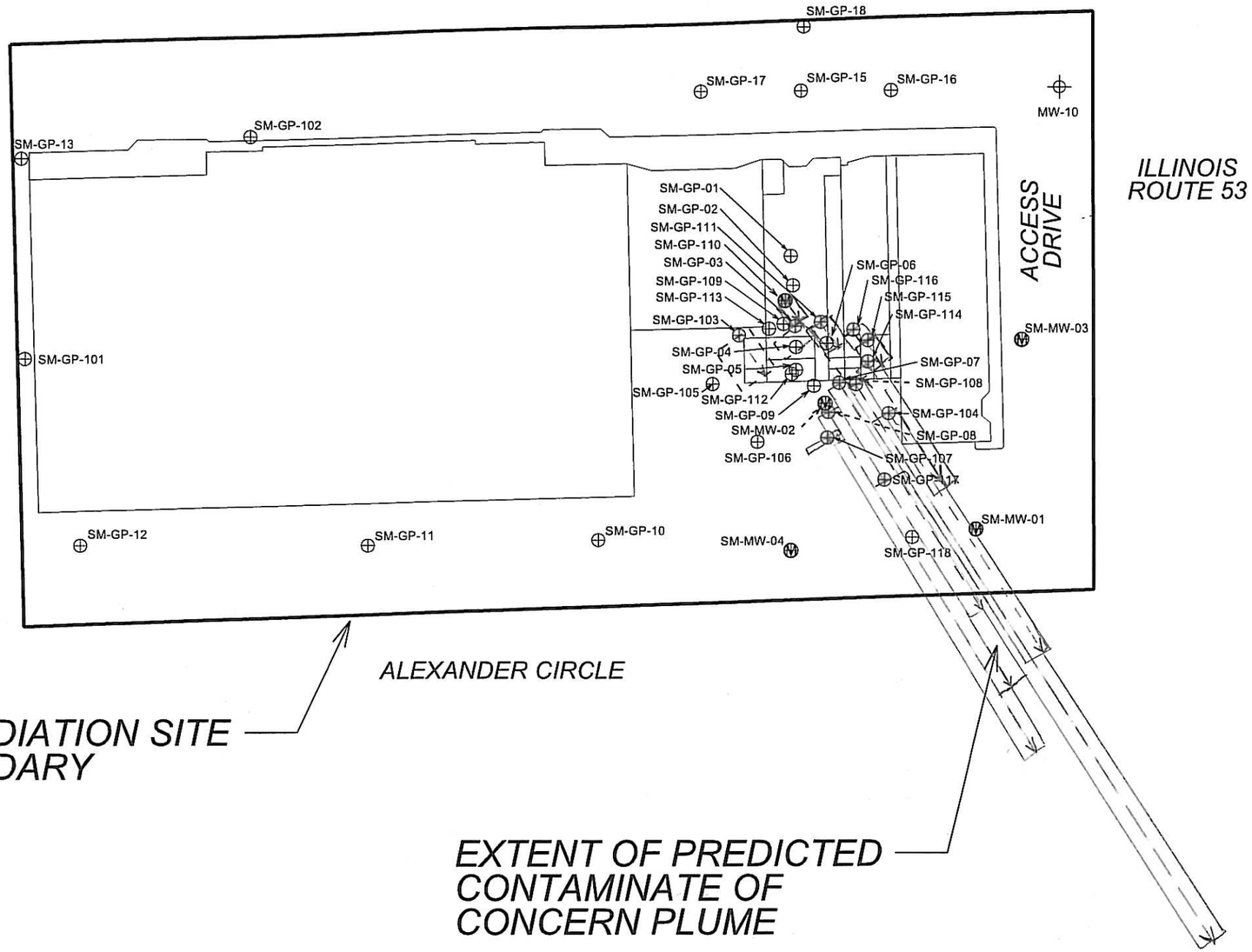
Monitoring Well:	SM-MW-03 / G103			SM-MW-04 / G104			
Chemical Consitituant:	Bromodichloromethane	Chloroform	tetrachloroethylene (PCE)	Aluminum	Iron	Lead	Manganese
Receptor	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy	property bndy
Site-Specific Parameters							
Source length parallel to GW flow [feet] W	68	68	68	56	56	56	56
Source width perpendicular to GW flow [feet] S_w	68	68	68	56	56	56	56
Fractional Organic Carbon (FOC) [%]	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hydraulic Gradient - (I)	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Hydraulic Conductivity - shallow [cm/s]	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04	1.79E-04
Distance to Receptor [feet]	60	60	60	27	27	27	27
Constituant concentration [mg/L]	0.004	0.0032	0.053	6.74	18.1	0.0101	0.386

TACO Plus! Results							
Meet Class I objectives at Receptor? /Distance to meet compliance?	N, 326.2 ft	N, 157.1 ft	N, 91.3 ft	N, 75.9 ft	N, 116.6 ft	N, 53.9 ft	N, 93.7 ft
Modeled concentration at property boundary C(X) [mg/L]	2.82E-03	1.43E-03	1.28E-02	6.64	17.83	9.95E-03	3.80E-01

Notes:
met=initial concentration meets objective prior to mod

Soil Type = gravel

How Sw cells were calculated for each:
SM-GP-07-GW = 1/2 distance between SM-GP-07 an
SM-GP-08-GW = 1/2 distance between SM-GP-08 an
SM-GP-108-GW = 1/2 distance between SM-GP-108
SM-GP-117 = 1/2 distance between SM-GP-117 and
SM-MW-01 = 1/2 distance between SM-MW-01 and S
SM-MW-02 = 1/2 distance between SM-MW-02 and S
SM-MW-03 = 1/2 distance between SM-MW-03 and M
SM-MW-04 = 1/2 distance between SM-MW-04 and S



60 0 60 120

1"=60'

SCALE FEET

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REVISIONS

NO.	DATE	DESCRIPTION

PROJECT NO.: 07292	DESIGNED BY: RKB
FILE NAME: FIG D4 SOILTIER2	DRAWN BY: KW/RKB
DATE: 06/21/13	CHECKED BY: CAM
SCALE: 1"=60'	PROJECT MANAGER: CAM

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TIER 2 SIMULATIONS MAP SOIL LOCATIONS

DRAWING NO. D4.1

07292-TIER 2 SIMULATIONS MAP-SOIL

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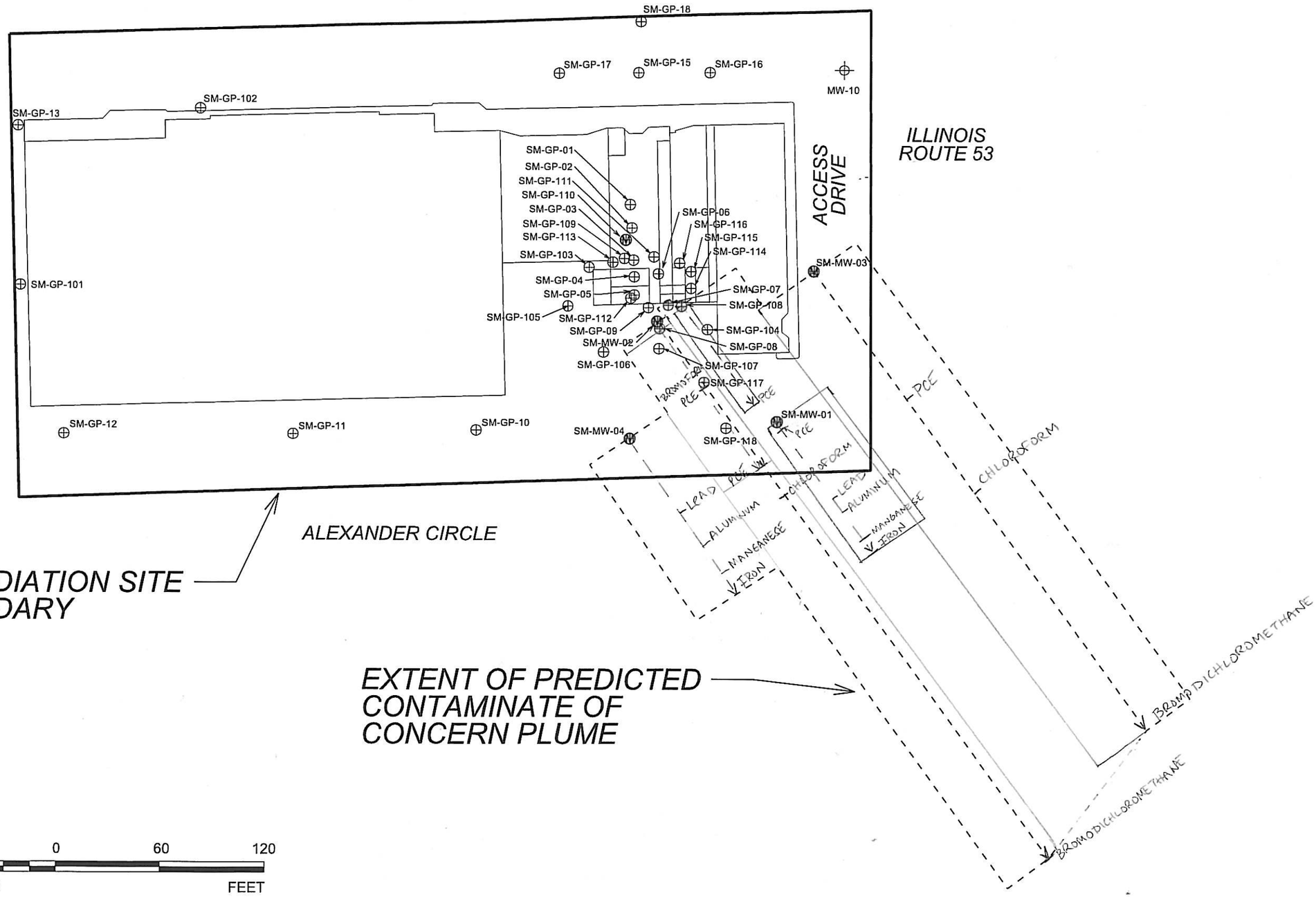

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SCALE: 1"=60'	PROJECT MANAGER: CAM

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TIER 2 SIMULATIONS MAP GROUNDWATER LOCATIONS

DRAWING NO. D4.2

07292-TIER 2 SIMULATIONS MAP-GROUNDWATER

$FILES $DATES $TIMES

RBCA Equations
Industrial-Commercial - soil migration to groundwater ingestion route

Calculations		Sample	SM-GP-03	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.555E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.086E+00
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	6.981E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	4.605E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	475
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	158
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	23.8
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	3.215E-05

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.65E-06		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-03	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	518	5.2	m	17	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	6.98E-03					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	4,754.6	47.5	m	156	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	32.14					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	10.71					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.61					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	518.1	5.2	m	17	ft	
S(w) Beta for error function					0.149					
S(d) Beta for error function					0.297					
erf(S(w) Beta) value, Appendix C, Table G:					0.1671345					
erf(S(d) Beta) value, Appendix C, Table G:					0.3259828					
For Sgw calc's:										
Csoil (at source)	0.1	mg/kg								
Cgw (at source) = Csoil*LF(sw)	6.98E-03	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-07	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.491E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	7.206E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	6.938E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	372
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	124
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	18.6
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.896E-03

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-07	Chemical	Tetrachloroethylene				
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225				
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200				
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene			
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08				
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14				
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene			
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene			
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default			
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100				
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO			
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04				
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	7.06E-01				
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	3,718.4	37.2	m	122	ft
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec
Hydraulic gradient (cm/cm):				*i*	0.0240				
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr		
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	25.13				
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	8.38				
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.26				
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30				
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200				
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene			
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel			
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel			
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene			
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081				
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100				
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel			
Water Density (g/cm3):				*p(w)*	1.00				
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default	
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft
S(w) Beta for error function					0.112				
S(d) Beta for error function					0.380				
erf(S(w) Beta) value, Appendix C, Table G:					0.1261175				
erf(S(d) Beta) value, Appendix C, Table G:					0.4093324				
For Sgw calc's:									
Csoil (at source)	14.6	mg/kg							
Cgw (at source) = Csoil*LF(sw)	7.06E-01	mg/L							
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91				
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene			

Calculations		Sample	SM-GP-08	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							8.809E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	4.257E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	1.175E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	320
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	107
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	16.0
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.331E-02

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-08	Chemical	Tetrachloroethylene				
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225				
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200				
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene			
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08				
Particulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14				
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene			
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene			
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default			
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100				
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO			
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04				
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	3.69E+00				
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	3,200.2	32.0	m	105	ft
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec
Hydraulic gradient (cm/cm):				*i*	0.0240				
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr		
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	21.63				
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	7.21				
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.08				
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30				
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200				
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene			
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel			
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel			
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene			
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081				
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100				
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel			
Water Density (g/cm3):				*p(w)*	1.00				
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default	
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft
S(w) Beta for error function					0.130				
S(d) Beta for error function					0.442				
erf(S(w) Beta) value, Appendix C, Table G:					0.1463221				
erf(S(d) Beta) value, Appendix C, Table G:					0.4679977				
For Sgw calc's:									
Csoil (at source)	76.3	mg/kg							
Cgw (at source) = Csoil*LF(sw)	3.69E+00	mg/L							
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91				
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene			

Calculations		Sample	SM-GP-103	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.268E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	9.487E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	7.481E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	5.270E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	472
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	157
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	23.6
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.731E-05

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.84E-06		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-103	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	579	5.8	m	19	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	8.98E-03					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	4,724.2	47.2	m	155	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	31.93					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	10.64					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.60					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	579.1	5.8	m	19	ft	
S(w) Beta for error function					0.168					
S(d) Beta for error function					0.299					
erf(S(w) Beta) value, Appendix C, Table G:					0.1876352					
erf(S(d) Beta) value, Appendix C, Table G:					0.3279636					
For Sgw calc's:										
Csoil (at source)	0.12	mg/kg								
Cgw (at source) = Csoil*LF(sw)	8.98E-03	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

RBCA Equations
Industrial-Commercial - soil migration to groundwater ingestion route

Calculations		Sample	SM-GP-104	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							4.028E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	2.593E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	6.436E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	1.929E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	311
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	104
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	15.5
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	1.117E-02

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.45E-06		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-104	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	457	4.6	m	15	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	5.79E-01					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	3,108.8	31.1	m	102	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	21.01					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	7.00					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.05					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	457.2	4.6	m	15	ft	
S(w) Beta for error function					0.201					
S(d) Beta for error function					0.455					
erf(S(w) Beta) value, Appendix C, Table G:					0.2241859					
erf(S(d) Beta) value, Appendix C, Table G:					0.4799922					
For Sgw calc's:										
Csoil (at source)	9	mg/kg								
Cgw (at source) = Csoil*LF(sw)	5.79E-01	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-107	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							3.302E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	2.470E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	7.481E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	2.024E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	328
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	109
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	16.4
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.997E-03

Assumptions:			
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06	
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33 lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70	
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0	
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160	
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5	
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20	
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.84E-06	
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0	
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene

Calculations		Sample	SM-GP-107	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	579	5.8	m	19	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	2.47E-01					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	3,279.5	32.8	m	107.6	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	22.17					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	7.39					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.11					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	579.1	5.8	m	19	ft	
S(w) Beta for error function					0.242					
S(d) Beta for error function					0.431					
erf(S(w) Beta) value, Appendix C, Table G:					0.2676081					
erf(S(d) Beta) value, Appendix C, Table G:					0.4580397					
For Sgw calc's:										
Csoil (at source)	3.3	mg/kg								
Cgw (at source) = Csoil*LF(sw)	2.47E-01	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-108	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.323E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	6.393E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	7.821E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	360
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	120
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	18.0
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	3.024E-01

Assumptions:			
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06	
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33 lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70	
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0	
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160	
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5	
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20	
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07	
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0	
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene

Calculations		Sample	SM-GP-108	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	3.87E+01					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	3,596.5	36.0	m	118	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	24.31					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	8.10					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.22					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft	
S(w) Beta for error function					0.116					
S(d) Beta for error function					0.393					
erf(S(w) Beta) value, Appendix C, Table G:					0.130355					
erf(S(d) Beta) value, Appendix C, Table G:					0.4218587					
For Sgw calc's:										
Csoil (at source)	800	mg/kg								
Cgw (at source) = Csoil*LF(sw)	3.87E+01	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

RBCA Equations
Industrial-Commercial - soil migration to groundwater ingestion route

Calculations		Sample	SM-GP-108	Chemical	Trichloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						8.162E+00	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	2.242E+00	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	2.746E-01	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	2.164E-02	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	360	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	120	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	18.0	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
	Eq. R20	Soil-Water Sorption Coefficient:					*k(s)*	0.81	
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						4.850E-02	T2
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	1.010E-03	

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.0059	Trichloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.007	Trichloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.43E-06		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	NA	Trichloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	2.86E-03	Trichloroethylene	

Calculations		Sample	SM-GP-108	Chemical	Trichloroethylene				
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225				
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200				
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	4.10E-01	Trichloroethylene			
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08				
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14				
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.90E-02	Trichloroethylene			
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	9.10E-06	Trichloroethylene			
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default			
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100				
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO			
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	4.85E-02				
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	4.67E-02				
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	3,596.5	36.0	m	118	ft
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec
Hydraulic gradient (cm/cm):				*i*	0.0240				
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr		
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	24.31				
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	8.10				
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.22				
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30				
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200				
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00042	Trichloroethylene			
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel			
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel			
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	100	Trichloroethylene			
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081				
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100				
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel			
Water Density (g/cm3):				*p(w)*	1.00				
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default	
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft
S(w) Beta for error function					0.116				
S(d) Beta for error function					0.393				
erf(S(w) Beta) value, Appendix C, Table G:					0.130355				
erf(S(d) Beta) value, Appendix C, Table G:					0.4218587				
For Sgw calc's:									
Csoil (at source)	0.17	mg/kg							
Cgw (at source) = Csoil*LF(sw)	4.67E-02	mg/L							
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1380.38				
Solubility in Water [mg/L]				*S*	1.50E+03	Trichloroethylene			

Calculations		Sample	SM-GP-110	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							4.889E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	2.363E+00
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	2.116E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	506
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	169
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	25.3
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	1.636E-05

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

Calculations		Sample	SM-GP-110	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	7.73E-03					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	5,059.4	50.6	m	166	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	34.20					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	11.40					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.71					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft	
S(w) Beta for error function					0.082					
S(d) Beta for error function					0.280					
erf(S(w) Beta) value, Appendix C, Table G:					0.0928674					
erf(S(d) Beta) value, Appendix C, Table G:					0.3073794					
For Sgw calc's:										
Csoil (at source)	0.16	mg/kg								
Cgw (at source) = Csoil*LF(sw)	7.73E-03	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-111	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							3.801E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.837E+00
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	2.722E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	475
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	158
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	23.8
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	2.499E-05

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-111	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	9.18E-03					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	4,754.6	47.5	m	156	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	32.14					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	10.71					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.61					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft	
S(w) Beta for error function					0.088					
S(d) Beta for error function					0.297					
erf(S(w) Beta) value, Appendix C, Table G:					0.0987909					
erf(S(d) Beta) value, Appendix C, Table G:					0.3259828					
For Sgw calc's:										
Csoil (at source)	0.19	mg/kg								
Cgw (at source) = Csoil*LF(sw)	9.18E-03	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-114	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.992E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	9.628E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	5.193E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	402
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	134
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	20.1
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	5.522E-04

Assumptions:			
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06	
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33 lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70	
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0	
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160	
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5	
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20	
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07	
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0	
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene

Calculations		Sample	SM-GP-114	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	1.06E-01					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	4,023.2	40.2	m	132	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	27.19					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	9.06					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.36					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft	
S(w) Beta for error function					0.104					
S(d) Beta for error function					0.352					
erf(S(w) Beta) value, Appendix C, Table G:					0.1166343					
erf(S(d) Beta) value, Appendix C, Table G:					0.3808964					
For Sgw calc's:										
Csoil (at source)	2.2	mg/kg								
Cgw (at source) = Csoil*LF(sw)	1.06E-01	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-115	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							2.849E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.377E+00
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	3.631E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	442
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	147
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	22.1
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	2.808E-05

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-115	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	7.73E-03					
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	4,419.4	44.2	m	145	ft	
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):				*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	29.87					
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	9.96					
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.49					
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel				
Water Density (g/cm3):				*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft	
S(w) Beta for error function					0.094					
S(d) Beta for error function					0.320					
erf(S(w) Beta) value, Appendix C, Table G:					0.1062425					
erf(S(d) Beta) value, Appendix C, Table G:					0.3491284					
For Sgw calc's:										
Csoil (at source)	0.16	mg/kg								
Cgw (at source) = Csoil*LF(sw)	7.73E-03	mg/L								
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91					
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene				

Calculations		Sample	SM-GP-116	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							3.518E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.700E+00
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	2.941E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	466
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	155
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	23.3
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	1.848E-05

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene	

Calculations		Sample	SM-GP-116	Chemical	Tetrachloroethylene				
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	305	3.0	m	10	ft
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225				
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200				
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene			
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08				
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14				
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene			
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene			
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default			
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100				
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO			
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04				
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	6.28E-03				
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	4,663.2	46.6	m	153	ft
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec
Hydraulic gradient (cm/cm):				*i*	0.0240				
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr		
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	31.52				
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	10.51				
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	1.58				
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30				
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200				
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene			
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel			
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel			
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene			
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081				
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100				
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel			
Water Density (g/cm3):				*p(w)*	1.00				
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default	
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	304.8	3.0	m	10	ft
S(w) Beta for error function					0.089				
S(d) Beta for error function					0.303				
erf(S(w) Beta) value, Appendix C, Table G:					0.1007177				
erf(S(d) Beta) value, Appendix C, Table G:					0.3319959				
For Sgw calc's:									
Csoil (at source)	0.13	mg/kg							
Cgw (at source) = Csoil*LF(sw)	6.28E-03	mg/L							
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91				
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene			

Calculations		Sample	SM-GP-117	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.079E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	6.948E-02
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	6.436E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	7.197E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	201
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	67
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	10.1
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	2.918E-02

Assumptions:			
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06	
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33 lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70	
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0	
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160	
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5	
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20	
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.45E-06	
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0	
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene

Calculations		Sample	SM-GP-117	Chemical	Tetrachloroethylene				
Width of Source Area Parallel to Groundwater Flow (cm):				*W*	457	4.6	m	15	ft
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:				*U(air)*	225				
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:				*&(air)*	200				
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:				*H'*	7.38E-01	Tetrachloroethylene			
Averaging Time for Vapor Flux (s); Appendix C, Table D:				*tau*	9.46E+08				
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:				*P(e)*	6.90E-14				
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:				*D(air)*	7.20E-02	Tetrachloroethylene			
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:				*D(water)*	8.20E-06	Tetrachloroethylene			
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:				*d*	100	default			
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:				*L(s)*	100				
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:				*GW(comp)*	0.0050	Tier 1 Class I RO			
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)				*GW(comp)*	5.30E-04				
Concentration of contaminant in groundwater at source (mg/l):				C(*source*)	4.05E-01				
Distance along centerline of plume in direction of groundwater flow (cm):				*X*	2,011.6	20.1	m	66	ft
Aquifer hydraulic conductivity (cm/d):				*K*	15.43	56	m/yr	1.786E-04	cm/sec
Hydraulic gradient (cm/cm):				*i*	0.0240				
Aquifer Longitudinal Seepage Velocity (m/yr):				*V(x)*	6.76	22.18	ft/yr		
Longitudinal Dispersion of Solute in Aquifer (m2/yr):				*D(x)*	13.60				
Horizontal Dispersion of Solute in Aquifer (m2/yr):				*D(y)*	4.53				
Vertical Dispersion of Solute in Aquifer (m2/yr):				*D(z)*	0.68				
Infiltration Rate (cm/yr); Appendix C, Table D:				*I*	30				
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:				*&(gw)*	200				
First Order Degradation Constant (1/day); Appendix C, Table E:				*lambda*	0.00096	Tetrachloroethylene			
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):				*theta(ws)*	0.20000	gravel			
Total Soil Porosity [cm3/cm3(soil)]:				*theta(T)*	0.250	gravel			
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:				*K(oc)*	631	Tetrachloroethylene			
Org. Carbon Content of Soil (g/g); Appendix C, Table F:				*f(oc)*	0.0081				
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:				*w*	0.100				
Soil Bulk Density (g/cm3); Appendix C, Table F:				*p(s)*	2.00	gravel			
Water Density (g/cm3):				*p(w)*	1.00				
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):				*S(d)*	200.0	2.0	m	default	
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):				*S(w)*	457.2	4.6	m	15	ft
S(w) Beta for error function					0.311				
S(d) Beta for error function					0.703				
erf(S(w) Beta) value, Appendix C, Table G:					0.3401438				
erf(S(d) Beta) value, Appendix C, Table G:					0.6798951				
For Sgw calc's:									
Csoil (at source)	6.3	mg/kg							
Cgw (at source) = Csoil*LF(sw)	4.05E-01	mg/L							
Equation for Derivation of the Soil Saturation Limit [mg/kg]			Eq. S29	*Csat*	1045.91				
Solubility in Water [mg/L]				*S*	2.00E+02	Tetrachloroethylene			

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-GP-07 (GW)	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.405E+01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	6.789E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	4.833E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	7.365E-03
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	366
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	122
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	18.3
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	9.427E-04

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.69E-07			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-GP-07 (GW)	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	305	3.0	m	10	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.28E-01					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,657.4	36.6	m	120	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	24.72					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	8.24					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.24					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	304.8	3.0	m	10	ft	
S(w) Beta for error function				0.114					
S(d) Beta for error function				0.387					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.1282014					
erf(S(d) Beta) value, Appendix C, Table G:				0.4155068					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-GP-08 (GW)	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.409E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.400E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	9.939E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	3.571E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	320
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	107
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	16.0
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	3.893E-03

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	3.10E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-GP-08 (GW)	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	975	9.8	m	32	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.09E-01					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,200.2	32.0	m	105	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	21.63					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	7.21					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.08					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	975.3	9.8	m	32	ft	
S(w) Beta for error function				0.417					
S(d) Beta for error function				0.442					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.4449226					
erf(S(d) Beta) value, Appendix C, Table G:				0.4679977					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-GP-108	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.415E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.604E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	1.133E-01
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	3.118E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	360
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	120
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	18.0
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	2.463E-03

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	4.17E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-GP-108	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,311	13.1	m	43	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	7.90E-02					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,596.5	36.0	m	118	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	24.31					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	8.10					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.22					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,310.6	13.1	m	43	ft	
S(w) Beta for error function				0.499					
S(d) Beta for error function				0.393					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.5196071					
erf(S(d) Beta) value, Appendix C, Table G:				0.4218587					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-GP-117	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							2.989E-01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	3.215E-02
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	1.075E-01
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	1.555E-01
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	201
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	67
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	10.1
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.044E-03

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	3.68E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-GP-117	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,158	11.6	m	38	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	2.60E-02					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	2,011.6	20.1	m	66	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	13.60					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	4.53					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.68					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,158.2	11.6	m	38	ft	
S(w) Beta for error function				0.788					
S(d) Beta for error function				0.703					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.735128					
erf(S(d) Beta) value, Appendix C, Table G:				0.6798951					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-01	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							4.953E-02
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	5.503E-03
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	1.111E-01
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	9.086E-01
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	15
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	5
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	0.7
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.997E-03

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	3.97E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-01	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,250	12.5	m	41	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	5.50E-03					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	149.3	1.5	m	4.9	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	1.01					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	0.34					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.05					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,249.6	12.5	m	41	ft	
S(w) Beta for error function				11.457					
S(d) Beta for error function				9.469					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			1					
erf(S(d) Beta) value, Appendix C, Table G:				1					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-01	Chemical	Aluminum				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						6.648E-01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	3.863E+00	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	5.810E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.061E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	110	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	37	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	5.5	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*		Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						3.500E+00	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	5.056E+00	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*		Aluminum		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Aluminum		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#VALUE!			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	NA	Aluminum		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Aluminum		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-01	Chemical	Aluminum					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,250	12.5	m	41	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*		Aluminum				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	NA	Aluminum				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	NA	Aluminum				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	3.5000	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)			*GW(comp)*	#DIV/0!					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	5.58E+00					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,097.2	11.0	m	36	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	7.42					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	2.47					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.37					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Aluminum				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Aluminum				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,249.6	12.5	m	41	ft	
S(w) Beta for error function				1.559					
S(d) Beta for error function				1.289					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9725774					
erf(S(d) Beta) value, Appendix C, Table G:				0.9316629					
			pH						

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-01	Chemical	Iron				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						9.497E-01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	5.518E+00	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	5.810E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.061E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	110	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	37	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	5.5	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*		Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						5.000E+00	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	1.468E+01	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	NA	Iron		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Iron		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#DIV/0!			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	7.00E-01	Iron		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Iron		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-01	Chemical	Iron					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,250	12.5	m	41	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	0.00E+00	Iron				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	0.00E+00	Iron				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	0.00E+00	Iron				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	5.0000	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)			*GW(comp)*	#VALUE!					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.62E+01					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,097.2	11.0	m	36	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	7.42					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	2.47					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.37					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Iron				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Iron				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,249.6	12.5	m	41	ft	
S(w) Beta for error function				1.559					
S(d) Beta for error function				1.289					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9725774					
erf(S(d) Beta) value, Appendix C, Table G:				0.9316629					
			pH						

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-01	Chemical	Lead				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						1.012E+01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	8.277E-03	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	8.182E-04	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.061E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	110	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	37	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	5.5	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*	710.00	Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						7.500E-03	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	1.042E-02	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	NA	Lead		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Lead		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#DIV/0!			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	NA	Lead		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Lead		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-01	Chemical	Lead					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,250	12.5	m	41	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	0.00E+00	Lead				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	0.00E+00	Lead				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	0.00E+00	Lead				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0075	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)			*GW(comp)*	#VALUE!					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.15E-02					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,097.2	11.0	m	36	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	7.42					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	2.47					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.37					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Lead				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Lead				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,249.6	12.5	m	41	ft	
S(w) Beta for error function				1.559					
S(d) Beta for error function				1.289					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9725774					
erf(S(d) Beta) value, Appendix C, Table G:				0.9316629					
			pH						

RBCA Equations
groundwater ingestion route

Calculations		Sample	SM-MW-01	Chemical	Manganese				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						1.359E-01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	1.655E-01	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	1.218E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.061E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	110	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	37	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	5.5	
	Eq. R19	Specific Discharge (cm/d):					*U*	14.81	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*	0.00	Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	1,351.8	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						1.500E-01	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	3.597E-01	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for Industrial/Commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for Industrial/Commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	NA	Manganese	NA=not applicable	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for Industrial/Commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Manganese		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for Industrial/Commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#DIV/0!	not calculated		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for Industrial/Commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	2.00E-02	Manganese		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	1.43E-05	Manganese		

RBCA Equations
groundwater ingestion route

Calculations	Sample	SM-MW-01	Chemical	Manganese					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,250	12.5	m	41	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	0.00E+00	Manganese				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	0.00E+00	Manganese				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	0.00E+00	Manganese				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.1500	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)			*GW(comp)*	#VALUE!	not calculated				
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	3.97E-01					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,097.2	11.0	m	36	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	154.31	563	m/yr	1.786E-03	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	67.59	221.76	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	74.16					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	24.72					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	3.71					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Manganese		no value		
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Manganese		no value		
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,249.6	12.5	m	41	ft	
S(w) Beta for error function				1.559					
S(d) Beta for error function				1.289					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9725774					
erf(S(d) Beta) value, Appendix C, Table G:				0.9316629					
			pH				no value		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-02	Chemical	Bromodichloromethane				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						2.347E-02	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	2.408E-02	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	1.026E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	1.917E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	335	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	112	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	16.8	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
	Eq. R20	Soil-Water Sorption Coefficient:					*k(s)*	0.41	
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						4.616E-03	T2
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	1.074E-03	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.062	Bromodichloromethane		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Bromodichloromethane		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	2.97E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	2.00E-02	Bromodichloromethane		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Bromodichloromethane		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-02	Chemical	Bromodichloromethane					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	975	9.8	m	32	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	6.60E-02	Bromodichloromethane				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	5.61E-02	Bromodichloromethane				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	1.06E-05	Bromodichloromethane				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0002	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	4.62E-03					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	5.60E-03					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,352.6	33.5	m	110	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	22.66					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	7.55					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.13					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*		Bromodichloromethane			No Data for lambda	
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	50	Bromodichloromethane				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	975.3	9.8	m	32	ft	
S(w) Beta for error function				0.398					
S(d) Beta for error function				0.422					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.4267987					
erf(S(d) Beta) value, Appendix C, Table G:				0.4491891					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-02	Chemical	Bromoform				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						7.839E+00	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	4.855E+00	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	6.193E-01	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	7.462E-03	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	335	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	112	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	16.8	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
	Eq. R20	Soil-Water Sorption Coefficient:					*k(s)*	0.74	
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						3.622E-02	T2
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	3.582E-05	

Assumptions:				
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06		
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70		
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial	
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial	
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.0079	Bromoform	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial	
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0		
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160		
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5		
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group	
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.00385	Bromoform	
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20		
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial	
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	1.23E-06		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0		
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial	
Oral Reference Dose (mg/kg-d):	*RfD(o)*	2.00E-02	Bromoform	
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Bromoform	

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-02	Chemical	Bromoform				
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	975	9.8	m	32	ft
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225				
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200				
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	2.19E-02	Bromoform			
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08				
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14				
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	1.49E-02	Bromoform			
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	1.03E-05	Bromoform			
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default			
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100				
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0010	Tier 1 Class I RO			
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	3.62E-02				
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	4.80E-03				
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,352.6	33.5	m	110	ft
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec
Hydraulic gradient (cm/cm):			*i*	0.0240				
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr		
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	22.66				
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	7.55				
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.13				
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30				
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200				
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00190	Bromoform			
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel			
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel			
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	91.2	Bromoform			
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081				
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100				
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel			
Water Density (g/cm3):			*p(w)*	1.00				
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default	
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	975.3	9.8	m	32	ft
S(w) Beta for error function				0.398				
S(d) Beta for error function				0.422				
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.4267987				
erf(S(d) Beta) value, Appendix C, Table G:				0.4491891				

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-02	Chemical	Chloroform				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						1.066E-01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	1.089E-01	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	1.022E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	8.477E-02	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	335	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	112	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	16.8	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
	Eq. R20	Soil-Water Sorption Coefficient:					*k(s)*	0.41	
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						9.232E-03	T2
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	2.713E-04	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.031	Chloroform		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.0805	Chloroform		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	4.58E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Chloroform		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	2.80E-02	Chloroform		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-02	Chemical	Chloroform					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	975	9.8	m	32	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	1.50E-01	Chloroform				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	1.04E-01	Chloroform				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	1.00E-05	Chloroform				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0002	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	9.23E-03					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	3.20E-03					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,352.6	33.5	m	110	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	22.66					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	7.55					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.13					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00039	Chloroform				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	50	Chloroform				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	975.3	9.8	m	32	ft	
S(w) Beta for error function				0.398					
S(d) Beta for error function				0.422					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.4267987					
erf(S(d) Beta) value, Appendix C, Table G:				0.4491891					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-02	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.645E+00
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	1.635E-01
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	9.939E-02
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	3.058E-02
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	335
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	112
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	16.8
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	4.587E-04

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	3.10E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-02	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	975	9.8	m	32	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.50E-02					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	3,352.6	33.5	m	110	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	22.66					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	7.55					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	1.13					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	975.3	9.8	m	32	ft	
S(w) Beta for error function				0.398					
S(d) Beta for error function				0.422					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.4267987					
erf(S(d) Beta) value, Appendix C, Table G:				0.4491891					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-03	Chemical	Bromodichloromethane				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						4.756E-03	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	6.543E-03	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	1.376E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	7.054E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	183	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	61	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	9.1	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
	Eq. R20	Soil-Water Sorption Coefficient:					*k(s)*	0.41	
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						4.616E-03	T2
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	2.822E-03	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.062	Bromodichloromethane		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Bromodichloromethane		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	6.30E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	2.00E-02	Bromodichloromethane		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Bromodichloromethane		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-03	Chemical	Bromodichloromethane					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	2,073	20.7	m	68	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	6.60E-02	Bromodichloromethane				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	5.61E-02	Bromodichloromethane				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	1.06E-05	Bromodichloromethane				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0002	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	4.62E-03					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	4.00E-03					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,828.7	18.3	m	60	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	12.36					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	4.12					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.62					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*		Bromodichloromethane			No Data for lambda	
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	50	Bromodichloromethane				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	2,072.5	20.7	m	68	ft	
S(w) Beta for error function				1.552					
S(d) Beta for error function				0.773					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9718142					
erf(S(d) Beta) value, Appendix C, Table G:				0.7258988					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-03	Chemical	Chloroform				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						1.514E-02	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	2.073E-02	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	1.370E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	4.452E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	183	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	61	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	9.1	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
	Eq. R20	Soil-Water Sorption Coefficient:					*k(s)*	0.41	
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						9.232E-03	T2
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	1.425E-03	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.031	Chloroform		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.0805	Chloroform		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	9.74E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Chloroform		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	2.80E-02	Chloroform		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-03	Chemical	Chloroform					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	2,073	20.7	m	68	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	1.50E-01	Chloroform				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	1.04E-01	Chloroform				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	1.00E-05	Chloroform				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0002	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	9.23E-03					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	3.20E-03					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,828.7	18.3	m	60	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	12.36					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	4.12					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.62					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00039	Chloroform				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	50	Chloroform				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	2,072.5	20.7	m	68	ft	
S(w) Beta for error function				1.552					
S(d) Beta for error function				0.773					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9718142					
erf(S(d) Beta) value, Appendix C, Table G:				0.7258988					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-03	Chemical	Tetrachloroethylene				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):							1.551E-01
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):						*GW(source)*	2.067E-02
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):						*LF(sw)*	1.333E-01
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:						*C(x)/C(source)*	2.419E-01
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):						*alpha(x)*	183
	Eq. R17	Transverse Dispersivity (cm):						*alpha(y)*	61
	Eq. R18	Vertical Dispersivity (cm):						*alpha(z)*	9.1
	Eq. R19	Specific Discharge (cm/d):						*U*	1.48
	Eq. R20	Soil-Water Sorption Coefficient:						*k(s)*	5.11
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):						*theta(as)*	0.050
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):						*theta(ws)*	0.200
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):						*theta(T)*	0.250
	Eq. R24	Groundwater Darcy Velocity (cm/yr):						*U(gw)*	135.2
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):							5.000E-03
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):						*C(x)*	1.282E-02

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	0.54	Tetrachloroethylene		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0.5	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	0.02065	Tetrachloroethylene		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	6.59E-06			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	1.00E-02	Tetrachloroethylene		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	7.71E-02	Tetrachloroethylene		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-03	Chemical	Tetrachloroethylene					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	2,073	20.7	m	68	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	7.38E-01	Tetrachloroethylene				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	7.20E-02	Tetrachloroethylene				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	8.20E-06	Tetrachloroethylene				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0050	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	5.30E-04					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	5.30E-02					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	1,828.7	18.3	m	60	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	12.36					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	4.12					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.62					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00096	Tetrachloroethylene				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	631	Tetrachloroethylene				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	2,072.5	20.7	m	68	ft	
S(w) Beta for error function				1.552					
S(d) Beta for error function				0.773					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9718142					
erf(S(d) Beta) value, Appendix C, Table G:				0.7258988					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-04	Chemical	Aluminum				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						5.430E-01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	3.554E+00	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	6.545E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.849E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	82	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	27	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	4.1	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*		Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						3.500E+00	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	6.638E+00	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*		Aluminum		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Aluminum		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#VALUE!			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	NA	Aluminum		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Aluminum		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-04	Chemical	Aluminum					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,707	17.1	m	56	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*		Aluminum				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	NA	Aluminum				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	NA	Aluminum				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	3.5000	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)			*GW(comp)*	#DIV/0!					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	6.74E+00					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	822.9	8.2	m	27	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	5.56					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	1.85					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.28					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Aluminum				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Aluminum				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,706.8	17.1	m	56	ft	
S(w) Beta for error function				2.840					
S(d) Beta for error function				1.719					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9999409					
erf(S(d) Beta) value, Appendix C, Table G:				0.9849166					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-04	Chemical	Iron				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						7.757E-01	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	5.077E+00	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	6.545E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.849E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	82	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	27	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	4.1	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*		Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						5.000E+00	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	1.783E+01	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	NA	Iron		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Iron		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#DIV/0!			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	7.00E-01	Iron		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Iron		

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations	Sample	SM-MW-04	Chemical	Iron					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,707	17.1	m	56	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	0.00E+00	Iron				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	0.00E+00	Iron				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	0.00E+00	Iron				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	5.0000	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	#VALUE!					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.81E+01					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	822.9	8.2	m	27	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	5.56					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	1.85					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.28					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Iron				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Iron				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,706.8	17.1	m	56	ft	
S(w) Beta for error function				2.840					
S(d) Beta for error function				1.719					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9999409					
erf(S(d) Beta) value, Appendix C, Table G:				0.9849166					

RBCA Equations
Industrial-Commercial -groundwater ingestion route

Calculations		Sample	SM-MW-04	Chemical	Lead				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						8.263E+00	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	7.615E-03	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	9.216E-04	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.849E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	82	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	27	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	4.1	
	Eq. R19	Specific Discharge (cm/d):					*U*	1.48	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*	710.00	Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	135.2	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						7.500E-03	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	9.947E-03	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendic C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for industrial/commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for industrial/commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	NA	Lead		
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for industrial/commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Lead		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for industrial/commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#DIV/0!			
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for industrial/commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	NA	Lead		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	NA	Lead		

Calculations	Sample	SM-MW-04	Chemical	Lead					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,707	17.1	m	56	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	0.00E+00	Lead				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	0.00E+00	Lead				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	0.00E+00	Lead				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.0075	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**:		(Carcinogenic)	*GW(comp)*	#VALUE!					
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	1.01E-02					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	822.9	8.2	m	27	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	15.43	56	m/yr	1.786E-04	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	6.76	22.18	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	5.56					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	1.85					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	0.28					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Lead				
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Lead				
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,706.8	17.1	m	56	ft	
S(w) Beta for error function				2.840					
S(d) Beta for error function				1.719					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9999409					
erf(S(d) Beta) value, Appendix C, Table G:				0.9849166					
			pH						

RBCA Equations
groundwater ingestion route

Calculations		Sample	SM-MW-04	Chemical	Manganese				
Equations for the migration	**Eq. R12**	Remediation Objective (mg/kg):						9.565E-02	
to Groundwater Portion	**Eq. R13**	Groundwater at the Source (mg/l):					*GW(source)*	1.523E-01	
of the Groundwater	**Eq. R14**	Leaching Factor (mg/l(water))/mg/kg(soil)):					*LF(sw)*	1.592E+00	
Ingestion Exposure	**Eq. R15**	Steady-State Attenuation along Centerline of Dissolved Plume:					*C(x)/C(source)*	9.849E-01	
Route.	**Eq. R16**	Longitudinal Dispersivity (cm):					*alpha(x)*	82	
	Eq. R17	Transverse Dispersivity (cm):					*alpha(y)*	27	
	Eq. R18	Vertical Dispersivity (cm):					*alpha(z)*	4.1	
	Eq. R19	Specific Discharge (cm/d):					*U*	14.81	
See App C, Table J		Soil-Water Sorption Coefficient:					*k(s)*	0.00	Kd for inorganic
	Eq. R21	Volumetric Air Content in Vadose Zone Soils (cm3(air))/cm3(soil)):					*theta(as)*	0.050	
	Eq. R22	Volumetric Water Content in Vadose Zone Soils (cm3(water))/cm3(soil)):					*theta(ws)*	0.200	
	Eq. R23	Total Soil Porosity (cm3/cm3(soil)):					*theta(T)*	0.250	
	Eq. R24	Groundwater Darcy Velocity (cm/yr):					*U(gw)*	1,351.8	
Equations for the Groundwater		Remediation Objective for Contaminants (mg/l):						1.500E-01	
Ingestion Exposure Route.	**Eq. R26**	Dissolved hydrocarbon concentration along centerline (mg/l):					*C(x)*	3.802E-01	

Assumptions:					
Target Cancer Risk; Appendix C, Table D:	*TR*	1.00E-06			
Adult Body Weight (kg); Appendix C, Table D:	*BW*	70.00	154.33	lbs	
Averaging Time for Carcinogens (yr); Appendix C, Table D:	*AT(c)*	70			
Exposure Frequency (d/yr), Appendix C, Table D:	*EF*	250	for Industrial/Commercial		
Exposure Duration (yr); Appendix C, Table D:	*ED*	25	for Industrial/Commercial		
Oral Slope Factor [1/(mg/kg-d)]:	*SF(o)*	NA	Manganese	NA=not applicable	
Soil Ingestion Rate (mg/d); Appendic C; Table D:	*IR(soil)*	50	for Industrial/Commercial		
Oral Relative Absorption Factor; Appendix C; Table D	*RAF(o)*	1.0			
Skin Surface Area (cm2/d); Appendix C, Table D:	*SA*	3,160			
Soil to Skin Adherance Factor (mg/cm2); Appendix C, Table D:	*M*	0.5			
Dermal Relative Absorption Factor; Appendix C, Table D:	*RAF(d)*	0	based on chemical group		
Inhalation Cancer Slope Factor [1/(mg/kg-d)]:	*SF(i)*	NA	Manganese		
Daily Outdoor Inhalation Rate (m3/day); Appendix C, Table D:	*IR(air)*	20			
Daily Water Ingestion Rate (L/day); Appendix C, Table D:	*IR(w)*	1	for Industrial/Commercial		
Vol. Factor for Surficial Soils (kg/m3); use lesser value of R03 or R04:	*VF(ss)*	#DIV/0!	not calculated		
Target Hazard Quotient; Appendix C; Table D:	*THQ*	1.0			
Averaging Time for Noncarcinogens (yr); Appendix C, Table D:	*AT(n)*	25	for Industrial/Commercial		
Oral Reference Dose (mg/kg-d):	*RfD(o)*	2.00E-02	Manganese		
Inhalation Reference Dose (mg/kg-d):	*RfD(i)*	1.43E-05	Manganese		

RBCA Equations
groundwater ingestion route

Calculations	Sample	SM-MW-04	Chemical	Manganese					
Width of Source Area Parallel to Groundwater Flow (cm):			*W*	1,707	17.1	m	56	ft	
Average Wind Speed Above Ground Surface (cm/s); Appendix C, Table D:			*U(air)*	225					
Ambient Air Mixing Zone Height (cm); Appendix C, Table D:			*&(air)*	200					
Henry's Law Constant [cm3(water)/cm3(air)]; Appendix C, Table E:			*H'*	0.00E+00	Manganese				
Averaging Time for Vapor Flux (s); Appendix C, Table D:			*tau*	9.46E+08					
Particlulate Emission Rate (g/cm2-s); Appendic C; Table D:			*P(e)*	6.90E-14					
Diffusion Coeficient in Air (cm2/s); Appendix C; Table E:			*D(air)*	0.00E+00	Manganese				
Diffusion Coeficient in Water (cm2/s); Appendix C; Table E:			*D(water)*	0.00E+00	Manganese				
Lower Depth of Surficial Soil Zone (cm); Appendix C, Table D:			*d*	100	default				
Depth to Subsurface Soil Sources (cm); Appendix C, Table D:			*L(s)*	100					
Groundwater Obj. at the Compliance Point (mg/l); Appendix B, Table E:			*GW(comp)*	0.1500	Tier 1 Class I RO				
Groundwater Obj. at the Compliance Point (mg/l); **Eq. R25**: (Carcinogenic)			*GW(comp)*	#VALUE!	not calculated				
Concentration of contaminant in groundwater at source (mg/l):			C(*source*)	3.86E-01					
Distance along centerline of plume in direction of groundwater flow (cm):			*X*	822.9	8.2	m	27	ft	
Aquifer hydraulic conductivity (cm/d):			*K*	154.31	563	m/yr	1.786E-03	cm/sec	
Hydraulic gradient (cm/cm):			*i*	0.0240					
Aquifer Longitudinal Seepage Velocity (m/yr):			*V(x)*	67.59	221.76	ft/yr			
Longitudinal Dispersion of Solute in Aquifer (m2/yr):			*D(x)*	55.62					
Horizontal Dispersion of Solute in Aquifer (m2/yr):			*D(y)*	18.54					
Vertical Dispersion of Solute in Aquifer (m2/yr):			*D(z)*	2.78					
Infiltration Rate (cm/yr); Appendix C, Table D:			*I*	30					
Groundwater Mixing Zone Thickness (cm); Appendix C, Table D:			*&(gw)*	200					
First Order Degradation Constant (1/day); Appendix C, Table E:			*lambda*	0.00000	Manganese		no value		
Volumetric Water Content in Vadose Zone Soils (cm3(water)/cm3(soil)):			*theta(ws)*	0.20000	gravel				
Total Soil Porosity [cm3/cm3(soil)]:			*theta(T)*	0.250	gravel				
Org. Carbon Partition Coef. (cm3/g or L/kg); Appendix C, Tables E or I:			*K(oc)*	0	Manganese		no value		
Org. Carbon Content of Soil (g/g); Appendix C, Table F:			*f(oc)*	0.0081					
Average Soil Moisture Content (g(water)/g(soil)); Appendix C, Table F:			*w*	0.100					
Soil Bulk Density (g/cm3); Appendix C, Table F:			*p(s)*	2.00	gravel				
Water Density (g/cm3):			*p(w)*	1.00					
Source Width Perpendicular to Groundwater Flow in Vertical Plane (cm):			*S(d)*	200.0	2.0	m	default		
Source Width Perpendicular to Groundwater Flow in Horizontal Plane (cm):			*S(w)*	1,706.8	17.1	m	56	ft	
S(w) Beta for error function				2.840					
S(d) Beta for error function				1.719					
erf(S(w) Beta) value, Appendix C, Table G:	Function of Sw and X			0.9999409					
erf(S(d) Beta) value, Appendix C, Table G:				0.9849166					
			pH				no value		

APPENDIX E

EXAMPLE GEOMEMBRANE SPECIFICATIONS

LAYFIELD
Product Cut Sheet

High Density Polyethylene (HDPE)

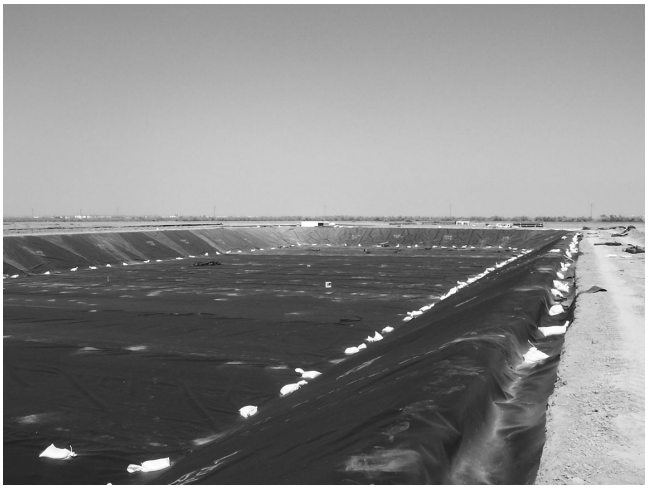
1. Product Description
The popularity of High Density Polyethylene (HDPE) is primarily due to its low initial material cost and excellent chemical reistance. This allows thicker sections to be used compared to other geomembrane materials. A thick, durable, HDPE liner can be placed in exposed applications where the cost of other materials would be prohibitive. HDPE has excellent chemical resistance which is often the driving force behind the selection of HDPE. HDPE is a field assembled lining material that cannot be practically fabricated in the shop. All HDPE projects, regardless of size, must be installed by trained installers.
HDPE is a versatile material which is used widely across all applications. One of the main uses of HDPE is for landfill base liners where its chemical resistance is used to good effect. HDPE can also be used in a multitude of secondary containments, pond linings, and water containment projects. HDPE is best used as an exposed lining material, and has the UV resistance required for many years of outstanding service.

2. Technical Data
Materials information is on page 2.

3. Installation
HDPE is a field fabricated material hence welding and testing need to be completed with great care. Field welding of HDPE is done with hot wedge welders as they are fast and produce excellent welds in sheets from 1.0 mm to 2.5 mm (40 to 100 mil). Hot wedge welders produce two weld tracks separated by a small unbonded channel. By sealing off both ends of this channel, and then pumping it full of air, entire seams can be checked quickly and effectively.

Weather is a major factor in all HDPE lining installations. Precipitation in any form, whether rain, snow, dew, or fog can bring HDPE installation to a halt. Cold weather can slow down an installation, however HDPE has been installed in temperatures as low as -30°C (-20°F). The presence of moisture in the form of frost, snow, and ice are bigger problems than outside air temperatures.

4. Availability and Cost
Available from Layfield or distributors. Call
425-254-1075 Pacific time
780-453-6731 Mountain time, or
905-761-9123 Eastern time



5. Manufactured For
Layfield Environmental Systems Corp.
Layfield Geosynthetics & Ind. Fabrics Ltd.

6. Warranty
Products sold will meet Layfield's published specifications. Any extended warranty required by the buyer must be negotiated at the time of order. Extended warranties may be available on this product and may be at extra cost. Full warranty details are available from Layfield.

7. Maintenance
Geomembranes should be inspected at least once per year for damage, stress, or any other detrimental condition. The entire containment area should be visually inspected annually. Layfield provides geomembrane maintenance services on request.

8. Designed and Installed By
Layfield Environmental Systems Ltd
Layfield Environmental Systems Corp

9. Filing Systems
www.LayfieldGroup.com
www.geomembranes.com

10. HDPE Material Properties

18 Oct 2010	HDPE Minimum Material Properties					
Style	**ASTM**	**HDPE 40 Smooth**	**HDPE 60 Smooth**	**HDPE 80 Smooth**	**HDPE 60 Textured**	**HDPE 80 Textured**
Nominal Thickness	D5199	40 mil 1.0 mm	60 mil 1.5 mm	80 mil 2.0 mm	57 mil 1.45 mm	76 mil 1.90 mm
Density (Untextured)	D792	0.94	0.94	0.94	0.94	0.94
Tensile Strength Modified Type IV Die	D638 Stress at Yield	84 ppi 15 kN/m	126 ppi 22 kN/m	168 ppi 29 kN/m	126 ppi 22 kN/m	168 ppi 29 kN/m
	Stress @ Break	152 ppi 27 kN/m	228 ppi 40 kN/m	304 ppi 53 kN/m	90 ppi 16 kN/m	120 ppi 21 kN/m
	Strain @ Yield 33 mm Guage	12%	12%	12%	12%	12%
	Strain @ Break 50 mm Guage	700%	700%	700%	100%	100%
Tear Resistance	D1004	28 lbs 125 N	42 lbs 187 N	56 lbs 249 N	42 lbs 187 N	56 lbs 249 N
Dimensional Stability	D1204 (Max)	± 2%	± 2%	± 2%	± 2%	± 2%
Stress Cracking	D5397	300 Hours	300 Hours	300 Hours	300 Hours	300 Hours
Puncture Resistance	D4833	72 lbs 320 N	108 lbs 480 N	144 lbs 640 N	90 lbs 400 N	120 lbs 534 N
Black Content	D1603	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%
Black Dispersion	D5596	CAT 1 or 2	CAT 1 or 2	CAT 1 or 2	CAT 1 or 2	CAT 1 or 2

11. Field Seam Strengths

18 Oct 2010	HDPE Minimum Field Seam Strengths					
Style	**ASTM**	**HDPE 40 Smooth**	**HDPE 60 Smooth**	**HDPE 80 Smooth**	**HDPE 60 Textured**	**HDPE 80 Textured**
Bonded Seam Strength Test Temp 23°C, 73°F	D6392	80 ppi 14 N/mm	120 ppi 21 N/mm	160 ppi 28 N/mm	120 ppi 21 N/mm	160 ppi 28 N/mm
Peel Adhesion Test Test Temp 23°C, 73°F	D6392	FTB 52 ppi 9 N/mm	FTB 78 ppi 14 N/mm	FTB 104 ppi 18 N/mm	FTB 78 ppi 14 N/mm	FTB 104 ppi 18 N/mm

Subgrade Preparation

The integrity of a lining system depends largely on the condition of the prepared subgrade.

Earthworks can be used to support, cover, protect, drain and separate components of a geosynthetic lining system. One of the most critical earthworks for lining systems is the prepared subgrade, since it forms the founding surface for the lining system. The short and long term integrity of the lining system depends on the condition of the prepared subgrade. This Tech Note discusses some key items to consider when evaluating the acceptability of a prepared subgrade.

Most soil materials can be used in a prepared subgrade. Both locally available fill materials as well as imported processed materials can be used. Fine grained, non-cohesive soils, such as sand or silty sand and most cohesive soils, such as clayey-silt glacial till, can be used as subgrade construction materials.

The prepared surface should be uniform, well compacted, and free of sharp rock fragments or stones, large stones and other deleterious matter such as tree roots, construction debris and metallic objects. The surface should not have any natural or foreign object that protrudes above the surface of the subgrade.

In a number of instances, the locally available source of fill is limited to coarse grained, non-cohesive soil such as pit run gravel. In addition, sometimes the area to be lined lies within a coarse grained deposit. Although these materials can be graded and compacted to a uniform and level subgrade surface, this surface should receive further treatment by the application of a finer material, such as sand, to form a cushion or bedding for the lining system. The bedding material should be a minimum of 150 mm (6") thick and should be compacted. This bedding thickness may have to be increased depending on local site conditions. Where bedding sand is not available, a non-woven geotextile may be used as an alternative.

Fine grained, cohesive clay soils can also be used as a subgrade construction material. Native clayey-silt or silty-clay glacial tills are often found in lining subgrades. These materials can be worked, graded, compacted and trimmed to create a smooth, level and competent surface, however, all angular and sharp rocks or stones should be removed from the surface or picked out of the prepared subgrade. Smooth, rounded stones less than 50 mm (2") may remain within the prepared subgrade, however, these should be driven into the clay subgrade by applying a compactive effort so that these do not protrude above the finished surface. The general rule of thumb is that all stones and rocks, regardless of shape and size, and clay lumps that lie above the subgrade surface should be removed.

The prepared subgrade should be compacted in accordance with design specifications and standard engineering practice. Generally this means that the subgrade should be compacted to a minimum 95% of maximum dry density according to the standard Proctor test (ASTM D698). The design of a prepared subgrade should carefully consider load bearing requirements, the amount of subgrade deformation expected, and whether or not local differential settlement may occur. Deformation of a subgrade beneath a lining system can result in excessive stresses in the liner material which, in turn, may cause the lining system to fail and leak. As a minimum, the subgrade should be firm and unyielding, and should be compacted to a level that permits the movement of construction equipment, liner deployment equipment, and other related traffic without causing rutting and/or deformation of the surface.

Compaction is especially important around pipe penetrations and concrete appurtenances. Often the piping is added after the earthworks are completed and compaction around the piping is done by a

different method than that of the overall earthworks. The use of different compaction techniques can lead to differential settlement at the pipe penetration which can cause lining system failure.

Final grading and the finished condition of the prepared subgrade is another important issue. The surface should be levelled and prepared to a uniform finish free of abrupt or sharp changes in grade. The surface should not include pockets or voids of any kind and should not be rutted or contain soil windrows along the surface. In addition, the surface should be free of frost lumps and ice. The use of a cushion of bedding sand or a geotextile cushion should be considered if other methods are not feasible. The prepared subgrade should also be shaped and graded to facilitate surface drainage both prior to, and during the installation of the lining system.

Care must be taken to maintain the prepared subgrade following completion. Vehicular traffic on the completed subgrade should be limited. Marks or ruts left in the subgrade by vehicular traffic should be repaired as soon as possible. The subgrade should be protected from desiccation, flooding and freezing. Standing water should be removed so that the earthwork does not become saturated (or frozen in cold weather). A frozen subgrade, which is not unsuitable in itself, can be covered with a bedding layer if the removal of small frost lumps is not practical. Again a geotextile cushion layer could be used to correct an imperfect surface.

On projects that involve the Layfield Construction Group, the subgrade will be inspected upon arrival at site. Our project supervisors will inspect the condition of the subgrade and will issue a "Certificate of Acceptance of Soil Subgrade Surface" if suitable. Corrective actions and activities to maintain the subgrade in a suitable condition for lining (including dewatering) are the responsibility of the owner or the general contractor.

In some locations a clay subgrade can be prepared and combined with a synthetic liner to create a composite lining system. When a low permeability subgrade is placed in intimate contact with a geomembrane, then the combination of these two components form a composite lining system. Composite liners are not double liners. The purpose of a composite liner is to combine the advantages of two materials, such as a geosynthetic liner and compacted clay soil, so that they compliment each other. Composite liners are more effective in reducing the rate of leakage than either a geosynthetic or a soil liner alone.

Backfilling Geomembranes

Backfill protects liners from environmental and mechanical damage. Backfill can also help to improve the impermeability of the liner system.

Almost all liner materials can benefit from using a backfill cover. Properly designed backfill systems can extend the life of a geomembrane liner to the maximum extent possible. Some backfilled PVC liners have been in service for over 40 years. This Tech Note will discuss some of the items to consider when selecting and placing backfill.

Backfill can often be selected from locally available fill materials. Processed or natural non-cohesive soils, such as a gravelly sand, screened sand, and pea gravel and well graded cohesive soils, such as clayey-silt or silty-clay are examples of suitable backfill materials. These fill materials can have some larger stones as long as no crushed or shattered rock fragments are present.

The "rule of thumb" for included stones (round) is that the largest stone or maximum size of any of the gravel inclusions should not be greater than 25 mm (1"). In addition, all gravel inclusions that are angular or have sharp or chiselled edges should be removed from the backfill either at the source or during placement.

The second "rule of thumb" regarding backfilling over a liner is that the soil material(s) used should be able to be compacted or consolidated with light to medium duty smooth drum or vibratory plate compaction equipment and should not require extensive reworking, conditioning, and kneading. Materials that contain lumps, clods, or cemented inclusions that require additional compactive effort to break them down are likely not suitable. Clean or screened sand is the ideal backfill material, however local availability of fill materials, and slope stability requirements will dictate what fill material is to be used.

Cohesive backfill materials, such as clay, that are placed directly over the liner can actually improve the performance of the liner system. Studies have shown that when clay is in intimate contact with the liner, the individual performance characteristics of both layers are additive. This means that, from a permeability perspective, the combined system performs better than the sum of the individual elements, therefore, leakage rates through minor defects in either the liner or the clay backfill are dramatically reduced when compared to each as a stand alone system.

In certain instances, locally available backfill material will contain significant amounts of oversize gravel and/or sharp, angular gravel. Even though these backfill materials can be easily worked and compacted to form a uniform, level backfill surface, the sharp stones and oversized gravel may damage the liner without the earthwork contractor’s knowledge. In cases such as these, it may be necessary to protect the liner with a cushion layer of sand. This cushion backfill layer should be in the order of 50 mm to 150 mm (2" to 6") thick, depending on the specifics of the installation, and should be compacted. In locations where sand is not available, a medium to heavy weight geotextile may be used as an alternative.

A final note on the selection of fill materials. Large clay lumps, roots (organics), and frozen lumps of fill are to be avoided. The fill must be "free-flowing" and placement methods that push fill onto the liner must be able to "roll" the fill ahead. This becomes very difficult in winter conditions where frozen fill and/or freezing conditions might be encountered. Watch carefully that the fill being placed does not "slip" or shear along the top of the liner. If this type of slippage or shearing occurs, check for damage under the backfill. Ensure that the fill rolls onto the liner so that shear forces are not transmitted to the liner.

In the attached table are minimum lift thicknesses for the initial lift of backfill. These minimum thicknesses are given as guidelines. Conditions may vary from site to site and the engineer in charge of the project may authorize different minimums from the numbers given here. Sound engineering practice must be exercised and appropriate equipment and methods must be selected if thinner initial lift thicknesses are to be considered.

Placement of backfill is usually dependant on the equipment used to place the fill rather than the liner material. HDPE is a special case and requires a minimum of 450 mm (18") of backfill due to the height of its slack wrinkles which can reach 150 to 200 mm (6 to 8") high. Each type of equipment has a specific ground pressure and weight that requires a different minimum thickness of backfill for liner protection. The initial lift thickness must be of a minimum to protect the liner from the equipment used. If backfill compaction is required, smaller equipment may be required to place the initial lift. Larger equipment can then be used for the second, and subsequent lifts. The usual method for placing thin backfill is to build a road through the pond of at least 600 mm (24") thickness (depending on the type of backfill material and equipment used, a road up to 1200mm (48"), may be required). Loaded trucks may use this road to deliver the backfill to the correct area. A wide pad Cat (bulldozer), or other small piece of equipment, then operates perpendicular to this road and pushes the backfill off the road to create a thin lift throughout the pond. The Cat operator needs to exercise caution at all times and must ensure that the fill rolls off the bottom of the blade and does not introduce a shearing force along the surface of the liner.

Minimum Lift Thickness	
Backfill Thickness	**Placement Equipment**
No Backfill	Foot Traffic or a 4 Track ATV vehicle only
150 mm (6") or less	Hand Placement
200-300 mm (8"-12")	D3-D4 LGP Cat
300 mm (12")	Bobcat (Skid-Steer)
300 mm (12")	D4-D6 Style Cat
600 mm (24")	D7-D9 Style Cat
900 mm (36")	Loaded Scrapers, Motor Graders
900-1200 mm (36"-48")<	Loaded Tandem Axle Trucks

Care should be taken during all aspects of backfill placement. A spotter should be in position beside the Cat to monitor the placement and thickness of the backfill on the liner. This spotter can usually identify any problems during placement that the Cat operator may not see. During backfill operations there are a few things to look out for. First, skid-steer equipment, such as a Bobcat, must not make any sharp skid turns on top of the liner or on top of a thin lift of backfill. Sharp turns with one tread (set of wheels) locked can damage the liner. Skid-steer equipment must make long sweeping turns at all times.

Care must be taken to maintain the appropriate thickness of fill beneath a vehicle. Vehicles should not travel on the unprotected liner at any time (4-track ATV’s may be excepted). The ground pressure or tire pressure of the vehicle can be used as a guide to minimum backfill thickness. Wheeled vehicles with tire pressures around 200 kPa (30 psi, such as Bobcats and pickup trucks) can operate on a minimum thickness of about 300mm (12"), however all trucks with tire pressures of 500 kPa (80 psi) or higher should have at least 900 mm (36") of fill beneath their wheels.

Place fill from the bottom to the top of slopes. Standing water should be removed prior to placement of the backfill. Backfill depth can be checked by carefully hand-excavating small test pits as required. Special grade stakes can be manufactured that rest on top of the liner. These stakes, usually an upside down wooden "tee", must be removed prior to backfill. Do not cover grade stakes with backfill. A more effective method of grade control involves the use of laser level survey equipment that eliminates the need for survey stakes. All measurements of grade are to be referenced to the actual liner elevation within the containment area.

The most significant problem when backfilling in cold weather is frozen fill. It may be necessary to heat your backfill stockpile or make provision for heating and hoarding at the backfill location. Layfield can supply large covers suitable for applying heat to a fill stockpile or for hoarding if required. Ice lumps in the backfill can also cause damage. Frost, or a dusting of snow on the liner does not always have to be removed, however, it becomes much more difficult to roll the backfill into place without sliding in these circumstances. Accumulations of snow and ice on the liner should be carefully removed prior to backfilling. Some lining materials, such as regular PVC have installation temperature limitations. Please see the Layfield's Plastics Tech Note on Cold Temperature Installations for further information.

Prepared by

INTERNATIONAL ASSOCIATION OF GEOSYNTHETIC INSTALLERS

HDPE AND LLDPE GEOMEMBRANE INSTALLATION SPECIFICATION

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The information herein has been composed by IAGI in accordance with current quality control and quality assurance standards of the geomembrane industry. Final determination of the suitability of any information or material for the use contemplated and its manner of use is the sole responsibility of the user.

PART 1 - GENERAL

1.01 Summary

A. This specification includes furnishing and installing HDPE and LLDPE geomembranes with a formulated sheet density of 0.940 g/cc or greater associated with HDPE geomembranes and a formulated sheet density of 0.939 or less for LLDPE geomembranes. Geomembranes with both smooth and textured surfaces are included.

1.02 References

A. American Society for Testing and Materials (ASTM):

1. D 638, Standard Test Method for Tensile Properties of Plastics.
2. D 751, Standard Test Methods for Coated Fabrics.
3. D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
4. D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
5. D 1204, Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.
6. D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
7. D 1505, Standard Test Method for Density of Plastics by Density-Gradient Technique.

8. D 1603, Standard Test Method for Carbon Black in Olefin Plastics.

9. D 3895, Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.

10. D 4218, Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

11. D 4437, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

12. D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

13. D 5199, Standard Test Method for Measuring Nominal Thickness of Smooth Geomembranes.

14. D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.

15. D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.

16. D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

17. D 5721, Practice for Air-Oven Aging of Polyolefin Geomembranes.

18. D 5820, Test Method for Air Testing.

19. D 5885, Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

20. D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembranes

21. D 6365, Standard Practice for the Nondestructive Testing of Geomembrane Seams using The Spark Test

22. D5820-95, Pressurized Air Channel Test for Dual Seamed Geomembranes

B. Geosynthetic Research Institute (GRI):

1. GRI GM 9, Cold Weather Seaming of Geomembranes

2. GRI GM 10, The Stress Crack Resistance of HDPE Geomembrane Sheet

3. GRI GM 13, Test Properties, Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

4. GRI GM 14, Test Frequencies for Destructive Seam Testing Selecting, variable intervals for taking geomembrane destructive samples using the method of attributes.

5. GRI GM 12, Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage

6. GRI GM 17, Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

7. GRI GM 19, Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

1.03 Submittals

A. Submit under provisions of Section 01300, Submittals.

B. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:

1. Documentation of manufacturer's qualifications as specified in subsection 1.04A of this Section.

2. Manufacturer's Quality Control program manual or descriptive documentation.

3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.

4. Sample of the material.

5. Documentation of Installer's qualifications, as specified below and in subsection 1.04B of this Section.

a. Submit a list of at least ten completed facilities. For each installation, provide: name and type of facility; its location; the date of installation; name and telephone number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.

b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.

c. Quality Control Program.

6. Example Material Warranty and Liner Installation Warranty

C. Shop Drawings

1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and details. Seams should generally follow the direction of the slope. Butt seams or roll-end seams should not occur on a slope unless approved by the Owner's Representative. Butt seams on a slope, if allowed, should be staggered.

2. Placement of geomembrane should not be allowed to proceed until Owner's Representative has received and approved the shop drawings.

D. Additional Submittals (In-Progress and at Completion)

1. Manufacturer's warranty (refer to subsection 1.07).
2. Geomembrane installation warranty (refer to subsection 1.08).
3. Daily written acceptance of subgrade surface (refer to subsection 3.01.C).
4. Low-temperature seaming procedures if applicable (refer to subsection 3.03.A).
5. Prequalification test seam samples (refer to subsection 3.05.A.6).
6. Field seam non-destructive test results (refer to subsection 3.05.B.1).
7. Field seam destructive test results (refer to subsection 3.05.C.6).
8. Daily field installation reports (refer to subsection 3.05.G).
9. Installation record drawing, as discussed in subsection 3.05.

1.04 Quality Control

A. Manufacturer's Qualifications: The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 1,000,000 M^2 (10,000,000 FT^2) of the specified type of geomembrane or similar product during the last five years.

B. Installer's Qualifications

1. The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Owner's Representative to install the geomembrane.

2. The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of 500,000 M^2 (5,000,000FT^2) of the specified type of geomembrane or similar during the last three years.

3. Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 10 projects involving a total of 500,000 M^2 (5,000,000 FT^2) of geomembrane of the type specified or similar product.

4. Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of 300,000M^2 (3,000,000FT^2) of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.

5. All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.05 Delivery, Storage and Handling

A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall be firmly affixed and shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll dimensions and roll weight.

B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

C. Rolls shall be stored away from high traffic areas. Continuously and uniformly support rolls on a smooth, level prepared surface.

1.06 Project Conditions

A. Geomembrane should not be installed in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in Section 3.03.

1.07 Material Warranty

As agreed by project participants.

1.08 Geomembrane Installation Warranty

A. The Geomembrane Installer shall guarantee the geomembrane installation against defects in the installation and workmanship for 1 year commencing with the date of final acceptance.

1.09 Geomembrane Pre-Construction Meeting

A. A Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. At a minimum, the meeting shall be attended by the Geomembrane Installer, Owner, Owner's representative (Engineer and/or CQA Firm), and the Earthwork Contractor.

B. Topics for this meeting shall include:

1. Health and Safety
2. Lines of authority and communication. Resolution of any project document ambiguity.
3. Methods for documenting, reporting and distributing documents and reports.
4. Procedures for packaging and storing archive samples.
5. Review of time schedule for all installation and testing.
6. Review of panel layout and numbering systems for panels and seams including details for marking on geomembrane.
7. Procedures and responsibilities for preparation and submission of as-built panel and seam drawings.
8. Temperature and weather limitations. Installation procedures for adverse weather conditions. Defining acceptable subgrade, geomembrane, or ambient moisture and temperature conditions for working during liner installation.

9. Subgrade conditions, dewatering responsibilities and subgrade maintenance plan.

10. Deployment techniques including allowable subgrade for the geomembrane.

11. Plan for controlling expansion/contraction and wrinkling of the geomembrane.

12. Covering of the geomembrane and cover soil placement.

13. Measurement and payment schedules.

14. Responsibilities of each party.

C. The meeting shall be documented by a person designated at the beginning of the meeting and minutes shall be transmitted to all parties.

PART 2 - PRODUCTS

2.01 Source Quality Control

A. Manufacturing Quality Control

1. The test methods and frequencies used by the manufacturer for quality control/quality assurance of the above geomembrane prior to delivery, shall be in accordance with GRI GM 13 for HDPE geomembrane or GRI GM 17 for LLDPE geomembrane, or modified as required for project specific conditions.

2. The manufacturer's geomembrane quality control certifications, including results of quality control testing of the products, as specified in subsection 2.01.A.3 of this Section, must be supplied to the Owner's Representative to verify that the materials supplied for the project are in compliance with all product and or project specifications in this Section. The certification shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers and corresponding shipping information.

3. The Manufacturer will provide Certification that the geomembrane and welding rod supplied for the project are made from the same material type and are compatible.

2.02 Geomembrane

A. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane rolls shall be seamless, high density polyethylene (HDPE - Formulated Sheet Density $\geq$ 0.94g/cc) or linear low density polyethylene (LLDPE - Formulated Sheet Density $\leq$ 0.939 g/cc) containing no plasticizers, fillers or extenders and shall be free of holes, blisters or contaminants, and leak free verified by 100% in line spark or equivalent testing. The geomembrane shall be supplied as a continuous sheet with no factory seams in rolls. The geomembrane will meet the property requirements as shown in Table A (GRI GM 13) or Table B (GRI GM 17)

B. Material conformance testing by the Owner's Representative, if required, will be conducted using in-plant sampling or as specified for the project.

C. The geomembrane seams shall meet the property requirements as shown in Table 2, (Attachment B) or as required by project specifications

PART 3 - EXECUTION

3.01 Subgrade Preparation

A. The subgrade shall be prepared in accordance with the project specifications. The geomembrane subgrade shall be uniform and free of sharp or angular objects that may damage the geomembrane prior to installation of the geomembrane.

B. The Geomembrane Installer and Owner’s Representative shall inspect the surface to be covered with the geomembrane on each day's operations prior to placement of geomembrane to verify suitability.

C. The Geomembrane Installer and Owner’s Representative shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.

D. All subgrade damaged by construction equipment and deemed unsuitable for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be approved by the Owner's Representative and the Geomembrane Installer. This damage, repair, and the responsibilities of the contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

3.02 Geomembrane Placement

A. No geomembrane shall be deployed until the applicable certifications and quality control certificates listed in subsection 1.03 of this Section are submitted to and approved by the Owner's Representative within the timeframe specified in the Contract Documents. If the material does not meet project specifications it shall be removed from the work area.

B. The geomembrane shall be installed to the limits shown on the project drawings and essentially as shown on approved panel layout drawings.

C. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0 degrees C (32 degrees F) unless otherwise approved by the Owner's Representative. The specified minimum temperature for material deployment may be adjusted by the Owner’s Representative .Temperature limitations should be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed.

D. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure Vehicle or equivalent.

E. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably - expected wind conditions. Sand bag material shall be sufficiently close- knit to prevent soil fines from working through the bags and discharging on the geomembrane.

F. Geomembrane placement shall not be done if moisture prevents proper subgrade preparation, panel placement, or panel seaming. Moisture limitations should be defined in the preconstruction meeting.

G. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.

H. The geomembrane shall not be allowed to "bridge over" voids or low areas in the subgrade. The geomembrane shall rest in intimate contact with the subgrade.

I. Wrinkles caused by panel placement or thermal expansion should be minimized in accordance with section 1.09 B11.

J. Considerations on Site Geometry: In general, seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade unless geometry requires seaming at such locations and if approved by the Owner's Representative.

K. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to affect a good weld and allow for proper testing. In no case shall this overlap be less than 75mm (3 in.).

3.03 Seaming Procedures

A. Cold weather installations should follow guidelines as outlined in GRI GM9.

B. No geomembrane material shall be seamed when liner temperatures are less than 0 degrees C (32 degrees F) unless the following conditions are complied with:

1. Seaming of the geomembrane at material temperatures below 0 degrees C (32 degrees F) is allowed if the Geomembrane Installer can demonstrate to the Owner's Representative, using pre-qualification test seams, that field seams comply with the project specifications, the safety of the crew is ensured, and geomembrane material can be fabricated (i.e. pipeboots, penetrations, repairs. etc.) at sub-freezing temperatures.

2. The Geomembrane Installer shall submit to the Owner's Representative for approval, detailed procedures for seaming at low temperatures, possibly including the following:

    1. Preheating of the geomembrane

    2. The provision of a tent or other device if necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.

    3. Number of test welds to determine appropriate seaming parameters

C. No geomembrane material shall be seamed when the sheet temperature is above 75 degrees C (170 degrees F) as measured by an infrared thermometer or surface thermocouple unless otherwise approved by the Owner's Representative. This approval will be based on recommendations by the manufacturer and on a field demonstration by the Geomembrane Installer using prequalification test seams to demonstrate that seams comply with the specification.

D. Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.

E. Fishmouths or excessive wrinkles at the seam overlaps shall be minimized and when necessary cut along the ridge of the wrinkles back into the panel so as to effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (1/2 in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.04 Pipe and Structure Penetration Sealing System

A. Provide penetration sealing system as shown in the Project Drawings.

B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The pre-fabricated or field fabricated assembly shall be field welded to the geomembrane as shown on the Project Drawings so as to prevent leakage. This assembly shall be tested as outlined in section 3.05.B. Alternatively, where field non destructive testing can not be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM 6365

Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.

a. Equipment for Spark testing shall be comprised of but not limited to: A hand held holiday spark tester and conductive wand that generates a high voltage.

b. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non welded segment shall be subject to a calibration test to ensure that such a defect (non welded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.

c. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.

d. Care should be taken if flammable gases are present in the area to be tested.

3.05 Field Quality Control

The Owner's Representative shall be notified prior to all pre qualification and production welding and testing, or as agreed upon in the pre construction meeting.

A. Prequalification Test Seams

1. Test seams shall prepare and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.

2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the same equipment and operator combination as production seaming. The test seam shall be approximately 3.3 meters (10 feet) long for fusion welding and 1 meter (3 feet) long for extrusion welding with the seam centered lengthwise. At a minimum, tests seams should be made by each technician 1 time every 4–6 hours; additional tests may be required with changes in environmental conditions.

3. Two 25 mm (1 in) wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen should fail in the parent

material and not in the weld, “Film Tear Bond"(F.T.D. failure). Seam separation equal to or greater than 25% of the track width shall be considered a failing test.

4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Subsection 3.05.C.4 of this Section. Four specimens shall pass for the test seam to be a passing seam.

5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are corrected and a successful test seam can be produced.

6. A sample from each test seam shall be labeled. The label shall indicate the date, geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Owner's Representative for archiving.

B. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.

2. Testing should be done as the seaming work progresses, not at the completion of all field seaming, unless agreed to in advance by the Owner's Representative. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.

3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.

4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.

5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:

a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.

b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).

c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.

d. All areas where soap bubbles appear shall be marked, repaired and then retested.

e. At locations where seams cannot be non destructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section 3.04.B) or equivalent should be substituted.

f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test.

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:

a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.

b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed,. Allow 2 minutes for the injected air to come to equilibrium in the channel, and sustain pressure for 5 minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.

c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.

d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

C. Destructive Field Seam Testing

1. One destructive test sample per 150 linear m (500 linear ft) seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Owner's Representative. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of

geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Owner's Representative as seaming progresses.

2. All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.

3. The destructive sample size shall be 300 mm (12 in) wide by 1 m (36 in) long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Owner's Representative as an archive sample; one section given to the Owner's Representative for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.

4. For field testing, the Geomembrane Installer shall cut 10 identical 25 mm (1 in) wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.02 with less than 25% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.

5. If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437 or GRI GM 6.

6. Reports of the results of examinations and testing shall be prepared and submitted to the Owner's Representative.

7. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall then be taken by the Geomembrane Installer at locations indicated by the Engineer; typically 3 m (10

ft) on either side of the failed sample and laboratory seem tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 50 M in length (150 FT) shall be destructively tested.

D. Identification of Defects

1. Panels and seams shall be inspected by the Installer and Owner's Representative during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

E. Evaluation of Defects: Each suspect location on the liner (both in geomembrane seam and non-seam areas) shall be non-destructively tested using one of the methods described in Section 3.05.B. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.

1. If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.

2. Defective seams, tears or holes shall be repaired by reseaming or applying a extrusion welded cap strip.

3. Reseaming may consist of either:

a. Removing the defective weld area and rewelding the parent material using the original welding equipment; or

b. Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.

4. Blisters, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 150 mm (6 in) beyond all edges of the defects.

5. All repairs shall be measured, located and recorded.

F. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.

G. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide the Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:

1. Total amount and location of geomembrane placed;
2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
3. Drawings of the previous day's installed geomembrane showing panel numbers, seam numbers and locations of non-destructive and destructive testing;
4. Results of pre-qualification test seams;
5. Results of non-destructive testing; and
6. Results of vacuum testing of repairs.

H. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.06 Liner Acceptance

A. Geomembrane liner will be accepted by the Owner's Representative when:

1. The entire installation is finished or an agreed upon subsection of the installation is finished;
2. All Installer’s QC documentation is completed and submitted to the owner
3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

3.07 Anchor Trench

A. Construct as specified on the project drawings.

3.08 Disposal of Scrap Materials

A. On completion of installation, the Geomembrane Installer shall dispose of all trash and scrap material in a location approved by the Owner, remove equipment used

in connection with the work herein, and shall leave the premises in a neat acceptable manner. No scrap material shall be allowed to remain on the geomembrane surface.

PART 4 - MEASUREMENT AND PAYMENT

As per project specifications.

PART 5 - GRI GM13 SPECIFICATION

"This section shall include the current GRI GM13 manufacturer's specification or a revision of GRI GM13 specific to the unique project requirements and/or standards, as determined by the owner or owners' agent."

Attachment A.

Geomembrane Nominal Thickness	20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams [1]								
shear strength[2], lb/in.	**30**	**45**	**60**	**75**	**90**	**120**	**150**	**180**
shear elongation at break[3] , %	50	50	50	50	50	50	50	50
peel strength [2], lb/in.	**25**	**38**	**50**	**63**	**75**	**100**	**125**	**150**
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams [1]								
shear strength[2], lb/in.	**30**	**45**	**60**	**75**	**90**	**120**	**150**	**180**
shear elongation at break[3] , %	50	50	50	50	50	50	50	50
peel strength [2], lb/in.	**25**	**34**	**44**	**57**	**66**	**88**	**114**	**136**
peel separation, %	25	25	25	25	25	25	25	25

Table 1(a) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured **Linear Low Density Polyethylene (LLDPE)** Geomembrane **(English Units)**

Notes for Tables 1(a) and 1(b):

1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strength are for 4 out of 5 test specimens; the 5th specimen can be low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 1(b) – Seam Strength and related Properties of Thermally Bonded Smooth and

Geomembrane Nominal Thickness	**0.50 mm**	**0.75 mm**	**1.0 mm**	**1.25 mm**	**1.5 mm**	**2.0 mm**	**2.5 mm**	**3.0 mm**
Hot Wedge Seams [1]								
shear strength[2], N/25mm	**131**	**197**	**263**	**328**	**394**	**525**	**657**	**788**
shear elongation at break[3] , %	50	50	50	50	50	50	50	50
peel strength [2], N/25mm	**109**	**166**	**219**	**276**	**328**	**438**	**547**	**657**
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams [1]								
shear strength[2], N/25mm	**131**	**197**	**263**	**328**	**394**	**525**	**657**	**788**
shear elongation at break[3] , %	50	50	50	50	50	50	50	50
peel strength [2], N/25mm	**95**	**150**	**190**	**250**	**290**	**385**	**500**	**595**
peel separation, %	25	25	25	25	25	25	25	25

Textured **Linear Low Density Polyethylene (LLDPE)** Geomembrane **(S.I. Units)**

Geomembrane Nominal Thickness	**30 mils**	**40 mils**	**50 mils**	**60 mils**	**80 mils**	**100 mils**	**120 mils**
Hot Wedge Seams [1]							
shear strength[2], lb/in.	**57**	**80**	**100**	**120**	**160**	**200**	**240**
shear elongation at break[3] , %	50	50	50	50	50	50	50
peel strength [2], lb/in.	**45**	**60**	**76**	**91**	**121**	**151**	**181**
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams [1]							
shear strength[2], lb/in.	**57**	**80**	**100**	**120**	**160**	**200**	**240**
shear elongation at break[3] , %	50	50	50	50	50	50	50
peel strength [2], lb/in.	**39**	**52**	**65**	**78**	**104**	**130**	**156**
peel separation, %	25	25	25	25	25	25	25

Table 2(a) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured Linear **High Density Polyethylene (HDPE)** Geomembrane **(English Units)**

Notes for Tables 2(a) and 2(b):

1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strength are for 4 out of 5 test specimens; the 5th specimen can be low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 2(b) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured **High Density Polyethylene (HDPE)** Geomembrane **(S.I. Units)**

Geomembrane Nominal Thickness	**0.75 mm**	**1.0 mm**	**1.25 mm**	**1.5 mm**	**2.0 mm**	**2.5 mm**	**3.0 mm**
Hot Wedge Seams [1]							
shear strength[2], N/25mm	**250**	**350**	**438**	**525**	**701**	**876**	**1050**
shear elongation at break[3] , %	50	50	50	50	50	50	50
peel strength [2], N/25mm	**197**	**263**	**333**	**398**	**530**	**661**	**793**
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams [1]							
shear strength[2], N/25mm	**250**	**350**	**438**	**525**	**701**	**876**	**1050**
shear elongation at break[3] , %	50	50	50	50	50	50	50
peel strength [2], N/25mm	**170**	**225**	**285**	**340**	**455**	**570**	**680**
peel separation, %	25	25	25	25	25	25	25