FINAL REPORT

Use of Compound-Specific Stable Isotope Analysis to Distinguish Between Vapor Intrusion and Indoor Sources of VOCs

ESTCP Project ER-201025

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ESTCP

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ACRONYMS

1,1,1-TCA	1,1,1-Trichloroethane
1,2-DCA	1,2-dichloroethane
bgs	Below ground surface
BTEX	Benzene, toluene, ethybenzene, xylenes
cis-1,2-DCE	cis-1,2-dichloroethylene
COC	Chemical of concern
CSIA	Compound-specific stable isotope analysis
cVOC	Chlorinated volatile organic compound
δ	Delta, an Isotope Ratio Measure
DoD	Department of Defense
DQO	Data quality objective
ESTCP	Environmental Security Technology Certification Program
FUDS	Formerly Used Defense Site
ft	Foot, feet
GC	Gas chromatography
GW	Groundwater
HCs	Hydrocarbons
HVAC	Heating, ventilation, and air conditioning
IDW	Investigation derived waste
IRMS	Isotope ratio mass spectrometer
MS	Mass spectrometry
N/A	Non-applicable
PAH	Polyaromatic hydrocarbon
PCE	Tetrachloroethylene
per mil (‰)	Parts per thousand
ppbV	Parts per billion by volume
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
sq ft	Square feet
TAGA	Trace Atmospheric Gas Analyzer
TCE	Trichloroethylene
THQ	Target Hazard Quotient
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
V-PDB	Vienna - Pee Dee Belemnite
V-SMOW	Vienna – Standard Mean Ocean Water
VC	Vinyl chloride
VI	Vapor intrusion
VOA	Volatile organic analysis
VOC	Volatile organic compound

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EXECUTIVE SUMMARY

OBJECTIVES OF THE DEMONSTRATION

Indoor sources of VOCs are ubiquitous, resulting in detectable concentrations in indoor air, often at levels exceeding regulatory screening criteria. At corrective actions sites with potential vapor intrusion concerns, the presence of indoor VOC sources significantly complicates the exposure pathway evaluation. Because of these indoor sources, the detection of a site-related VOC in a potentially affected building does not necessarily indicate a vapor intrusion impact. However, because conventional investigation methods often do not clearly identify the source of VOCs, additional rounds of sampling are commonly required.

The overall goal of this demonstration was to validate use of compound-specific stable isotope analysis (CSIA) to distinguish between vapor intrusion and indoor sources of VOCs. As part of this project, a step-by-step protocol has been developed which can be used to provide an independent line of evidence to determine whether or not buildings are impacted by vapor intrusion.

TECHNOLOGY DESCRIPTION

Many elements, such as carbon, occur as different isotope species, differing in their number of neutrons present in the nucleus. For example, ^{12}C, with 6 neutrons, is the most abundant form of carbon. ^{13}C, with 7 neutrons, makes up a small fraction (~1%) of the carbon in the environment. Isotopic ratios ($^{13}C/^{12}C$) of a specific compound (e.g., TCE) can vary as a result of differences in their source material or compound synthesis or due to transformation in the environment (USEPA, 2008). Differences in the isotopic ratio measured in organic contaminants present in environmental samples can be used to i) distinguish between different sources of the contaminants and ii) understand biodegradation and other transformation processes occurring in the environment.

While CSIA has been applied to groundwater investigations, its applicability to vapor intrusion assessments has only recently been explored (e.g., McHugh et al., 2011). As part of this ESTCP project, we have evaluated the applicability of CSIA for vapor intrusion and have developed a step-by-step protocol for investigations using CSIA. This protocol includes a decision matrix to guide users who may be unfamiliar with isotope analyses.

DEMONSTRATION RESULTS

The field investigation program included application of the CSIA protocol at four Department of Defense (DoD) sites. To evaluate the validity of this investigation approach, we also conducted conventional vapor intrusion and on-site GC/MS analysis protocol (ESTCP Project ER-201119) investigations at the same buildings. In two of four buildings, the CSIA approach yielded results consistent with the other investigation methods. In another building, a spray can was planted in a closet; the CSIA approach correctly identified an indoor source as being the source of VOCs in indoor air. In the fourth building, the CSIA approach was better than the other approaches in that it provided clear and strong evidence of an indoor source while the other methods yielded ambiguous results.

Overall, the demonstration results validated the CSIA protocol as a useful tool for distinguishing between vapor intrusion and indoor sources of VOCs.

IMPLEMENTATION ISSUES

The CSIA protocol for vapor intrusion is not a standalone investigation approach. The CSIA protocol is most useful in buildings which have previously been sampled, in which investigation results show VOC concentrations near or above regulatory screening levels. In these buildings, differentiating between indoor and subsurface sources becomes critical for site- and risk-management.

Advantages of the CSIA protocol include:

- Less intrusive than an intensive (manual) source identification and removal effort commonly used in conventional investigations; and

- Less training needed to implement the protocol, as compared to other source identification methods (i.e., on-site GC/MS analysis [ER-201119]).

Limitations on the use of the CSIA protocol include:

- Sample collection methods. Sample collection using adsorbent tubes and pumps is slightly more complicated than sample collection using Summa canisters. This limitation can be mitigated by identifying a sampling team with prior experience using USEPA Method TO-17.

- Potential for inconclusive results. Interpretation of CSIA results is largely a matter of pattern-matching. If the isotope composition of subsurface VOCs is within the range commonly observed for VOCs in consumer products, there is more uncertainty in data interpretation. Because of this limitation, the investigation protocol recommends characterization of the subsurface source either prior to collection of indoor air samples or in conjunction with sampling at the first one or two buildings included in a site investigation. The investigation method should be applied as part of a larger indoor air sampling program only when the subsurface source has been found to be distinct from most potential indoor sources.

- Issues with hydrocarbon sites. At chlorinated hydrocarbon sites, two isotope ratios can be developed ($\delta^{13}C$ and $\delta^{37}Cl$ from TCE), providing more data for interpretation. At petroleum hydrocarbon sites, it may not be practical to analyze for both relevant isotope ratios ($\delta^{13}C$ and $\delta^{2}H$ from benzene). CSIA for hydrogen requires a large sample mass which, in turn, may require an overly long sample collection period. Other potential issues include saturation of the sorbent tubes and interference from other hydrocarbon compounds which may complicate the laboratory analysis. Coordination with the analytical laboratory is important to mitigate these risks.

- High concentrations of VOCs in indoor air. In some buildings, indoor sources may cause indoor air concentrations to exceed screening levels by a large margin (e.g., >10x screening levels). In these buildings, additional CSIA sampling may be helpful after indoor source removal, to account for uncertainty in isotope mixing and potential low-level vapor intrusion.

1.0 INTRODUCTION

The purpose of this project is to validate the application of compound-specific stable isotope analysis (CSIA) as a tool to distinguish between vapor intrusion (VI) and indoor sources of volatile organic compounds (VOCs). The specific goals of the project are as follows:

- Task 1: Validate the use of active adsorbent samplers for the collection of vapor-phase samples for carbon, chlorine, and hydrogen CSIA of VOCs (i.e., tetrachloroethylene (PCE), trichloroethylene (TCE), and benzene) that commonly drive vapor intrusion investigations.

- Task 2: Develop a protocol for application of CSIA for vapor intrusion investigations: i) Characterize the stable isotope signatures for common indoor sources of VOCs; ii) Characterize the stable isotope signatures of subsurface sources of VOCs and the variability in these signatures in close proximity to potentially affected buildings; and iii) Develop a protocol for application of CSIA to distinguish between vapor intrusion and indoor sources of VOCs.

- Task 3: Demonstrate CSIA for vapor intrusion investigations: Demonstrate the performance of the CSIA protocol through application at four different U.S. Department of Defense (DoD) sites potentially affected by vapor intrusion.

Task 1 was accomplished through a laboratory study which i) identified and validated the use of an adsorbent (Carboxen 1016) for sample collection, ii) optimized an analysis method, and iii) developed a streamlined laboratory study process in the event that additional target analytes are identified (Kuder et al., 2012).

Task 2 was accomplished through characterization of indoor and subsurface source isotopic signatures and development of an investigation protocol for using CSIA to distinguish between indoor VOC sources and vapor intrusion (GSI, 2012c).

This report summarizes the results of Task 3. Findings from the Task 3 field demonstrations were used to refine the investigation protocol. The revised protocol is provided in Appendix E of this report.

1.1 BACKGROUND

Indoor sources of VOCs are ubiquitous, resulting in detectable concentrations in indoor air, often at concentrations above regulatory screening levels. In residences, background concentrations of PCE, TCE, benzene, and several other VOCs commonly exceed regulatory screening levels (USEPA, 2011; Dawson and McAlary, 2009). The background concentration of VOCs in indoor air can increase or decrease over time based on changes in the use of these VOCs in consumer products. At corrective action sites with potential vapor intrusion concerns, the presence of indoor VOC sources significantly complicates the exposure pathway investigation. Because of these indoor sources, the detection of a site-related VOC in a potentially affected building at a concentration above the regulatory screening level does not necessarily indicate a vapor intrusion impact. Additional investigation is typically required to determine the sources of the detected VOCs.

Currently, the most common approaches for identification of indoor sources of VOCs during vapor intrusion investigations are i) visual building surveys, and ii) room-by-room measurement of VOC concentrations. Both of these approaches have limitations, as described below:

Visual survey: Most vapor intrusion guidance documents recommend visual identification and removal of indoor sources of VOCs prior to collecting indoor air samples for VOC analysis (e.g., USEPA, 2002). However, this approach has limited effectiveness because many indoor sources of VOCs are not identified by visual inspection and some identified sources (e.g., carpet, furniture, etc.) cannot easily be removed. For VOCs with indoor air screening concentrations close to 1 $\mu g/m^3$ (e.g., benzene, TCE, and PCE), a one-gram source (i.e., approximately 1 mL) emitted into indoor air over a one-year period can result in a sustained exceedance of the indoor air screening concentration over that time. Although less prevalent than in the past, a wide variety of consumer products still contain high concentrations of PCE and/or TCE including spot remover, hobby glues, metal polish, gun cleaner, and lubricant spray. Product labeling laws are complex and subject to varying interpretations resulting in inconsistencies regarding identification of product ingredients. Although the primary ingredients are often identified on the labels, “inert ingredients” and incidental contaminants are often not identified. For example, some brands of self-defense pepper spray use TCE as the carrier solvent, resulting in a product that is >90% TCE. However, TCE is not required to be identified on the product label because it is not an “active ingredient” for the purpose of self-defense.

As a further complication, changes in manufacturing over time also result in temporal changes in product composition. Manufacturers of consumer products (e.g., cleaning agents, repair kits) may switch from one chemical agent to another (e.g., from TCE to methylene chloride) so that currently available information on ingredients does not reflect the composition of the product manufactured a few years ago. Similarly, a recent change in manufacturing processes has resulted in newly manufactured hard plastic objects (e.g., Christmas ornaments) serving as a source of 1,2-dichloroethane (1,2-DCA) to indoor air (Doucette et al., 2009). All of these factors complicate the use of visual surveys to identify indoor sources of VOCs.

Room-by-room sampling: The distribution of VOCs within a building can provide a strong indication of the location of the indoor source (i.e., the VOC concentration is highest in the room containing the indoor source) or the entry point for subsurface vapors. As a result, a room-by-room sampling program can be effective for distinguishing between vapor intrusion and indoor sources of VOCs. However, such an approach can be both expensive and time consuming. When using an off-site laboratory, the investigation of a single building is likely to take at least 3-4 weeks (assuming two rounds of sampling and 1 to 2 weeks for off-site analysis) and result in over $2.4-4.8K in analytical costs (e.g., 12 samples at $200 to $400 per sample, not including sample collection and data interpretation costs). In addition, such a program would require access to the building on at least two different occasions, which can be difficult for off-site buildings or buildings not operated by the responsible party. Use of on-site analysis can decrease the time required to conduct room-by-room sampling by providing real-time results that facilitate the collection of source confirmation samples. However, the required equipment is very expensive (e.g., $120K to purchase a HAPSITE portable gas chromatograph/mass spectrometer

(GC/MS) or approximately $5 to 10K per day for use of the USEPA Trace Atmospheric Gas Analyzer (TAGA) or similar mobile laboratory capable of TO-15 analyses). In addition, this equipment has limited availability, potentially causing delays in field investigation programs. As a result, room-by-room sampling to identify the source of VOCs detected in indoor air is impractical for many vapor intrusion investigations.

If CSIA is demonstrated to provide reliable discrimination between subsurface and indoor sources of VOCs detected in indoor air samples, then the use of CSIA would dramatically simplify the building investigation program required to distinguish between vapor intrusion and indoor sources of VOCs.

1.2 OBJECTIVE OF THE DEMONSTRATION

The overall goal of this project was to develop a reliable protocol for incorporating CSIA into vapor intrusion investigations. The objectives of the demonstration (Task 3) were to apply the draft protocol at four sites, evaluate its performance, and refine it as indicated by the demonstration results.

The performance evaluation serves to validate the various aspects of the draft protocol (Section 5 of GSI, 2012c) including sample collection methods, analysis methods, and the data interpretation process. This evaluation also serves to refine our understanding of the variability in isotope ratios for both indoor sources and subsurface sources of target VOCs.

1.3 REGULATORY DRIVERS

At a limited number of sites in the U.S., migration of VOCs from contaminated groundwater via vapor phase diffusion has impacted indoor air quality in overlying structures, posing a potentially significant, yet previously unrecognized human health concern for such properties. To address this concern, the USEPA has issued the "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils," (USEPA, 2002), providing conservative screening criteria for various VOCs in groundwater and soil gas. These conservative screening values eliminate few sites and, as a result, a majority of sites with VOCs in groundwater require field investigation of the vapor intrusion pathway. We expect that updated USEPA vapor intrusion guidance due in 2013/2014 will include increased requirements for testing of indoor air during vapor intrusion investigations. When implementing these new requirements, accurate methods to distinguish vapor intrusion from indoor sources of VOCs will be important to facilitate efficient investigation approaches and reduced investigation costs.

Indoor air testing may be conducted using either traditional investigation methods (i.e., collection of sub-slab and indoor air samples using Summa canisters), advanced investigation methods such as CSIA or on-site GC/MS analysis (e.g., ESTCP Project ER-201119), or a combination of methods. The likelihood that the traditional investigation method will provide definitive results depends on a number of factors including most importantly:

1. The conservatism of the data evaluation: Traditional investigation results are typically evaluated using a multiple lines of evidence approach that includes both quantitative measures and qualitative measures. If concentrations of chemicals of concern (COCs) in indoor air exceed the applicable screening levels, then the likelihood of indoor sources is

evaluated based on the distribution of COCs in subslab and indoor air samples. This qualitative evaluation relies on the professional judgment of the stakeholders. In some cases, indoor air concentrations greater than 1% to 10% of the subslab concentration are taken as strong evidence of indoor sources. In other cases, indoor air concentrations less than the maximum subslab concentration are considered sufficient evidence of potential vapor intrusion to merit additional investigation. When a more conservative data evaluation approach is used, it is more likely that a traditional investigation method will not yield a definitive result.

2. The prevalence of indoor and ambient sources for the COCs: Indoor and ambient sources of benzene and many other hydrocarbons are ubiquitous, resulting in indoor air concentrations that exceed a 10^{-6} risk level in almost all buildings. Sources of chlorinated VOCs vary by compound. Approximately 50% of buildings have PCE concentrations that exceed a 10^{-6} risk level due to indoor sources, and 5-10% of buildings have TCE concentrations that exceed a 10^{-6} risk level due to indoor sources (Dawson and McAlary, 2009). In contrast, most buildings have no detectable indoor sources of 1,1-DCE or vinyl chloride. The concentration of 1,2-DCA in indoor air has increased significantly in recent years (Kurtz et al., 2010), a change attributable to plastic decorations (Doucette et al., 2009). If a site investigation includes COCs with common indoor sources such that background indoor air concentrations commonly exceed applicable screening levels, then it is more likely that a traditional investigation method will not yield a definitive result.

2.0 TECHNOLOGY

The technology being demonstrated for this project is the application of CSIA to distinguish between vapor intrusion and indoor sources of VOCs.

2.1 TECHNOLOGY DESCRIPTION

2.1.1 Isotope Analysis

Many elements, such as carbon, occur as different isotope species, differing in their number of neutrons present in the nucleus. For example, ^{12}C, with 6 neutrons, is the most abundant form of carbon, but ^{13}C, with 7 neutrons, makes up a small fraction of the carbon in the environment (~1%). Isotopic ratios (e.g., the ratio of $^{13}C/^{12}C$) of a specific compound (e.g., TCE) can vary as a result of differences in their source material or compound synthesis or due to transformation in the environment (USEPA, 2008). Differences in the isotopic ratio measured in organic contaminants present in environmental samples can be used to i) distinguish between different sources of the contaminants and ii) understand biodegradation and other transformation processes occurring in the environment.

CSIA measures the carbon, chlorine, and/or hydrogen isotope ratios for individual chemicals. Such differences in environmental samples are used to identify different pollutant sources or to understand pollutant transformation processes (USEPA, 2008). CSIA involves the separation of chemical compounds using GC, followed by conversion of the separated target compound to an easily measurable surrogate compound (e.g., CO_2 for $^{13}C/^{12}C$ measurements) in an inline reactor. Finally, the abundance of stable isotopes of the surrogate compound is measured by isotope ratio mass spectrometry. For $^{37}Cl/^{35}Cl$, owing to the relatively high abundance of ^{37}Cl, CSIA methods have been devised that use conventional GC/MS analysis (similar to that of USEPA Method 8260) thereby eliminating the need for conversion of the target chemical to a surrogate compound (Sakaguchi et al., 2007).

While the ability to analyze isotope ratios in single-compound samples dates back to the first half of the last century, CSIA is still a relatively new approach. Commercially available CSIA instrumentation was introduced two decades ago, initially only for carbon and nitrogen isotopes (Sessions, 2006) but more recently also for hydrogen and chlorine isotopes (Sessions, 2006; Sakaguchi et al., 2007). Applications of CSIA in environmental contaminant studies appeared shortly after the instrumentation became available (e.g., Sherwood-Lollar et al., 1999), and were almost exclusively centered on aqueous and sediment samples. In the past decade, CSIA evolved from purely academic research to a technique with widespread application in environmental cleanup projects. The increased practical interest in CSIA is illustrated by the recent USEPA publication of a CSIA guidance document (USEPA, 2008).

2.1.2 Isotope Ratio Analysis

Stable isotope analysis of carbon, chlorine, or hydrogen involves measurement of the relative abundance of the two stable isotopes of the element (e.g., ^{12}C and ^{13}C). However, the results are not reported as a direct ratio of the isotopes. In order to ensure inter-laboratory comparability and accuracy, these ratios are expressed relative to an international standard (typically V-PDB for carbon and V-SMOW for hydrogen). Measured values are compared to the standard and reported as $\delta^{13}C$, $\delta^{37}Cl$, and $\delta^{2}H$ respectively. These terms are defined as illustrated in Equation 1 below for carbon.

$$\delta^{13}C(‰) = \left[\frac{\left({}^{13}C/{}^{12}C\right)_{sample} - \left({}^{13}C/{}^{12}C\right)_{standard}}{\left({}^{13}C/{}^{12}C\right)_{standard}}\right] x\ 1000 \qquad (1)$$

For manufactured products (i.e., potential indoor sources), the correction for the international standard typically results in negative values for the reported isotope ratios. Fractionation effects that result in enrichment of the lighter isotope (e.g., ^{12}C) in the sample result in $\delta^{13}C$ isotope ratio values that are more negative (i.e., larger negative values). Fractionation effects that result in enrichment in the heavier isotope (e.g., ^{13}C) result in isotope ratio values that are less negative (or even positive).

2.1.3 Application to Vapor Intrusion

Various processes can change the isotope ratios of a compound (so-called isotope fractionation). Molecular bonds containing the lighter isotopes are broken at slightly faster rates than those containing the heavier isotopes. As a result, the isotopic ratio for a compound can change over time as the compound is biodegraded in the subsurface. The parent compound (e.g., TCE) becomes relatively enriched in heavy isotopes (i.e., less negative $\delta^{13}C$ and $\delta^{37}Cl$ values), while transformation products (e.g., cis-1,2-DCE) end up with less of the heavy isotopes (i.e., more negative $\delta^{13}C$ and $\delta^{37}Cl$ values). While physical processes such as evaporation and sorption can also cause fractionation at contaminated sites, these processes are often too subtle to have a measurable effect on isotope ratios, except for hydrogen.

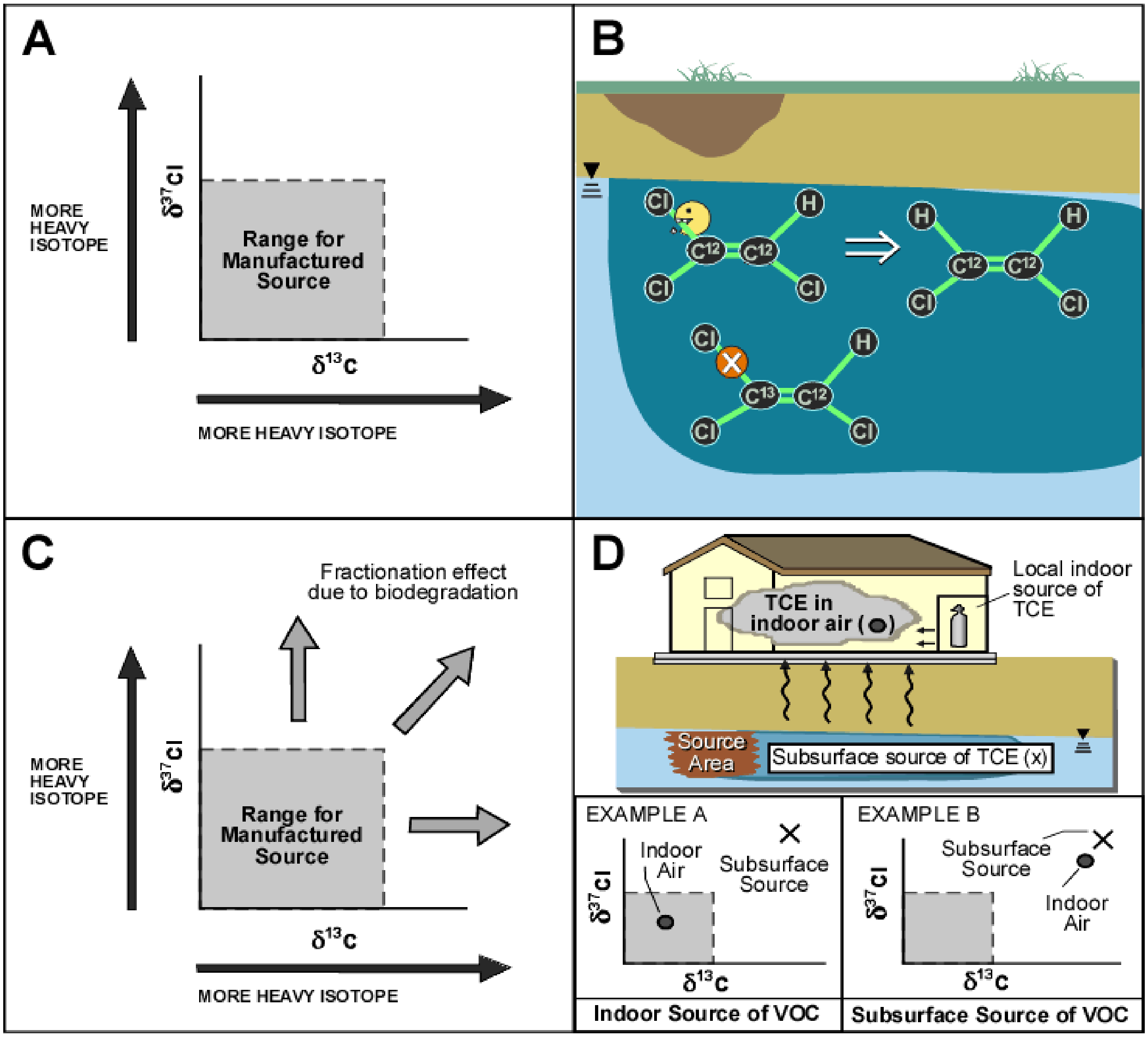
The proposed investigation approach involves i) determination of stable isotope ratios of the target VOCs present in the air ($^{13}C/^{12}C$, $^{37}Cl/^{35}Cl$ for PCE and TCE; $^{13}C/^{12}C$ and $^{2}H/^{1}H$ in the case of benzene) and ii) use of those ratios to differentiate between VOCs sourced from the subsurface (true vapor intrusion) and those sourced from miscellaneous household products. The conceptual basis for application of CSIA to vapor intrusion is illustrated in Figure 1. The basic hypothesis is that:

1. Isotope ratios for VOCs originating from different manufactured sources have isotope ratios within a defined range (Figure 1, Panel A). This range is small compared to the range of isotope ratios created by isotope fractionation effects that occur in the subsurface.
2. VOCs originating from subsurface sources commonly undergo biodegradation in groundwater and later in the unsaturated soil prior to entering indoor air. Individual molecules that contain the lighter isotopes are often preferentially biodegraded, resulting in enrichment of the heavier isotope species in the undegraded residue (Figure 1, Panel B). This enrichment process is known as isotope fractionation.
3. The consequence of isotope fractionation is that isotope composition of VOCs originating from the subsurface is often clearly different than that of pristine (undegraded) manufactured products acting as indoor sources of the same VOCs (Figure 1, Panel C).

4. This difference allows the successful differentiation between VOCs from indoor sources and those from true vapor intrusion sources (Figure 1, Panel D).

The proposed methodology for determination of isotope ratios in VOCs present in air or in soil gas involves i) recovery/preconcentration of the target volatiles from soil gas or from indoor air by sample processing by standard methods such as those described in USEPA Methods TO-15 or TO-17 (USEPA 1999a; USEPA 1999b) and ii) analysis of the collected samples for their isotope ratios, using CSIA adopted from the protocols used for analysis of the same VOCs present in groundwater samples (USEPA, 2008).

Figure 1: Conceptual Diagram of Basis for Use of CSIA to Distinguish between Indoor and Subsurface VOCs Sources



Interpretation of the origin of VOCs in indoor air based on CSIA results will be relatively straightforward in comparison to traditional vapor intrusion investigation methods. The isotope ratios from VOCs in indoor air will be directly compared to those from the subsurface source and those measured in a variety of available consumer products. Isotope ratios dissimilar from the subsurface source but similar to the values characteristic of, for example, TCE present in household products is a strong indication that the latter is responsible for the indoor air contamination (see Figure 1, Panel D, Example A). On the other hand, the isotope ratios of TCE in indoor air can be similar to the subsurface sources and different from indoor sources, confirming the impact of vapor intrusion (Figure 1, Panel D, Example B).

2.2 TECHNOLOGY DEVELOPMENT

In their December 2008 guide, the USEPA states that "*Currently, CSIA is in transition from a research tool to an applied method that is well integrated into comprehensive plans for management of contaminated sites.*" For groundwater contaminants, CSIA has been applied at more than 50 sites over the last 10 years to distinguish between different sources of the same contaminant and to document the occurrence of biodegradation or other transformation processes. Although CSIA is well validated for groundwater, additional work is required to validate the use of CSIA to distinguish between vapor intrusion and indoor sources of VOCs. This technology demonstration project will extend the application of CSIA techniques to vapor-phase samples to provide an effective tool to distinguish between vapor intrusion and indoor sources of VOCs. For this application, the isotopic signatures of individual VOCs in an indoor air sample will be compared to the isotopic signatures from local indoor and local subsurface sources of the same VOCs. A match between the isotopic signature of the indoor air sample and either the indoor or the subsurface source is expected to provide a clear identification of the primary source of the VOC in the indoor air sample. Key components for application of CSIA to vapor intrusion have been validated through work completed in Tasks 1 and 2 of this ESTCP project:

Active Sorbent Sample Collection and Analysis Method: CSIA requires a 100 to 1000 ng of an individual VOC in order to obtain a clear isotope signature. For indoor air samples, up to 100 L of air may be required for CSIA analysis. Sampling this volume of air requires use of a sorbent to capture and concentrate the VOCs of interest. Use of a sorbent allows the transfer of contaminants from a large volume of air to a small volume of sorbent, eliminating the problems associated with large volumes and low concentrations. For Task 1 of this project, a laboratory study was completed that validated the use of active sorbent sampling using Carboxen 1016 for the collection of indoor air samples for the analysis of isotope ratios of PCE, TCE, or benzene. In addition, a streamlined procedure was developed for validation of other sorbents or target analytes (Kuder et al., 2012).

Characterization of Indoor and Subsurface Sources: The typical range of carbon and chlorine isotope ratios for PCE and TCE sources and the typical range of carbon and hydrogen isotope ratios for benzene sources have been determined by compilation of literature studies supplemented by additional laboratory measurements. The results of this analysis are presented in GSI, 2012c.

Investigation Protocol: The protocol (Section 5 of GSI, 2012c) was based on the results of Project ER-201025 Task 1 and Task 2. This protocol was tested through implementation at four demonstration sites discussed below.

2.3 ADVANTAGES AND LIMITATIONS OF THE TECHNOLOGY

As illustrated in Figure 1 above, CSIA can be used to identify the source of a chemical (i.e., indoor source vs. vapor intrusion) present in indoor air based on the measured isotope ratio. This analysis is independent of other common lines of evidence used to identify VOC sources such as attenuation factors and concentration ratios. In most cases, CSIA will be able to provide evidence of the source of a VOC based on the analysis of as few as one subsurface sample (e.g., groundwater) and one indoor air sample. As a result, CSIA is a cost-effective vapor intrusion investigation method that can be used as the primary line of evidence for source identification or in conjunction with other lines of evidence.

With respect to sample collection, the main limitation of the CSIA approach is the sample collection method required for indoor air samples. In order to obtain sufficient sample mass for analysis, the sample must be collected using an adsorbent tube and pump, such as that specified by USEPA Method TO-17. Although this equipment is readily available, the use is slightly more complicated than Summa canisters and some field personnel may not be familiar with its operation. This limitation can be mitigated by identifying a sampling team with prior experience in sample collection using USEPA Method TO-17.

A second limitation is the potential for inconclusive results. If the isotope composition of subsurface VOCs is within the range commonly observed for VOCs in consumer products, then CSIA is likely to yield inconclusive results (i.e., the isotope ratio measured for the target VOC in indoor air may match both the subsurface source and potential indoor sources). This limitation may apply at up to 50% of candidate sites (GSI, 2012c). Because of this limitation, the investigation protocol recommends characterization of the subsurface source either prior to collection of indoor air samples or in conjunction with sampling at the first one or two buildings included in a site investigation. The investigation method should be applied as part of a larger indoor air sampling program only when the subsurface source has been found to be distinct from most potential indoor sources.

3.0 PERFORMANCE OBJECTIVES

The hypothesis for this demonstration project is that the site-specific application of CSIA to a limited number of indoor air and subsurface (water and/or soil gas) samples will allow the user to distinguish between indoor and subsurface sources of VOCs in indoor air, providing a valuable tool for source identification (i.e., indoor vs. subsurface). However, other investigation tools will still be required to address other aspects of the vapor intrusion pathway such as determining whether VOC concentrations in indoor air are above a regulatory screening level and evaluating temporal variability.

The overall objective of the demonstration was to validate the draft protocol for the application of CSIA to distinguish between vapor intrusion and indoor sources of VOCs. The demonstration was done in the field at "full-scale", that is, in typical buildings subject to vapor intrusion investigations. This objective was met by:

1) Applying the draft protocol to one to two buildings with vapor intrusion concerns at each of four demonstration sites,
2) Utilizing the results obtained from the protocol to determine the vapor intrusion conditions in the buildings,
3) Conducting additional sampling in each building consisting of i) samples typically collected for a conventional vapor intrusion investigation and ii) application of the draft protocol for use of on-site GC/MS analysis for the investigation of vapor intrusion (from ER-201119), and
4) Comparing the interpretation of the additional sampling to the interpretation from the CSIA results in order to determine the reliability and comparability of the different investigation approaches.

Specific performance objectives are summarized in Table 1.

Table 1:   Performance Objectives

Performance Objective	Data Requirements	Success Criteria
Quantitative Performance Objectives		
1) Collection of data representative of site conditions.	Subsurface samples (groundwater samples collected in VOA vials or soil gas samples collected on sorbent tubes or in Summa canisters) and analytical results. Indoor air samples collected on sorbent tubes, and associated analytical results.	Precision, Accuracy, Completeness, Representativeness, and Comparability as defined in the quality assurance project plan. **Result: Data met overall QA goals.**
Qualitative Performance Objectives		
2) Validation of the draft protocol for the use of CSIA to distinguish between indoor sources of VOCs and vapor intrusion.	Determination of VOC sources using results from i) application of the protocol, ii) conventional sampling approach, and iii) on-site GC/MS analysis (per ER-201119).	Success will be achieved if: 1) The three investigation methods all yield definitive and consistent determinations regarding the primary source of VOCs in indoor air, or 2) If one or more of the methods yields ambiguous results regarding the primary source, attainment of a definitive determination using the CSIA method that is consistent with a definitive determination from one of the two alternate methods (if available). **Result: Performance objective met. CSIA results were consistent with overall weight of evidence at demonstration sites. CSIA protocol correctly identified a building with a planted source. CSIA protocol provided strong evidence of indoor source for a building for which the other methods yielded more ambiguous results.**
3) Validation of draft protocol for identification of both indoor and subsurface sources.	Application of the draft protocol for at least one site with VOCs originating from a subsurface source and at least one site with VOCs originating from an indoor source.	Attainment of the validation success criteria at both types of sites (i.e., subsurface source sites and indoor source sites). **Result: Performance objective met. Vapor intrusion was indicated in 1 of 4 demonstration buildings. Indoor sources were the primary sources of VOCs in 3 of 4 demonstration buildings. Calculations were completed to evaluate the impact of mixed indoor/subsurface sources.**
4) Implementability of the draft protocol for the use of CSIA to evaluate vapor intrusion.	Field experience implementing the protocol and interpreting the results.	Determination that the protocol is implementable and cost effective. **Result: The protocol is usable and cost effective. Recommendations for protocol improvement based on demonstration findings have been incorporated into a revised protocol (Appendix E of this report).**

3.1 PERFORMANCE OBJECTIVE 1: COLLECTION OF DATA REPRESENTATIVE OF SITE CONDITIONS

The collection of site data representative of actual site conditions was achieved by adhering to the sampling and analysis procedures specified in Section 5 of this report and the Demonstration Plan (GSI, 2012d).

3.1.1 Data Requirements

As discussed in Section 5.1, the demonstration program for each site consisted of i) collection of samples associated with a conventional vapor intrusion investigation, ii) collection of samples for CSIA, and iii) application of the on-site analysis investigation protocol for the ER-201119 demonstration program. The data requirements and QA procedures for the conventional sampling program and the on-site analysis program are detailed in the Demonstration Plan and Final Report for ER-201119 (GSI, 2012b; GSI, 2013).

For the CSIA samples, proper sample collection procedures were utilized and QA/QC samples collected to ensure that the data were representative of actual site conditions. As detailed in the Quality Assurance Project Plan (QAPP; see GSI, 2012d, Appendix D), field QA/QC samples included field duplicates and trip blanks.

3.1.2 Success Criteria

QA/QC samples were evaluated to determine the data quality. Details of the data quality review are presented in Section 6.1 of this report.

3.2 PERFORMANCE OBJECTIVE 2: VALIDATION OF DRAFT PROTOCOL FOR USE OF CSIA TO EVALUATE VAPOR INTRUSION

The goal of the field demonstration was to produce a validated procedure for the use of CSIA to evaluate vapor intrusion. The draft protocol tested during the demonstration included a step-wise sampling program and data interpretation matrix (GSI, 2012c).

3.2.1 Data Requirements

Validation of the draft protocol required comparison of the results from application of the protocol with results obtained using other investigation approaches. The two approaches for comparison were i) conventional building-specific vapor intrusion sampling (i.e., collection of sub-slab and indoor air samples) and ii) on-site GC/MS analysis per ER-201119. Each of the data sets was analyzed independently to determine the primary source of VOCs detected in the target building.

3.2.2 Success Criteria

The performance objective was considered met if i) the three investigation methods yielded consistent, definitive determinations regarding the presence or absence of vapor intrusion, or ii) if one or more of the methods yielded ambiguous results, but a definitive determination could be made using the CSIA method. Details of this evaluation are provided in Section 6.2 of this report.

3.3 PERFORMANCE OBJECTIVE 3: VALIDATION OF DRAFT PROTOCOL FOR IDENTIFICATION OF BOTH INDOOR AND SUBSURFACE SOURCES

A comprehensive validation of the draft protocol requires validation for the identification of both indoor sources of VOCs and subsurface sources of VOCs.

3.3.1 Data Requirements

Comprehensive validation requires application of the protocol for at least one building where the VOCs detected in the building originate from a subsurface source and at least one building where the VOCs originate from a subsurface source.

3.3.2 Success Criteria

The CSIA protocol will be considered fully validated if the validation criteria (Section 3.2) are met for sites covering both subsurface and indoor sources of VOCs. An evaluation of this performance objective is provided in Section 6.3 of this report.

3.4 PERFORMANCE OBJECTIVE 4: IMPLEMENTABILITY AND COST EFFECTIVENESS

The protocol should be implementable by environmental professionals with typical training and experience. The protocol should also be a cost effective adjunct to a larger vapor intrusion investigation.

3.4.1 Data Requirements

Field experience obtained during the demonstration program was evaluated. Qualitative success criteria included complexity of the protocol implementation and any other logistical issues and costs associated with implementation.

3.4.2 Success Criteria

The objective was considered to be met if the protocol was determined to be implementable and cost effective. An evaluation of this performance objective is provided in Section 6.4 of this report.

4.0 SITE DESCRIPTION

The field demonstration was completed at four sites: i) Joint Base Lewis-McChord near Tacoma, Washington, ii) Selfridge Air National Guard Base, near Detroit, Michigan, iii) Tyndall Air Force Base, near Panama City, Florida, and iv) the former Raritan Arsenal in Edison, New Jersey. Prior to each demonstration, on-site screening was conducted in order to select the buildings for implementation of the full demonstration program. The CSIA demonstration was combined with the demonstration of another innovative vapor intrusion investigation method (on-site GC/MS analysis to distinguish between VI and indoor sources of VOCs; ESTCP ER-201119). Both projects involve protocols to distinguish between indoor sources of VOCs and vapor intrusion. Site selection prioritized the following:

- *Building Characteristics*: Availability of one to three buildings at each site. Specific buildings for investigation were to be residential or industrial, large or small, and occupied or suitable for occupancy.

- *Subsurface Sample Points*: Presence of at least three existing subsurface sample points (either monitoring wells or soil gas sample points) with detectable concentrations of VOCs located within 1000 ft of a target building (either upgradient of the building or within 100 ft downgradient). These sample points were used to characterize the isotope fingerprint of the subsurface VOC source.

- *Vapor Intrusion Concern*: Presence of building(s) with either i) known vapor intrusion issues or ii) high vapor intrusion concern based on the presence of VOCs in close proximity to the building.

- *Building Access*: Availability of access to all parts of the building(s) during normal working hours for up to three days.

4.1 SITE LOCATION AND HISTORY

Each of the demonstration sites has a dissolved chlorinated solvent or petroleum hydrocarbon plume, or both, in shallow groundwater that has migrated away from the source (release) area. Prior to the demonstration, each site had been investigated in sufficient detail to provide an understanding of site geology and contaminant distribution in the subsurface and to allow selection of candidate buildings for the demonstration. Final selection of buildings for the demonstration was based on the existing data supplemented, in some cases, by field screening.

The demonstration sites included:

- *Joint Base Lewis-McChord (Lewis-McChord)*: This site is a military facility located south of Tacoma, Washington, that is an amalgam of US Army Fort Lewis and McChord Air Force Base. A chlorinated solvent plume is present in the uppermost aquifer beneath buildings in the Logistics Center. Because of the potentially large number of candidate buildings at the site, GSI prioritized the buildings by selecting those with footprints located within 200 feet of a shallow zone monitoring well having TCE concentrations greater than 10 µg/L in the most recent monitoring event. This prioritization yielded eight buildings (Buildings 9522, 9671, 9666, 9679, 9674, 9669, 9564, and 9673). At the beginning of the field demonstration, indoor air in these buildings was screened using the HAPSITE ER. The key analyte used for screening was TCE, the primary COC in groundwater.

The highest TCE concentration (TCE 0.3 ppbV [1.6 µg/m^3]) was found in Building 9669, which was selected as the first demonstration building. The other buildings had lower TCE concentrations, ranging from below detection limits to 0.03 ppbV (0.2 µg/m^3).

- *Selfridge Air National Guard Base (Selfridge)*: This site is an active military installation located north of Detroit, Michigan. Building 1533, located on the southwest corner of the base, was selected for the demonstration. This building is currently used as a maintenance facility for the U.S. Border Patrol.

  Releases from two underground storage tanks (USTs) located northeast of Building 1533 were discovered in 1992. One of the tanks reportedly contained leaded gasoline and the other, diesel fuel. The tanks were removed in 1992, and remediation and groundwater monitoring have been conducted since that time. The shallow petroleum hydrocarbon plume is present beneath much of the Building 1533 footprint. The key target compound in groundwater is benzene.

- *Tyndall Air Force Base (Tyndall)*: This site is an active military installation located near Panama City, Florida. Chlorinated solvent plumes are present in shallow groundwater beneath several on-site buildings. To prioritize buildings for investigation, GSI reviewed building locations relative to recent groundwater monitoring results, focusing on TCE, one of the key COCs in groundwater. Based on this evaluation, we prioritized six buildings: Building 156, 246, 219, 522, 258, and 560. GSI screened the indoor air in the six buildings, analyzing the samples with a HAPSITE SMART instrument. TCE concentrations were typically less than 0.1 ppbV (0.54 µg/m^3). Because the concentrations were relatively low, Building 219 was selected as a building to test a "planted" source, to determine if the CSIA protocol could correctly identify the indoor VOC source. Access was also available for Building 156. Low TCE concentrations in indoor air made this building inappropriate for the CSIA demonstration. However, groundwater and sub-slab soil gas samples were collected for isotope analysis at Building 156, to evaluate sample locations which best characterize the isotope signature in the subsurface (see Section 6.2.2).

- *Former Raritan Arsenal Site (Raritan)*: This Formerly Used Defense Site (FUDS) is located in Middlesex County, New Jersey. The site was operated by the US Army and was used for handling ammunition and ordnance from 1917- 1963. Since site closure in 1963, various environmental investigation, remediation, and monitoring projects have been conducted. Over the last 10 years, more than 45 buildings have been evaluated for the vapor intrusion pathway, and six are subject to ongoing monitoring. Several buildings have had mitigation systems installed (Weston, 2012). The Campus Plaza 4 (CP4) building was selected for the CSIA demonstration because it is located near shallow impacted groundwater plumes, ii) it does not have an active mitigation system,

> and iii) historical indoor air and sub-slab VOC sample results are available for comparison from 2004 – present. CP4 has been partitioned into separate suites to accommodate the current tenants. It is occupied by three tenants and the property owner's firm. To screen the indoor air VOC concentrations in building, at least one indoor air sample was collected in each of the four tenant spaces. Based on the TCE results, the office/warehouse space on the west end of Campus Plaza 4 was selected for the demonstration. TCE indoor air concentrations in the west end was approximately 1 ppbV (5.4 µg/m^3), but ranged from below detection limits to 0.2 ppbV (1 µg/m^3) in the other tenant spaces.
>
> In addition to CP4, Building 209 was accessible for the demonstration. TCE was not detected in indoor air screening samples, making the building unsuitable for the CSIA protocol. However, groundwater and soil gas samples were collected to evaluate sample locations which best characterize the isotope signature in the subsurface (see Section 6.2.2).

In summary, four industrial buildings (Lewis-McChord Building 9669, Selfridge Building 1533, Tyndall Building 219, Raritan Building CP4) were included in the field demonstration. The demonstration included conventional VI sampling in each building as well as application of the on-site GC/MS analysis (ESTCP Project ER-201119) and CSIA protocols as summarized in Table 2. Although the CSIA protocol was not applicable at two additional buildings (Tyndall Building 156, Raritan Building 209) because of low VOC concentrations in indoor air, groundwater and sub-slab soil gas samples were collected to evaluate sample locations which best characterize the isotope signature in the subsurface.

Table 2: Demonstration Buildings

Building / Use	**Size (sq ft)**	**Construction**	**Key VOC for VI Evaluation**	**On-Site GC/MS Analysis Demonstration Completed (ER-201119)**	**CSIA Demonstration Completed (ER-201025)**
Joint Base Lewis-McChord, Washington					
9669/ Warehouse[1]	20,000	Slab on grade	TCE	Yes	Yes
Selfridge Air National Guard Base, Michigan					
1533/ Vehicle Maintenance	2,000	Slab on grade	Benzene	Yes	Yes
Tyndall Air Force Base, Florida					
219 / Office[2]	7,000	Slab on grade	TCE	Yes	Yes (Planted Indoor Source)
Former Raritan Arsenal, New Jersey					
Campus Plaza 4[3] Office and Warehouse	30,000	Slab on grade	TCE	Yes	Yes

Notes:
1) Building 9669 is approximately 40,000 sq ft and is divided into 2 halves. The demonstration was conducted the southeastern half of the building.
2) Building 219 is approximately 23,000 sq ft. The demonstration was conducted in the central portion of the building where access was granted.
3) Campus Plaza 4 building area is approximately 73,500 sq ft. The demonstration was conducted in the western portion of the building.

4.2 SITE GEOLOGY, HYDROGEOLOGY, AND CONTAMINANT DISTRIBUTION

The demonstration sites and buildings have varying degrees of concern with respect to vapor intrusion based on previously conducted environmental assessments. The geology, hydrogeology, and contaminant distribution at each site are summarized in Table 3.

Table 3: Demonstration Site Geology/Hydrogeology and Key Contaminants

Site	Geology/Hydrogeology	Contaminant Distribution
Joint Base Lewis-McChord Logistics Center	Shallow stratigraphy consists of alternating glacial and non-glacial sediments (Envirosphere, 1988). Depth to water approximately 20-30 feet bgs. Hydraulic gradient to the northwest.	Chlorinated VOCs (cVOCs) are present in shallow groundwater as a result of historic releases from former disposal areas located upgradient of the buildings cVOCs included in site groundwater monitoring program: TCE, cis-1,2-DCE, PCE, 1,1,1-TCA, VC Near the demonstration buildings, TCE concentrations in groundwater in the shallow aquifer range from 60 – 110 µg/L, based on monitoring conducted in Spring 2012.
Selfridge Air National Guard Base	Shallow stratigraphy consists of glacial lake sediments (e.g., clays and silts) overlying a sedimentary bedrock. In the vicinity of Building 1533, shallow soils are predominantly sand and gravel fill. Underlying the fill is a clay layer approximately 30-40 feet thick (AMEC, 2010). Depth to water approximately 2 – 6 feet bgs. Hydraulic gradient to the south-southwest.	Impacted soils were excavated from the former UST basin and nearby areas in 1992 and 2003. Remaining soil and groundwater impacts are present along the western edge of the former UST basin/excavation area, under the eastern portion of Building 1533, and south of Building 1533. Key COCs from the site investigation are BTEX and PAH compounds. Benzene was considered the primary COC for the vapor intrusion evaluation.

Site	Geology/Hydrogeology	Contaminant Distribution
Tyndall Air Force Base	Shallow stratigraphy consists primarily of unconsolidated sands approximately 50 feet thick. This interval is underlain by a calcareous sandy clay to clayey sand (Jackson Bluff Formation). Depth to the water table aquifer ranges from 2 – 7 feet bgs. In the vicinity of the study building, the hydraulic gradient is generally towards the north/northeast.	cVOCs are present shallow (water table) and deeper zones at the site. The areal extent of cVOCs in the shallow zone is smaller than in the deeper zones. Recent groundwater monitoring results near the demonstration buildings indicate that TCE and cis-1,2-DCE are the primary constituents. Near Building 219, TCE concentrations are less than 10 µg/L; cis-1,2-DCE concentrations have been measured at more than 2,000 µg/L (3E Consultants, 2011).
Former Raritan Arsenal Site	The shallow stratigraphy consists of interbedded sands and clays. Gravels may also be present. There are two separate plumes with separate source areas in the vicinity of the demonstration building. The hydraulic gradient is generally towards the southeast. (Weston, 2013) The Campus Plaza 4 building is located above the Area of Concern 2 plume. The depth to water in the vicinity of Campus Plaza 4 is approximately 10 feet bgs.	2012 groundwater monitoring results near the demonstration buildings indicate that TCE is the primary COC. At Campus Plaza 4, TCE concentrations are approximately 8 µg/L.

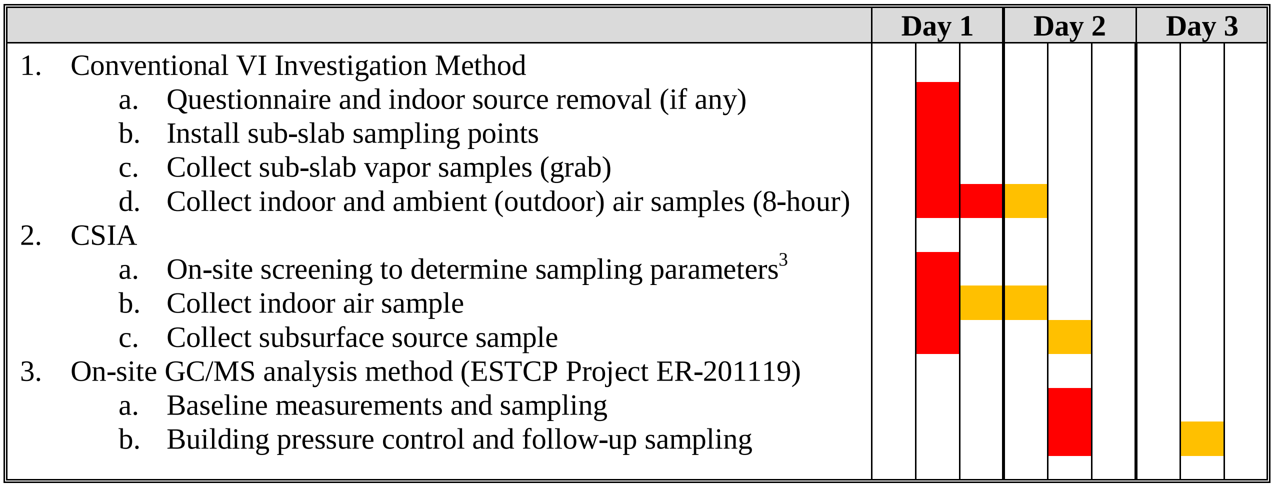
5.0 TEST DESIGN

The field demonstration of this protocol was conducted at four DoD sites.

5.1 CONCEPTUAL EXPERIMENTAL DESIGN

In general terms, at each target building, the demonstration program consisted of i) collection of indoor air and sub-slab soil gas samples in accordance with conventional vapor intrusion investigation methods (Section 5.1.1), ii) collection of samples for stable isotope analysis (Section 5.1.2), and iii) implementation of the draft protocol for evaluation of vapor intrusion using on-site analysis (ESTCP Project ER-201119; Section 5.1.3) [see Figure 2]. The results from each of the three sampling programs were evaluated as described in Section 5.7 in order to assess the comparability of the three investigation methods.

Figure 2: Building-Specific Field Testing Schedule



	Day 1			Day 2			Day 3		
1. Conventional VI Investigation Method									
a. Questionnaire and indoor source removal (if any)		🟥							
b. Install sub-slab sampling points		🟥							
c. Collect sub-slab vapor samples (grab)		🟥							
d. Collect indoor and ambient (outdoor) air samples (8-hour)		🟥	🟥	🟧					
2. CSIA									
a. On-site screening to determine sampling parameters[3]		🟥							
b. Collect indoor air sample		🟥	🟧	🟧					
c. Collect subsurface source sample		🟥			🟧				
3. On-site GC/MS analysis method (ESTCP Project ER-201119)									
a. Baseline measurements and sampling					🟥				
b. Building pressure control and follow-up sampling					🟥			🟧	

Notes: 1) Pre-sampling equipment checks and calibration are not shown. These activities occurred prior to any building investigations (prior to "Day 1"); 2) Orange = contingent; 3) For CSIA, VOC concentrations must be estimated to determine sample locations and sampling time.

5.1.1 Conventional Program - Collection of Indoor Air and Sub-Slab Soil Gas Samples

Currently, building-specific vapor intrusion investigations are most commonly conducted by collecting a limited number of indoor air and sub-slab soil gas samples for off-site analysis. The results are interpreted using a multiple-lines-of-evidence approach.

For the demonstration, the conventional program was completed first. A visual building survey, interview with building representative, and record review were conducted to identify indoor VOC sources for removal prior to sampling, consistent with conventional approaches. No indoor sources were identified and removed from any of the demonstration buildings using this approach. The conventional sampling program implemented in each building is summarized in Table 4.

Table 4: Summary of Conventional Vapor Intrusion Sampling Program

Component	Matrix	Typical Number of Samples[1]	Analyte	Location
Conventional Vapor Intrusion Sampling Program (each test building)	Indoor air	2	VOCs	Indoors, with number of locations depending on building size
	Sub-slab vapor	3	VOCs	Sub-slab, 3 locations
	Ambient air	1	VOCs	Outdoors, upwind of building

Note: 1) Table does not include QA samples.

5.1.2 Collection of Samples for Stable Isotope Analysis

ESTCP Project ER-201025 involved the use of CSIA for the evaluation of vapor intrusion. Because the on-site analysis protocol (Section 5.1.3) could include identification and removal of indoor VOC sources as well as manipulation of building pressure conditions, the CSIA and conventional programs were completed first to avoid inadvertently influencing the results of these programs.

The CSIA sampling program is summarized in Table 5.

Table 5: Summary of CSIA for Vapor Intrusion Sampling Program

Component	Matrix	Number of Samples[1]	Analyte	Location
CSIA for Vapor Intrusion Sampling Program (each test building)	Indoor air	1 - 3	Isotope ratios for target VOC	Inside target building
	Sub slab vapor	1 - 2	Isotope ratios for target VOC	Below target building foundation
	Subsurface source	1 - 3	Isotope ratios for target VOC	Nearby monitoring well(s)

Note: 1) Table indicates approximate number of samples collected. Detailed information concerning the logic for determining the sample locations and the specific number of samples to be collected is provided in the Demonstration Plan for ER-201025 (GSI, 2012d).

Section 5 of the Task 2 report (GSI, 2012c) presents the protocol for application of CSIA to vapor intrusion that was validated through this demonstration. The protocol provides a detailed description of the sample collection process. In general, the process included i) identification of subsurface and indoor air sampling locations, ii) estimation of the target VOC concentration at each sample point, iii) identification of the appropriate sample collection method based on the estimated concentration, and iv) sample collection.

5.1.3 Protocol for Use of On-Site Analysis for Vapor Intrusion

Following collection of the conventional samples and CSIA samples, the on-site analysis protocol (GSI, 2012a) was implemented in each building. The protocol uses a step-wise sampling and analysis program to identify vapor entry points and indoor sources of VOCs. The specific number of samples collected varied from building to building because the scope of each step in the investigation process is defined by the prior results.

5.2 BASELINE CHARACTERIZATION

As discussed in Section 4, site and building selection was based on pre-existing data. No additional baseline characterization was conducted prior to the demonstration at each building.

5.3 LABORATORY STUDY RESULTS

A laboratory study was conducted to evaluate the analytical method and isotope signatures associated with indoor VOC sources (Kuder et al., 2012). That study was followed by a literature review as well as analysis of additional samples of common indoor VOC sources (GSI, 2012c). During the demonstration, GSI collected two additional samples of natural gas, a potential indoor source of benzene, for isotopic analysis. Those results are summarized in Section 5.8 below.

5.4 DESIGN AND LAYOUT OF TECHNOLOGY COMPONENTS

At each building selected for the demonstration, the field program consisted of i) collection of samples associated with a conventional VI investigation, ii) collection of samples for demonstration of CSIA for VI evaluation, and iii) implementation of the on-site analysis protocol. Sections 5.4.1-5.4.3 describe sampling point installation procedures for each of the investigation methods.

5.4.1 Sampling Points for Conventional Samples

Sub-slab Sample Points: For the first three demonstration sites (Lewis-McChord, Selfridge, and Tyndall), three sub-slab sample points were installed in each test building to characterize the distribution of VOCs below the building foundation. Specific sample locations were distributed across the building and were adjusted to minimize the disturbance of building activities. Sample points for the collection of sub-slab soil gas samples were installed by drilling a ¾ to 1 inch hole through the building slab and into the underlying soil or fill material to a depth of 3 to 4 inches below the base of the foundation. A length of 1/8 inch outside diameter (OD) nylon tubing was placed in the hole and covered with approximately 3-4 inches of 20/40 sand. The remainder of the hole was sealed with a combination of hydrated bentonite clay and modeling clay. The end of the tubing was plugged with modeling clay when samples were not being collected. After sample collection was completed, the sample points were removed and the holes were sealed with cement or concrete patch.

At the last demonstration site (Raritan), permanent sub-slab sampling points had previously been installed for on-going VI monitoring. Rather than install new sub-slab sampling points, GSI used the existing points in the test buildings at this site.

Indoor Sample Points: For each test building, one to three indoor air sample points were collected to characterize the distribution of VOCs inside the building. Specific sample points were selected based on an evaluation of building operating characteristics, building size, and layout. Sample locations were also chosen to minimize disruption of building activities.

Outdoor Sample Point: For each demonstration site, at least one ambient (outdoor) air sample point was selected to characterize the concentration of VOCs outside the building. Specific sample points were located to balance the following factors: i) upwind, ii) avoid disruption to building occupants, and iii) location next to the HVAC system air intake if access to this point was available.

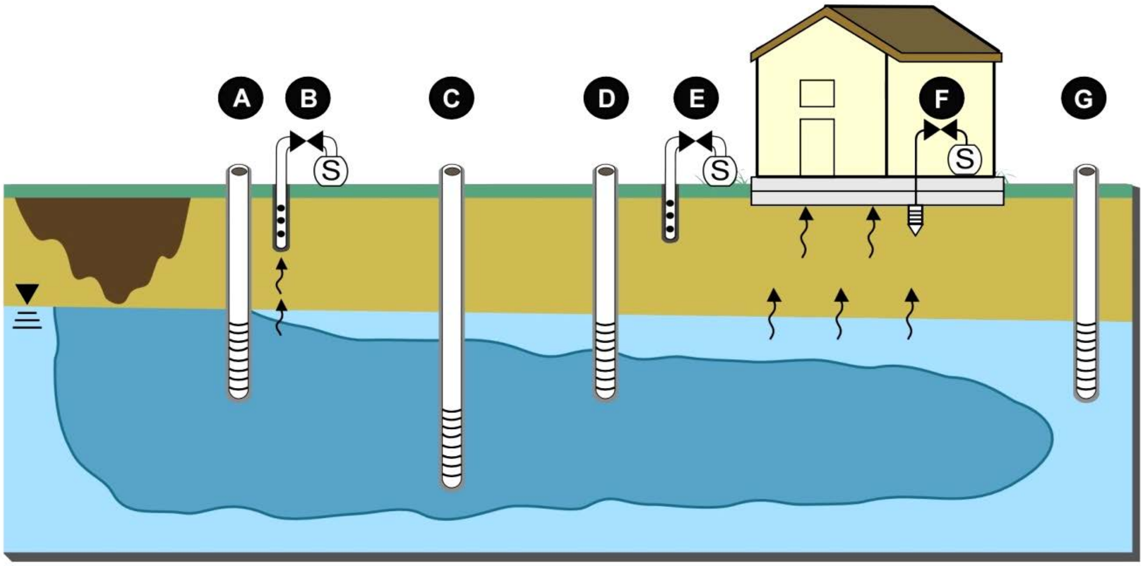
5.4.2 Sampling Points for CSIA Samples

Indoor Air Sampling Points: Sampling points were selected based on criteria in the protocol (Section 5.3 of GSI 2012c). In short, a sample was collected from the area of the building most likely to be impacted by vapor intrusion (e.g., location with elevated target VOC concentration based on on-site analysis (screening) result). Additional samples were collected based on building size, construction, or results of field screening.

Subsurface Sampling Points (Sub-slab): At least one sub-slab sample point used during the conventional program (Section 5.4.1) was also sampled for stable isotope analysis. The sub-slab sample point was selected based on field screening (i.e., the sub-slab location with the highest target VOC concentration was sampled for stable isotope analysis). Sub-slab sampling (Location F in Figure 3) is not recommended in the protocol for primary subsurface source characterization, but was done during the demonstration to help evaluate variability of the isotope ratios.

Subsurface Sampling Points (Groundwater): Existing groundwater monitoring points were used to collect samples for stable isotope analysis to characterize the subsurface source. Sample locations were selected using the criteria in the protocol (Section 5.2 of GSI, 2012c; see also Figure 3). No soil gas monitoring points (Location Type E) were available to be sampled during the field demonstration.

Figure 3: Advantages and Disadvantages of Sample Locations for Characterization of the Subsurface VOC Isotope Signature



Location	Advantages	Disadvantages
A) Upgradient Groundwater Well (Screened at water table)	• Water sample easier to collect than soil gas sample. • Easiest sample point if this is the closest existing well to target building.	• Does not account for any additional enrichment that occurs closer to building. • Isotope ratios for this sample may be more similar to indoor sources than actual VOCs entering building. As a result, sample may underestimate potential for CSIA to yield definitive results.
B) Soil Gas Sampling Point Not Close to Target Building (i.e., >100 m from building[1])	• Not recommended	• High uncertainty. Isotope ratios may not be representative of actual VOCs entering building due to spatial variability in vadose zone biodegradation processes.
C) Deep Groundwater Well	• Not recommended	• High uncertainty. Isotope ratios may not be representative of VOCs at top of water table.
D) Groundwater Well Close to Target Building (Screened at water table)	• Water sample easier to collect than soil gas sample. • This water sample will be most representative of VOCs potentially entering building.	• Does not account for any additional enrichment that occurs within vadose zone.
E) Soil Gas Sample from Close to Building	• Not recommended based on findings from the demonstration	• More difficult to collect than water sample. • Further testing recommended. Based on the demonstration, sub-slab vapors were not representative of source vapors entering a building. Because sub-slab vapors not representative, further testing is needed to determine whether soil gas samples would be representative.
F) Sub-slab Soil Gas Sample	• Not recommended for primary characterization of subsurface source.	• May contain VOCs originating from within building. • Sample collection can be a lengthy process, depending on concentration
G) Downgradient Groundwater Well	• Not recommended	• May be more enriched in heavy isotopes than VOCs entering building. • Could yield false negative results.

Note: 1) This table summarizes sample location selection criteria. Updated recommendations based on findings from the demonstration are also provided in Appendix E.

5.4.3 Sampling Points for On-Site Analysis Protocol

Implementation of the on-site analysis protocol did not require the collection of any samples from the subsurface and, therefore, did not require the installation of any sample points. Indoor air sample locations were selected in accordance with the protocol for ER-201119, which involves iterative sampling within a building to follow VOC concentration gradients to the source.

5.5 FIELD TESTING

5.5.1 Field Testing for Conventional Vapor Intrusion Program

Conventional vapor intrusion investigation programs do not typically utilize field testing. An attempt to identify and remove indoor sources of VOCs is commonly conducted using a questionnaire and interview with the building owner or operator.

For each of the test buildings, the investigation team met with building representative(s) to complete an occupied building questionnaire and to conduct a visual inspection for potential indoor sources. For the Raritan buildings, previously-completed questionnaires were available for review.

No indoor VOC sources were removed from the test buildings based on these procedures.

5.5.2 Field Testing for CSIA Samples

Collection of vapor-phase samples for CSIA required an estimation of the concentration of the target VOC at the sample location. This estimate is needed to determine the proper sample volume. For the demonstration, estimates of target VOC concentrations were based on on-site analysis typically conducted the same day as the CSIA sampling. Other information such as data from previous studies was used, if available.

On-site analysis was used to estimate target VOC concentrations in different areas of the building. Potential indoor air sample locations were selected based on the building characteristics (e.g., separate tenant suites). Additional indoor air sample locations were selected based on building size or VOC concentration from the on-site analysis.

Three sub-slab sample points were installed during the conventional program. After installation of each point, the sub-slab soil gas was screened using on-site analysis. One to two sub-slab points with the highest concentrations were selected for CSIA sampling.

Field testing prior to groundwater sample collection was not needed.

5.5.3 Field Testing for On-Site Analysis Protocol

Field testing for the on-site analysis program is described in the Demonstration Plan for ER-201119 (GSI, 2012b).

5.6 SAMPLING AND ANALYSIS METHODS

As described above, three different vapor intrusion investigation methods were employed during the demonstration. Each method included specific sampling procedures and analysis of samples at an off-site laboratory. Laboratory analytical methods are summarized in Table 6.

Table 6: Laboratory Analytical Methods for Demonstration

Matrix	Analyte	Method	Container	Preservative	Holding Time
Conventional Vapor Intrusion Program					
Vapor	VOCs	USEPA TO-15[1]	6-L Summa Canister	None	30 days
CSIA Program					
Vapor	VOCs and corresponding isotopes	Klisch et al., 2012[2]	Sorbent tube	Ice	4 weeks[2]
Ground-water	VOCs and corresponding isotopes	Klisch et al., 2012[2]	VOA vials	Ice	2 weeks
On-Site GC/MS Program					
Vapor	Radon	McHugh et al., 2008[3]	1-L Tedlar bag	None	14 days[4]
	VOCs	USEPA TO-15[1]	6-L Summa Canister	None	30 days

Notes:
1) Samples analyzed by ALS/Columbia Analytical Services in Simi Valley, CA.
2) Samples analyzed by the University of Oklahoma, Norman, OK. Holding time for vapor samples was originally 2 weeks but has been extended based on additional studies. See Section 6.1.2.
3) Samples analyzed by the University of Southern California, Los Angeles, CA.
4) No holding time specified, but lab tests demonstrate accurate results after 14 days storage in Tedlar bag (McHugh et al., 2008).

5.6.1 Conventional Vapor Intrusion Program

The conventional sampling program consisted of indoor and ambient air and sub-slab soil gas sample collection for VOC analysis.

Collection and Analysis of Indoor and Ambient Air Samples: At each test building, indoor and outdoor air samples were collected in individually certified, 6-L Summa canisters. Flow controllers were used to collect 8-hour composite samples for analysis of VOCs by USEPA Method TO-15 or TO-15 SIM.

Collection and Analysis of Sub-Slab Gas Samples: Prior to sample collection, the sample points were purged and a helium tracer test was conducted to verify that the point was not leaking. The test was conducted by threading the sample point tubing through a shroud. The shroud was then filled with at least 10% helium, as measured with an MGD-2002 portable helium meter. After the shroud filled with the desired amount of helium, the helium meter was attached to the probe tubing. The point passed the leak test if the concentration in the tubing was less than 10% of the concentration in the shroud. In addition to the helium tracer test, a shut-in test was conducted to verify that the sampling train did not leak. Any leaks at the probe point or in the sampling train were repaired by rehydrating the bentonite or tightening connections in the sampling train, respectively. After confirming that the points were leak free, the sample was collected. Samples were collected in individually certified, 6-L Summa canisters. The samples were collected as grab samples (i.e., without flow controllers) for analysis of VOCs by USEPA Method TO-15 or TO-15 SIM.

5.6.2 CSIA Samples

Collection and Analysis of Vapor Samples: Indoor air and soil gas samples can be collected using Summa canisters or sorbent tubes, depending on the sample mass required for analysis. The mass is a function of sample volume and concentration. Recommendations for sample containers and parameters were provided in the demonstration protocol (GSI, 2012c). For the demonstration, all samples were collected using sorbent tubes.

Collection and Analysis of Water Samples: Water samples for CSIA can be collected using the same sampling procedures used to collect samples to measure concentration. The number of VOA vials, preservative, and other information is provided in the protocol.

5.6.3 On-Site Analysis Protocol Confirmation Samples

Collection and Analysis of Indoor Air Samples: The majority of samples collected for this protocol are analyzed on-site. However, at the end of each phase of the protocol (i.e., baseline building characterization, characterization of depressurized building conditions, etc.), a sample is collected for off-site laboratory analysis. These samples are used to i) assess the accuracy of the on-site analysis results and ii) to provide fully validated documentation of VOC concentrations in indoor air. Each confirmation sample was collected as a grab sample in an individually certified, 6-L Summa canister, with VOC analysis by USEPA Method TO-15 or TO-15 SIM. Separate ambient (outdoor) air samples were not collected for this portion of the demonstration because an ambient air sample was already collected for the conventional program (Section 5.6.1).

Collection and Analysis of Indoor and Outdoor Air Samples for Radon: The on-site analysis protocol includes an option to manipulate building pressure to further evaluate the source of VOCs in indoor air. At each test building where the optional building pressure control procedure was implemented, at least two indoor air samples and one ambient air sample were collected in Tedlar bags for off-site radon analysis. The indoor air samples for radon analysis were paired with the samples collected in Summa canisters for VOC analysis.

5.6.4 Sample Summary and Quality Assurance Procedures

In addition to samples collected for the demonstration (summarized in Table 7 below), samples were collected for quality assurance purposes. QA samples collected for off-site laboratory analysis consisted of field duplicates and trip blanks. Field duplicates were collected at a rate of at least 1:20 Summa canisters, 1:20 Tedlar bags, and 1:10 sorbent tubes. One sorbent tube trip blank was also analyzed for each demonstration site.

In addition to QA samples, other measures were taken to assure data quality. These measures included:

- Adhering to the Demonstration Plans for ER-201119 and ER-201025 and associated QAPPs (GSI, 2012b; GSI, 2012d)

- Collecting and analyzing field QA samples (see Section 6.1 and Appendix D)

- Use of Decontamination Procedures, where applicable. All sampling equipment was either i) single-use, disposable material or ii) flushed/purged before samples were collected. Sampling equipment used to collect samples from locations with potentially high VOC concentrations (e.g., sub-slab sample points) was not used subsequently for the collection of low concentration samples (e.g., indoor air). Summa canisters used for collection of sub-slab, indoor, and ambient vapor samples were supplied by ALS/Columbia Analytical Services (Simi Valley, CA), and were individually certified clean to prevent any contamination from previous samples. Samples for radon analysis were collected using single-use Tedlar sample bags. Cleaned and prepared sorbent tubes and VOA vials were provided by University of Oklahoma and TestAmerica Laboratories (Houston, TX), respectively.

- Sample Documentation. Field documentation was facilitated by pre-printed tables, labels, and log forms that simplified and allowed for more precise notation of sample collection and conditions while in the field. All samples for laboratory analysis were submitted under chain-of-custody control. All laboratory reports included a narrative that discussed any quality control excursions. Photographs were also taken to document project activities.

5.7 SAMPLING RESULTS

Tables 7 and 8 summarize the demonstration program and key analytes considered for each demonstration building. Vapor intrusion classifications for the four demonstration buildings are summarized in Appendix B, along with the lines of evidence applicable to each investigation method. Comprehensive sampling results for ER-201025 (CSIA demonstration) and ER-201119 (on-site analysis demonstration) are included in Appendix C. Appendix D contains tables summarizing the data quality review. Laboratory reports are also provided in Appendix D.

Table 7: Summary of Demonstration Program

	Conv. VI Program			CSIA			On-Site Analysis		
Site / Building	**Sub-slab Sample Locations**	**Indoor Air Sample Locations**	**Outdoor Air Sample Locations**	**Source (GW) Sample Locations**	**Sub-slab Sample Locations**	**Indoor Air Sample Locations**	**On-Site GC/MS Indoor Air Samples**	**On-Site Surveys**	**Pressure Conditions Tested**
Joint Base Lewis-McChord, Washington									
Building 9669	3	2	1	3	1	1	35	3	BL, NP, PP
Selfridge Air National Guard Base, Michigan									
Building 1533	3	1	1	1	2	1	28	6	BL, NP, PP
Tyndall Air Force Base, Florida									
Building 219	3	2	1	1	1	1	9	0	BL
Former Raritan Arsenal Site, New Jersey									
Campus Plaza 4	2	2	1	2	1	2	56	0	BL, NP

Note: BL = baseline (normal) operating conditions; NP = induced negative pressure; PP = induced positive pressure

Table 8: Key Analytical Parameters

	Conv. VI and On-Site Analysis Program		CSIA		
Site / Building	**TO-15 (Key Analyte[1])**	**On-Site Analysis (Key Analyte[1])**	**Compound**	**Isotope 1**	**Isotope 2**
Joint Base Lewis-McChord, Washington					
Building 9669	cVOCs (TCE)	cVOCs (TCE)	TCE	C	Cl
Selfridge Air National Guard Base, Michigan					
Building 1533	Petroleum HCs (Benzene)	PHC (Benzene)	Benzene	C	-
Tyndall Air Force Base, Florida					
Building 219	cVOCs (TCE)	cVOCs (TCE)	TCE	C	Cl
Former Raritan Arsenal Site, New Jersey					
Campus Plaza 4	cVOCs (TCE)	cVOCs (TCE)	TCE	C	Cl

Notes: Key Analyte = key analyte for vapor intrusion evaluation

Each test building, the vapor intrusion classification was interpreted based on the framework set out in the Demonstration Plan. For the **conventional and on-site analysis protocols**, a lines-of-evidence approach was used. Key questions were developed for each investigation method. The answers to the questions dictated the building's vapor intrusion classification (Table 9).

Table 9: VI Classification using Lines of Evidence Approach

Results of Lines of Evidence Evaluation	Vapor Intrusion Classification
All lines of evidence indicate absence of vapor intrusion.	No evidence of current vapor intrusion.
Mixed results, but weight of evidence indicates absence of vapor intrusion.	Supporting evidence of no current vapor intrusion.
Mixed lines of evidence.	Inconclusive.
Weight of evidence suggests vapor intrusion with some uncertainty.	Supporting evidence of current vapor intrusion.
Lines of evidence predominately indicate vapor intrusion. Strongest lines indicate vapor intrusion.	Clear evidence of current vapor intrusion.

Note: This table applies to the conventional and on-site analysis approaches.

For each building evaluated with the conventional and on-site analysis protocols, two types of evaluations were done. The first included a lines of evidence evaluation of vapor intrusion (i.e., Is there evidence of vertical migration of VOCs into the building?). The second evaluation addressed regulatory implications (i.e., Is there evidence of vapor intrusion at levels approaching or greater than a "screening level"?). A response action is required only if the concentration of the target VOC in indoor air exceeds the applicable regulatory standard.

For the assessment of regulatory implications, we applied USEPA screening values to all the demonstration sites. These values may not be the legal standards for regulatory responses at the individual sites, however, they were used for this demonstration in order to provide consistency between the sites. For the demonstration buildings, the key COC for the vapor intrusion evaluation was either TCE or benzene. Therefore, the values in Table 10 were used for comparisons with site data.

Table 10: Numeric Standards Used for VI Classifications

Analyte	Risk-Based Screening Level ($\mu g/m^3$)	
TCE	3.0	USEPA Regional Screening Level Tables, May 2013; commercial/industrial setting; 10^{-6} target risk; THQ=1.0
Benzene	1.6	USEPA Regional Screening Level Tables, May 2013; commercial/industrial setting; 10^{-6} target risk; THQ = 1.0

Note: Screening levels used in conventional and on-site analysis protocol building evaluations.

The **CSIA protocol** is not a standalone investigation method. The protocol would be used if target VOCs are detected in indoor air at levels approaching or greater than screening (regulatory) levels. The conventional and on-site analysis protocols can be used as standalone methods, and both of these approaches yield indoor air concentration data. Because the CSIA approach requires advance knowledge of indoor air concentrations, it would not be used in the absence of other evidence that VOC concentrations are high enough to be of concern.

5.7.1 Vapor Intrusion Classification using Conventional Lines of Evidence Approach

Conventional sampling was done in three demonstration buildings. The results from the conventional sampling program were evaluated using a lines-of-evidence approach which included the following questions:

1. <u>Comparison of key COC concentrations in indoor air to ambient (outdoor) air</u>: Do indoor concentrations of the key COC exceed outdoor concentrations? To be conservative, a "Yes" response was considered consistent with vapor intrusion.

   In all three buildings, indoor air concentrations of the key COC exceeded ambient (outdoor) air concentrations. This line of evidence, however, is not definitive with respect to vapor intrusion because of potential contributions from indoor sources.
2. <u>Sub-slab to indoor air attenuation factors</u>: Are concentrations of the key COC below the building significantly (e.g., >10x) higher than in indoor air?

   At each building, the sub-slab concentrations varied widely. In two of three buildings, at least one sub-slab result was more than 10x higher than the indoor air result.
3. <u>Sub-slab to indoor air ratios</u>: Are other VOCs found beneath the slab, and are sub-slab to indoor air concentration ratios similar?

   At two of three demonstration buildings, other VOCs (beyond the key target COC) were found at relatively high concentrations beneath the slab, and were also detected in indoor air. This general pattern was taken to suggest VI.
4. <u>Composition of COCs (e.g., concentration ratios) present in indoor air compared to composition of COCs present in groundwater</u>: Are ratios in indoor air consistent with a subsurface source?

   This line of evidence is applicable when multiple COCs are associated with the groundwater. Multiple COCs were detected in groundwater near all the demonstration buildings. However, this line of evidence was generally inconclusive.

Other lines of evidence are used in various guidance documents. For example, the vertical distribution of COCs within a building (e.g., main floor concentrations vs. basements/crawl space) is often evaluated. However, the demonstration buildings were all one story, slab-on-grade, industrial buildings. Therefore, this line of evidence is not considered further in the data evaluation.

Based on the lines of evidence evaluation (Questions 1 – 4), each building was classified with respect to vapor intrusion as shown in Table 9 above.

Building-specific results and interpretation of the conventional lines of evidence approach are presented in Table 11. It is important to note that the regulatory implication is based on the generic screening level (Table 10) used to standardize data interpretations *for this report*. Actual needs or requirements may be different, and will depend on each site's particular circumstances.

Table 11: Conventional Program Results

Building	Finding Based on Conventional Approach	Additional Information
Lewis-McChord Building 9669	FINDING: Supporting evidence of current vapor intrusion *IMPLICATION: Indoor air concentration (1.5 µg/m^3) is BELOW USEPA screening level (3 µg/m^3); however, monitoring may be appropriate to characterize temporal variability.* ***Based on the indoor air results, this building would be a candidate for CSIA.***	Appendix B, Figure B.1.1
Selfridge Building 1533	FINDING: Inconclusive, can't distinguish between VI and indoor sources. *IMPLICATION: (1) Indoor benzene concentration greater than USEPA screening level (1.6 µg/m^3); (2) Further study needed to determine source.* ***Based on the indoor air results, this building would be a candidate for CSIA.***	Appendix B, Figure B.2.1
Tyndall Building 219 (Planted Indoor Source)	Not applicable. No VI concern due to low TCE concentration. CSIA protocol was tested using a planted indoor source.	N/A
Raritan Building CP4	FINDING: Supporting evidence of current vapor intrusion *IMPLICATION: Indoor air TCE concentration is within 50% of USEPA screening level (3 µg/m^3). Monitoring may be needed to characterize temporal variability.* ***Based on the indoor air results, this building would be a candidate for CSIA.***	Appendix B, Figure B.3.1

Note: Findings and implications above are based on the conventional program only. See Section 6.2 for an evaluation of the full dataset (e.g., results from conventional, CSIA, and on-site analysis approaches).

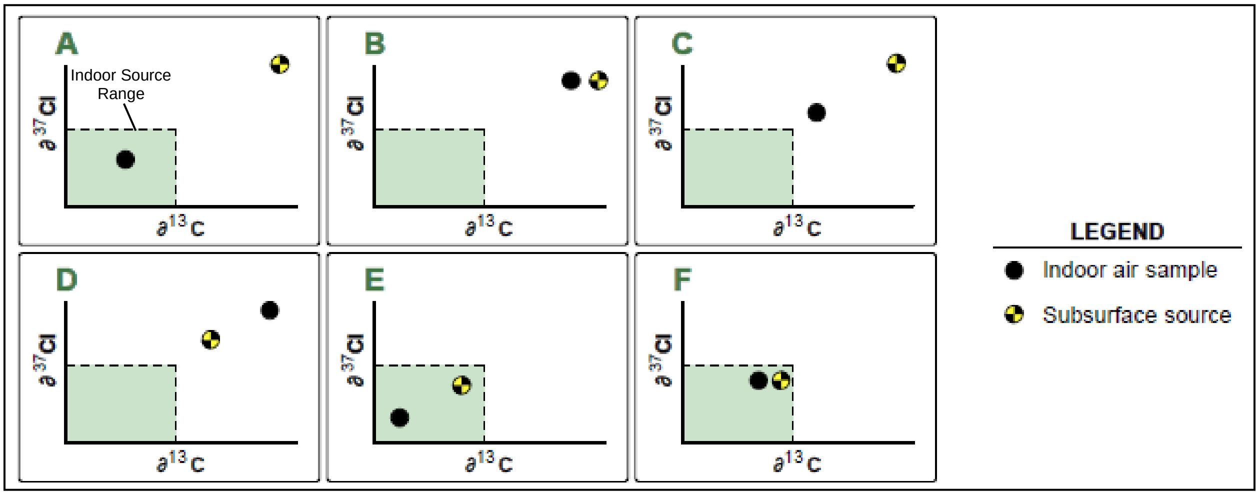
5.7.2 VI Classification using the CSIA Protocol

One building at each of three demonstration sites (Lewis-McChord 9669, Selfridge 1533, and Raritan CP4) was a suitable candidate for application of the CSIA protocol, based on concentrations of target VOCs in indoor air. A fourth building (Tyndall 219) was tested by planting a known source in the building to evaluate whether the CSIA protocol could accurately identified the source.

To evaluate the presence or absence of vapor intrusion, the compound-specific isotope ratios measured in indoor air samples were compared to i) subsurface (groundwater) samples and ii) the range of isotopic signatures for indoor sources. A decision matrix which includes the level of confidence in the interpretation is provided in Figure 4. The draft CSIA protocol proposed to use isotope measurements from either groundwater or soil gas samples to characterize the subsurface source. However, evaluation of the demonstration dataset as a whole suggests that the isotope measurements from sub-slab soil gas samples do not accurately characterize the subsurface source (see Section 6.2.2). Therefore, the vapor intrusion classifications have been made using only the isotope results from groundwater samples for characterization of the subsurface source. The finalized CSIA protocol (Appendix E) has been revised to reflect the greater reliability of groundwater isotope results compared to soil gas.

CSIA results fall into six categories, as illustrated in Figure 4.

Figure 4: Interpretation of CSIA Results



Data interpretation is based on pattern matching, as follows:

(A) Strong evidence that an indoor source is the primary source of VOCs in indoor air.
(B) Strong evidence that the subsurface source is the primary source of VOCs in indoor air.
(C) Evidence of mixed subsurface and indoor air sources.
(D) Evidence that the subsurface source is the primary source of VOCs in indoor air, additional enrichment in the heavy isotopes is likely occurring between the subsurface measurement point and the target building.
(E) Supporting evidence that an indoor source is the primary source of VOCs in indoor air.
(F) Supporting evidence that the subsurface source is the primary source of VOCs in indoor air. However, results are also potentially consistent with an indoor source, so the results should be interpreted within the context of other lines of evidence.

Individual demonstration building results are summarized in Table 12.

Table 12: CSIA Protocol Results

Building	Finding Based on CSIA Protocol	Additional Information
Lewis-McChord Building 9669	Supporting evidence of current vapor intrusion	Appendix B, Figure B.1.2
Selfridge Building 1533	Supporting evidence of NO current vapor intrusion	Appendix B, Figure B.2.2
Tyndall Building 219 (Planted Indoor Source)	Strong evidence of an indoor source	Section 6.2.1, Figure 6
Raritan Building CP4	Strong evidence of an indoor source, not vapor intrusion	Appendix B, Figure B.3.2

Note: Findings and implications above are based on the CSIA protocol only. See Section 6.2 for an evaluation of the full dataset (e.g., results from conventional, CSIA, and on-site analysis approaches).

5.7.3 VI Classification using the On-Site Analysis Protocol

In general terms, the on-site analysis protocol involves characterizing the VOC concentrations in a building under normal operating conditions (i.e., "baseline" conditions). Multiple indoor air samples are analyzed in order to find and follow concentration gradients to the source. Building pressure is measured and may be manipulated to get a better understanding of the source of VOCs in indoor air.

Key lines of evidence for the baseline building characterization include:

1. Comparison of target VOC concentrations in indoor air to ambient (outdoor) air: Do indoor concentrations of the key COC exceed outdoor concentrations? A "Yes" response is conservatively considered to be consistent with vapor intrusion. This line of evidence is not definitive with respect to vapor intrusion, however, because of potential contributions from indoor sources.
2. No indoor sources: Were known indoor sources of target VOCs removed prior to the end of the baseline period such that no (known) indoor sources remain in the building? If "Yes", then the source of target VOCs may be consistent with vapor intrusion. If "No", known indoor sources remain, and these indoor sources may be the primary source(s) of VOCs in indoor air. This question does not apply if the on-site results for the target VOC are below detection limits.
3. Baseline building pressure: Is baseline building pressure negative (i.e., building depressurized relative to outdoors [ambient])? A "No" provides evidence of an indoor source because a positive building pressure does not support the flow of soil gas into the building. A "Yes" response is conservatively considered to be consistent with vapor intrusion. However, this line of evidence alone is not definitive with respect to vapor intrusion because a negative building pressure does not eliminate the possibility of an indoor source.
4. Vapor entry point: Were vapor entry points found? If "Yes", then vapor intrusion could contribute to target VOCs in indoor air.

The range of building classifications based on these lines of evidence is summarized in Table 9 above.

Building pressure may also be manipulated to get a better understanding of the source of VOCs in indoor air. Lines of evidence for the optional pressure control evaluation focus on change in target VOC concentrations relative to baseline, and relative to the building pressure condition.

1. Building pressurization: Are target VOC concentrations suppressed by building pressurization? A “Yes” response is consistent with VI.
2. Building depressurization: Are target VOC concentrations enhanced by depressurization? A “Yes” response is consistent with VI.

The range of building classifications based on these lines of evidence is summarized in Table 9 above. Refer to the final report for ER-201119 for additional details regarding the on-site analysis protocol and data interpretation methods.

The VI classifications for the demonstration buildings are summarized in Table 13. Note that the regulatory implication is based on the generic screening level (Table 10) used to standardize data interpretations *for this report*. Actual needs or requirements may be different, and will depend on each site’s particular circumstances.

Table 13: On-Site Analysis Protocol Results

Building	Results Based on On-Site Analysis Protocol	Additional Information
Lewis-McChord Building 9669	<u>OVERALL FINDING</u>: Evidence of current vapor intrusion *<u>IMPLICATION</u>: Indoor air concentration (2 µg/m^3) is BELOW USEPA screening level (3 µg/m^3). Pressure control evaluation increases confidence in result, and decreases concern with temporal variability.*	Appendix B, Figure B.1.3
Selfridge Building 1533	<u>OVERALL FINDING</u>: No evidence of current/potential vapor intrusion *<u>IMPLICATION</u>: Primary sources of benzene are indoors. Indoor air benzene concentration greater than USEPA screening level due to indoor sources. No additional evaluation warranted under current building use.*	Appendix B, Figure B.2.3
Tyndall Building 219 (Planted indoor source)	Not applicable. VI not likely based on on-site analysis protocol. No VI concern due to low TCE concentration. CSIA protocol was tested using a planted indoor source.	Section 6.2.1, Figure 6
Raritan Building CP4	<u>OVERALL FINDING</u>: Office Area: Supporting evidence of VI. Warehouse: Suggestive of VI. *<u>IMPLICATION</u>: Indoor air concentration (0.43 µg/m^3 in warehouse) is BELOW USEPA screening level (3 µg/m^3). Controlled depressurization did not enhance vapor intrusion reducing concern regarding temporal variability.*	Appendix B, Figure B.3.3

Note: Findings and implications above are based on the on-site analysis protocol only. See Section 6.2 for an evaluation of the full dataset (e.g., results from conventional, CSIA, and on-site analysis approaches).

5.8 SUPPLEMENTAL DATA

During Task 2 of this project, we characterized the stable isotope signatures for common indoor sources of VOCs by compiling data available in the literature and analyzing samples of indoor sources (GSI, 2012c). Likely ranges of isotope ratios for indoor sources of PCE, TCE and benzene were developed. Isotope ratios for benzene were developed for gasoline, cigarette smoke, and natural gas, common indoor sources with sufficient benzene for isotope testing.

During the CSIA demonstration (Task 3 of ER-201025), we collected two additional natural gas samples for isotope analysis. The results were consistent with previous findings. As shown in Table 14, the natural gas signature is distinct from that of gasoline and cigarette smoke.

Table 14: Isotope Ratios for Benzene in Natural Gas

Source	Carbon Isotope Ratio (‰)	Hydrogen Isotope Ratio (‰)
Natural Gas (GSI, 2012c)	-23.3	-92
Austin, TX Natural Gas (this study)	-22.2	-84
Houston, TX Natural Gas (this study)	-22.0	-77.5 [-75 to -80]
Other Benzene Sources (mean [range] of measured values)		
Gasoline (GSI, 2012c)	-27.7 [-28.9 to -26.6]	-55 [-37 to -82]
Cigarette Smoke (GSI, 2012c)	-32.0	Not determined

Finding: *Because of the distinct ranges, CSIA may be useful in distinguishing between types of indoor benzene sources.*

6.0 PERFORMANCE ASSESSMENT

This section summarizes the data analysis completed to assess the performance objectives described in Section 3 and determine if the success criteria were met.

6.1 OBJECTIVE 1: COLLECTION OF DATA REPRESENTATIVE OF SITE CONDITIONS

6.1.1 Data Quality Review

This performance objective focuses on collection of representative data for isotope analysis. To evaluate whether success criteria were met, we reviewed sampling and custody procedures as well as analytical procedures and results. A data quality review of samples collected for the conventional and on-site analysis protocols is provided in the final report for ER-201119.

6.1.1.1 Sampling Procedures

Groundwater and vapor samples for isotope analysis were collected in accordance with the demonstration plan and associated QAPP (GSI, 2012d). All planned samples were collected. During the field programs covered by this report, the following deviations from planned procedures occurred:

- At Raritan Building CP4, the pump for sample CP4-IA-4 failed during sample collection. A second sample (CP-4-IA-4B) was collected the following day. The first sample was retained for analysis, and evaluated as a duplicate.

- At the Raritan buildings, permanent sub-slab vapor probes had been installed during previous investigations, and have been monitored on a routine basis for the last several years. Rather than installing new, temporary points, GSI collected sub-slab samples from the existing points.

- Groundwater sample collection procedures at the following sites were modified based on site-specific needs. At the Lewis-McChord site, groundwater samples were collected by personnel from Versar, the site contractor. At the Selfridge site, GSI collected the groundwater samples using low-flow/no-purge methods because of limited options to manage investigation-derived waste (IDW). At the Raritan site, GSI collected groundwater samples with bailers because of pump malfunctions.

- Groundwater samples were collected for the CSIA protocol to characterize the isotope signature of the subsurface source. At the Selfridge site, the monitoring well had not been sampled for several years. Therefore, the groundwater sample was split, with one portion submitted for VOC analysis and the other submitted for the isotope analysis.

6.1.1.2 Custody and Sample Handling Procedures

Groundwater samples were collected in VOA vials provided by TestAmerica laboratory in Houston, Texas. Vapor samples were collected in sorbent tubes provided by the University of Oklahoma Geology Department contract laboratory. All samples were shipped on ice under chain of custody control to the University of Oklahoma for analysis. Samples were received by the lab in good condition, with one exception. Several VOA vials collected from the Raritan site groundwater were broken upon receipt by the lab. However, there was sufficient sample volume remaining to complete the requested analyses.

6.1.1.3 Holding Time

68% (42 of 62) of the CSIA analyses were analyzed outside of the two week holding time validated during the laboratory study for this ESTCP project. Therefore, we conducted additional study of the effect of holding time on sample results (see Table D.1.1). This additional analysis served to validate an extended holding time of up to 4 weeks for refrigerated samples (i.e., 4 °C) and up to nine months for samples frozen prior to analysis (see Section 6.1.2). All of the CSIA samples were analyzed within the extended holding times validated as part of this demonstration.

6.1.1.4 Laboratory Precision and Accuracy Assessment

Precision is the degree to which two or more measurements are in agreement as a result of repeated application of a process under specific conditions. Accuracy is the degree of agreement between an observed value (or an average of several values) and an accepted reference value. For CSIA, precision and accuracy is supported by laboratory procedures as follows:

Isotope ratios determined by CSIA are presented in delta (δ) notation (Equation 2). The sample isotope ratios (e.g., $R_{sample} = {}^{13}C/{}^{12}C$) are normalized to an international standard scale (e.g., V-PDB for carbon isotope ratios). Thus, δ units represent the difference between the sample's ratio and the ratio of the international standard, reported in parts per thousand (‰).

$$\delta^{13}C = (R_{sample}/R_{standard} - 1) \text{ x } 1000 \qquad (2)$$

QA/QC in CSIA is required to control the analytical precision and accuracy of isotope ratio determination. The precision reflects the stability and linearity of the mass spectrometer detector (adversely affected by electronic noise and by fluctuations of water and oxygen present in trace amounts in the mass spectrometer source) and by fluctuations of baseline noise that affect the quality of quantitation of individual isotope peak areas for calculation of isotope ratios. A built-in routine of using internal standard gas for calibration of mass spectrometer output eliminates the problem of uncertain accuracy of the mass spectrometer detector. The overall accuracy can be adversely affected by: i) less than ideal thermal conversion of the analyte to the IRMS-amenable surrogate, ii) by the quality of GC peak separation (peak tailing resulting in a portion of analyte mass lost to integration and coelutions resulting in integration of the target peaks together with additional signal added by coeluent), and iii) by isotope species disproportionation by incomplete recovery from sample matrix. The latter applies specifically to environmental samples run by methods involving techniques such as P&T and thermal desorption. Matrix spikes prepared with standards (e.g., TCE, PCE and benzene) of known isotope composition are analyzed under identical conditions as the environmental samples of interest, to determine the analytical bias. GC separation quality poses a separate challenge that cannot be addressed adequately by matrix spikes, because the GC interferents in real samples are usually more abundant and diverse than in a matrix spike. The quality of GC separation has to be assessed by a trained operator, who can identify compromised peaks by examination of peak geometry and the geometry of isotope ratio output (Figure 5). Minor coelutions are acceptable (and unavoidable). The net analytical uncertainty should account for all these potential problems, including problems caused by minor coelutions and peak integration deficiencies. Stated uncertainty for different isotopes is typically higher than the performance for clean matrix spikes, because it allows for additional factors present in actual samples. Stated uncertainty should be given for specific analytes analyzed by a particular method. The performance for the same isotope for different analytes and for the same analyte and isotope for different analytical methods is not necessarily identical.

Implementation of the QA/QC evaluations described above ensures that the accuracy and precision of the results remain within an acceptable range. The procedures do not support separate quantification of accuracy vs. precision. The accuracy/precision values for the analytes of interest (i.e., benzene, TCE, and PCE) and the methods of interest are: C: ±0.5 ‰; Cl ±1 ‰; H: ±5 ‰.

Figure 5: Example CSIA Chromatogram

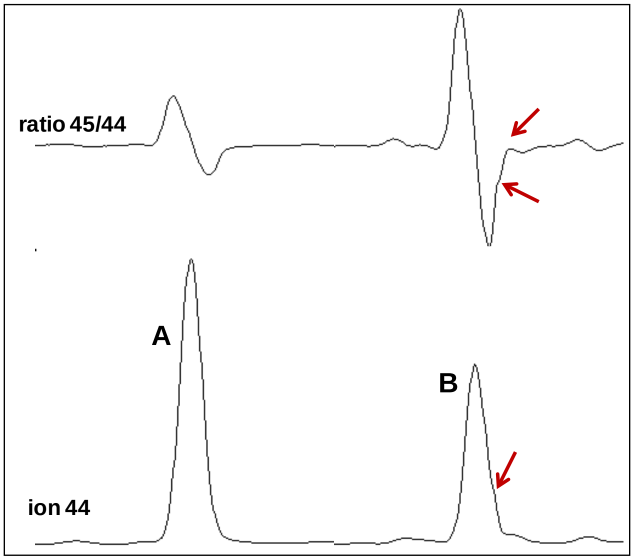


Figure 5. The lower trace is a chromatogram drawn for mass 44 ($^{12}C^{16}O_2$). The upper trace is drawn for the ratio of masses 45/44 ($^{13}C^{16}O_2/^{12}C^{16}O_2$). The characteristic sinusoid appearance of the ratio trace results from slightly faster travel of ^{13}C species through the GC column. Compound A is well-resolved, permitting accurate definition of isotope ratio. Compound B overlaps (coelutes) with another unidentified compound, mostly hidden underneath peak B. The coelution can be identified by careful examination of the geometry of the GC peak and the corresponding 45/44 ratio trace (arrows point to asymmetries resulting from such coelution).

6.1.1.5 Field Quality Assurance

Field precision was determined based on the difference in measured isotope ratios between paired normal and duplicate samples. Field accuracy was verified based on an evaluation of trip blanks.

- Field Duplicates: A total of five normal-field duplicate sample pairs were collected over the course of the demonstration. The field precision was evaluated by calculating the difference between the measured isotope ratios between the paired samples. The precision objective was ±1‰ for $\delta^{13}C$, ±2 ‰ for $\delta^{37}Cl$, and ±10 ‰ for $\delta^{2}H$.

  As indicated on Table D.1.2, the difference between results was less than ±1‰ for all samples. Note that $\delta^{2}H$ was not evaluated in the demonstration dataset.

- Trip Blanks: One set of sorbent tubes per demonstration site was transported with the samples and analyzed as a trip blank. Analysis focused on the site-specific VOCs (i.e., TCE for Lewis-McChord, Tyndall, and Raritan, and benzene and TCE for Selfridge). As indicated on Table D.1.3, no TCE was found in the trip blanks for Lewis-McChord and Tyndall, and small amounts were found at Selfridge (0 – 0.2 ng) and Raritan (0.1 – 1.3 ng). Similarly, small amounts of benzene were found at Selfridge (0.4 – 1.4 ng). The target mass for sample collection was 100 ng. The small mass found in the trip blanks would have constituted about 1% of the total, and would, therefore, have had minimal effect on the samples.

6.1.1.6 Completeness Assessment

With the exceptions noted in Sections 6.1.1.1 (Sampling Procedures) and 6.1.1.2 (Custody and Sample Handling Procedures), all necessary analytical samples were collected and analyzed.

6.1.2 Validation of Extended Holding Time

Additional analysis of twelve samples was completed to assess the impact of holding time on sample results. Each sample consisted of four sorbent tubes which were refrigerated (4°C) or frozen (-10°C) during storage prior to analysis. For the Lewis-McChord, Selfridge, and Tyndall demonstrations, the tubes were analyzed at different times ranging from 21 days to 9 months after sample collection (Table 15). The results of re-analysis were within the expected accuracy/precision range for all but two samples. In Lewis-McChord 1-SS-2-CSI, no peaks were observed in the sorbent tubes used for the supplemental analyses. In Selfridge SS-2 Low, the difference between the initial and subsequent results was 1.3 ‰, slightly greater than the typical analytical precision of ±1 ‰. However, this low concentration sample had only 10-20 ng of benzene (i.e., less than the minimum recommended sample mass of 30 ng), resulting in lower expected laboratory precision.

Table 15: CSIA Holding Time Evaluation

Sample	Analysis 1 month after sample collection	Analysis 3 months after sample collection	Analysis 6-9 months after sample collection
δ^{13}C TCE Result [analytical error ±1 ‰]			
Lewis-McChord 1-IA-1-CSI	-25.9	-	-26.2
Lewis-McChord 1-SS-2-CSI	-18.5	no peak	no peak
Lewis-McChord 3-SS-2-CSI	-18.8	-19.5	-18.8
Selfridge Indoor-1	-32.6	-	-31.8
Selfridge SS-2 High	-25.5	-	-24.6
δ^{37}Cl TCE Result [analytical error ±2 ‰]			
Tyndall 156-SS-3	6.3	6.3	-
Tyndall 219-IA-3 Pump 1	-3.5	-3.3	-
Tyndall 219-IA-3 Pump 2	-3.15	-3.30	-
δ^{13}C Benzene Result [analytical error ±1 ‰]			
Selfridge Indoor-1	-29.0	-	-28.9
Selfridge SS-1	-29.8	-	-29.8
Selfridge SS-2 1 Hour	-29.4	-	-29.4
Selfridge SS-2 Low	-28.9	-	-30.2

Based on the additional analyses completed to assess the impact of different holding times on sample results, holding times longer than the originally-validated 2 week period are acceptable.

Finding: *Holding times of up to 4 weeks for samples stored at 4°C (i.e., refrigerated samples) are acceptable and do not adversely impact results. Samples analyzed after 6 months in a freezer (-10°C) are also not adversely impacted.*

6.1.3 Evaluation of Performance Objective 1

Overall, the project data quality objectives were met (Table 16). Data quality exceptions occurred during the CSIA demonstration program as described above (e.g., holding time issues), but had little to no impact on the results.

Table 16: Summary of CSIA Data Quality Evaluation

Data Quality Objective	Data Quality Evaluation
Sample collection and handling procedures	Acceptable
Holding time	Acceptable*
Laboratory Precision/Accuracy Assessment	Acceptable
Field Duplicate	Acceptable
Field Blank Analysis	Acceptable*
Completeness Assessment	Acceptable*
Overall Data Usability	**Acceptable**

Note: Acceptable = This DQO was evaluated and found to have met the requirements outlined in the QAPP. Acceptable* = This DQO was found to have deficiencies or exceptions as discussed in the text. However, the data were determined to be usable.

Finding: *The data quality for the demonstration program dataset is acceptable and suitable for evaluation of demonstration performance.*

6.2 OBJECTIVE 2: VALIDATION OF DRAFT CSIA PROTOCOL TO DISTINGUISH BETWEEN INDOOR SOURCES OF VOCS AND VAPOR INTRUSION

The vapor intrusion classification of each demonstration building was evaluated separately, in accordance with criteria established for each approach (see Sections 5.7.1 – 5.7.3). This section compares the results of the full dataset.

6.2.1 Site-by-Site Analysis of Results: Building VI Classifications

Comparison of Vapor Intrusion Classifications from the Different Investigation Methods: A conventional and two innovative vapor intrusion investigation methods were applied at four demonstration sites. The vapor intrusion classifications were compared to determine method performance. When the classification was the same, the methods were determined to have performed equally. When one method resulted in a more definitive classification than another (e.g., supporting evidence vs. results not definitive), that method was determined to have performed better. The results for each of the four buildings are discussed below and summarized in Table 17.

Table 17: VI Classification based on Investigation Method

Building	Conventional Approach	CSIA Protocol	On-Site Analysis Protocol	Overall Result
Lewis-McChord 9669	Supporting evidence of current VI (below reg. level)	Supporting evidence of current VI	Evidence of current VI (below reg. level)	**Results generally consistent between three methods. Results from on-site protocol were most definitive.**
Selfridge 1533	Inconclusive	Supporting Evidence of No Current VI	No evidence of current/potential VI	**Results generally consistent between CSIA and on-site methods. Results from on-site and CSIA protocols were more definitive than the conventional approach.**
Tyndall 219 (Planted Indoor Source)	n/a	Strong Evidence of Indoor Source (not VI)	Evidence of Indoor Source	**CSIA correctly identified the planted indoor source and the source of TCE in indoor air.**
Raritan CP4	Supporting evidence of current VI (below reg. level)	Strong evidence of indoor source	Supporting evidence of current VI (below reg. level)	**CSIA protocol performed best. On-site protocol and conventional approach both provided incorrect results.**

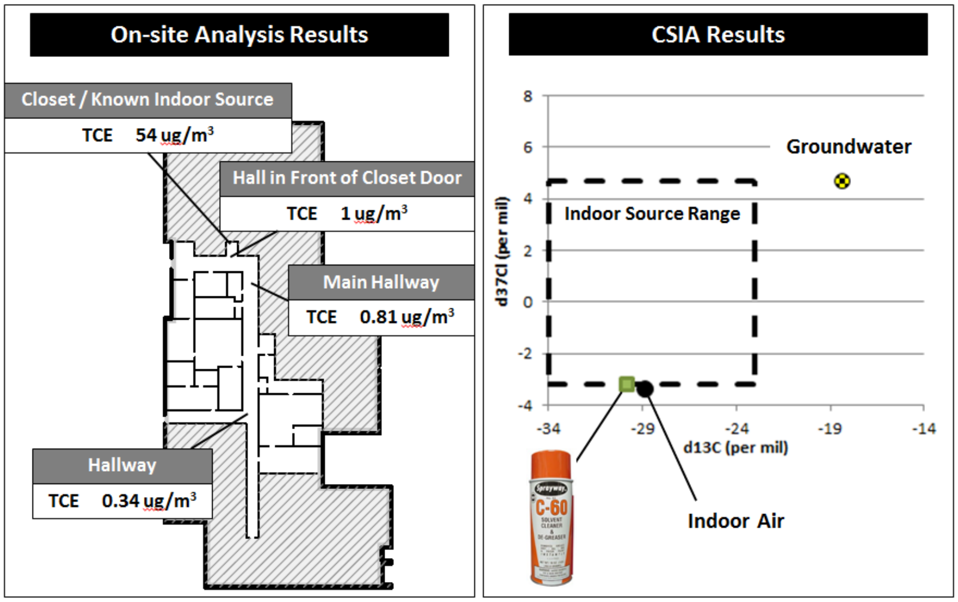
Demonstration Buildings:

- Lewis-McChord 9669: The conventional results were generally indicative of current vapor intrusion. However, TCE was the only subsurface COC consistently detected in indoor air limiting the ability to evaluate the constituent ratio line of evidence. Building 9669 is a supply distribution warehouse that contains a large variety (over 100) of VOC-containing products. As a result, using the conventional results alone, it would be difficult to conclude with a high degree of confidence that no indoor sources of TCE were present. The on-site analysis protocol (both the baseline sampling and the pressure control) yielded results inconsistent with an indoor source of TCE. These results provided a higher degree of confidence that the TCE detected in indoor air originated in the subsurface. **The CSIA protocol also provided supporting evidence of a subsurface source.**

- Selfridge 1533: The conventional results were generally indicative of no vapor intrusion because the maximum benzene concentration in the sub-slab was less than 10x the concentration in indoor air and there were obvious non-removable sources in the building (i.e., automobiles being repaired). However, the benzene concentration in indoor air (14 µg/m^3) was almost 10x greater than the risk-based screening value and the maximum benzene concentration in the sub-slab (58 µg/m^3) was greater than the concentration in indoor air. As a result, a regulator may have required additional evaluation of whether vapor intrusion was contributing to the benzene detected in indoor air. The results from the on-site protocol provided greater confidence that indoor sources were the predominate sources of benzene in indoor air because i) the on-site analysis documented the temporally variable impact of the indoor sources on benzene concentration in indoor air and ii) the building pressure control results were consistent with an indoor source of benzene. **The CSIA protocol provided supporting evidence of NO current vapor intrusion, consistent with the on-site protocol.**

- Tyndall 219: The standard CSIA protocol was not applicable in this building because of the low TCE concentrations. Therefore, this building was used to test whether the isotope analysis could correctly identify a known, planted indoor source. An unopened cardboard box containing an unopened 16 oz. aerosol can of Sprayway C-60 Solvent Cleaner and Degreaser was placed in a closet. A sorbent tube sample and duplicate were immediately set up and left to collect overnight. The next morning, several indoor air samples were collected for on-site GC/MS analysis using the HAPSITE SMART. The HAPSITE SMART showed a slight concentration gradient towards the closet where the source was hidden (Figure 6, left panel). The isotope result for indoor air was distinct from the groundwater result, and was in the range of isotopic signatures associated with indoor sources (Figure 6, right panel). **Therefore, the CSIA protocol correctly identified the source of TCE in indoor air as an indoor source.**

Figure 6: Building with Planted Indoor TCE Source



According to the product MSDS, the ingredients included TCE (>90%) and carbon dioxide (3-5%). The isotopic signatures of this product from the original laboratory testing and indoor air testing during the demonstration were similar although the sampling was done more than a year apart (Table 18).

Table 18: Isotope Ratios for TCE in Planted Source

Material Tested	δ^{13}C (‰)	δ^{37}Cl (‰)
Sprayway C-60 (McHugh, et al., 2011)	-29.8	-3.2
Air inside closet with planted Sprayway C-60 can (this study)	-28.8 to -29	-3.5 to -3.2

- Raritan CP4: The conventional results provided supporting evidence of vapor intrusion because the maximum TCE concentration in the sub-slab was more than 10x the TCE concentration in indoor air. The on-site analysis protocol results also provided supporting evidence of vapor intrusion because TCE was detected in indoor air, no indoor sources of TCE were found, two floor cracks were identified as vapor entry points, and the TCE concentrations measured in the wall gap of one room was higher than the highest TCE concentration measured in indoor air. Elevated COC concentrations in wall gaps are consistent with vapor intrusion because wall gaps can be connected to vapor entry points and have lower air exchange rates than building interior spaces. The on-site analysis protocol results were not considered definitive for two reasons. First, the two floor crack entry points appeared to be minor; no strong entry points were identified. Second, the wall gap appeared to represent a limited reservoir of TCE. TCE concentrations within the wall gap decreased after collection of a 6-L summa sample. In addition, several other wall gaps tested did not show elevated concentrations of TCE.

Based on the CSIA results, both the conventional and the on-site analysis protocol results appear to have provided an incorrect indication of vapor intrusion as the source of the TCE in indoor air.

Further support of the CSIA results comes from passive sorbent samplers provided by Geosyntec Consultants. At the end of the demonstration, GSI deployed six passive samplers at the CP4-IA-4 location. Geosyntec retrieved the samplers three weeks later. The samplers were split, with three submitted to the University of Oklahoma and three submitted to the University of Waterloo for analysis. The results from the active and passive sampling were consistent (Table 19). These preliminary results suggest that, with additional validation, passive sorbent samples may serve as an alternative sample collection device for CSIA for indoor air.

Table 19: Results from Active vs. Passive Sampling

Sampling Method:	**Active Sampling (this study)**	**Passive Sampling**	
Laboratory:	**Univ. of Oklahoma**	**Univ. of Oklahoma**	**Univ. of Waterloo**
$\delta^{13}C$ (‰)	-30.7	-31.1	-29.2
$\delta^{37}Cl$ (‰)	-0.2	Note 2	0.7

Notes: 1) Average result shown; 2) Insufficient TCE mass for analysis of $\delta^{37}Cl$.

The CSIA results for Raritan CP4 provided strong evidence of an indoor source because the TCE in groundwater was enriched in both ^{13}C and ^{37}Cl, consistent with the kinetic isotope effect of biodegradation, while the TCE in indoor air had lower levels of ^{13}C and ^{37}Cl, consistent untransformed TCE. Although no indoor source of TCE was identified during the site visit, the building manager reported that the building's cleaning service had used a TCE-based spot remover in the past. Although she had requested that they not use chlorinated solvents in the building, she indicated that it was possible that they were still using them during some cleaning events.

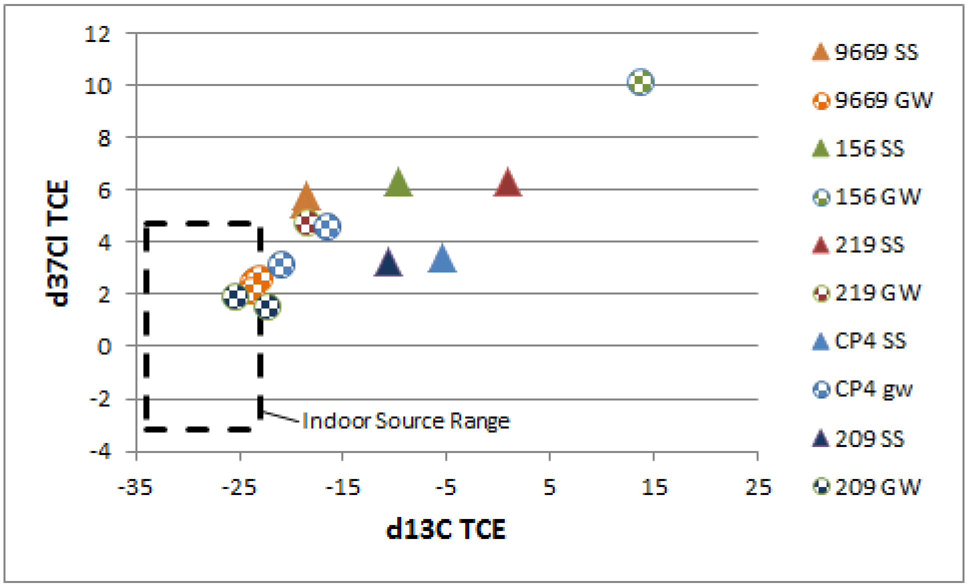
Although the combined results from the conventional and on-site analysis investigations of Raritan CP4 did not support definitive source identification, the most likely explanation is the recent use of a TCE-containing spot remover. Based on the on-site analysis results, the highest TCE concentrations were found within a cluster of conference rooms that were the only carpeted spaces within the building. TCE concentrations within this cluster of rooms decreased from approximately 6 µg/m^3 on the first day of the demonstration to approximately 2 µg/m^3 on the fourth day. Although there is some uncertainty because a specific indoor source was not identified, the elevated concentration of TCE in the wall gap would be consistent with recent use of TCE in the building because elevated TCE concentrations would persist longer in the wall gap than in the more ventilated room space.

6.2.2 Evaluation of Subsurface Sample Locations

Groundwater vs. Sub-Slab Soil Gas

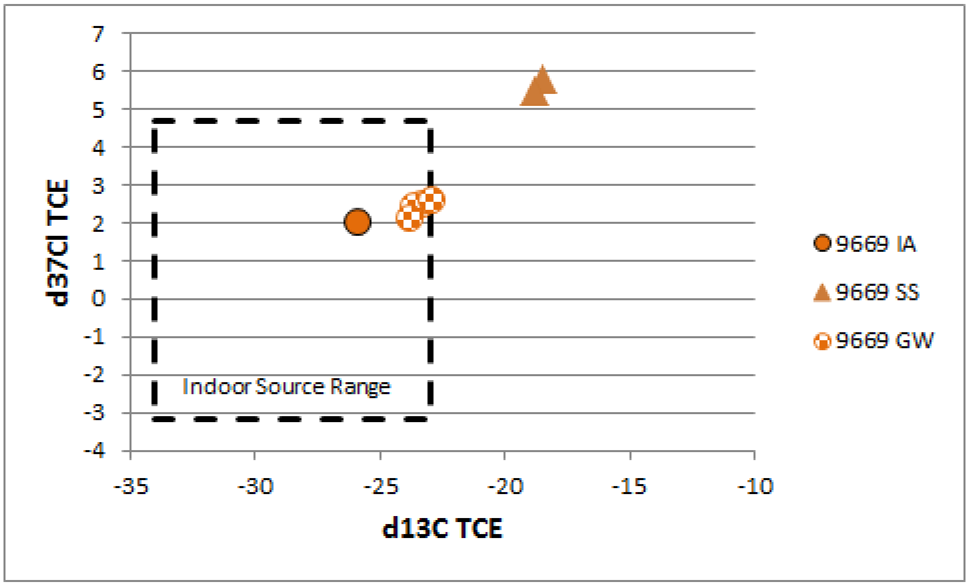
The draft CSIA protocol included several options for collecting samples to characterize the subsurface source (e.g., groundwater, soil gas, sub-slab soil gas). During the demonstration, we collected paired groundwater and sub-slab soil gas samples for TCE $\delta^{13}C$ and $\delta^{37}Cl$ analysis at five buildings (Lewis-McChord 9669, Tyndall 156, Tyndall 219, Raritan CP4, and Raritan 209). As shown in Figure 7, the sub-slab results are distinct from the groundwater results, and are outside of the indoor source range. The sub-slab samples showed a shift towards the "heavier" ratios relative to groundwater for all pairs except Tyndall Building 156. For Tyndall 219, Raritan CP4, and Raritan 209, the shift was primarily in the carbon ratios.

Figure 7: Comparison of Paired Groundwater and Sub-Slab TCE Isotope Ratios



The groundwater, sub-slab, and indoor air isotope results for Lewis-McChord Building 9669 are shown in Figure 8. The indoor air results are similar to groundwater, suggesting a subsurface source of TCE in indoor air. This is consistent with the interpretation from the conventional and on-site analysis investigation methods. Because of the shift between the groundwater and sub-slab samples, comparing the sub-slab and indoor results would have resulted in an interpretation of evidence of an indoor source. The isotopic shift between the groundwater and sub-slab results may be due to degradation in the subsurface or other, unknown factors. For use in this CSIA protocol, groundwater provides the best characterization of the subsurface source. Validation of soil gas sampling using this protocol would require additional research.

Figure 8: Lewis-McChord Building 9669 CSIA Results



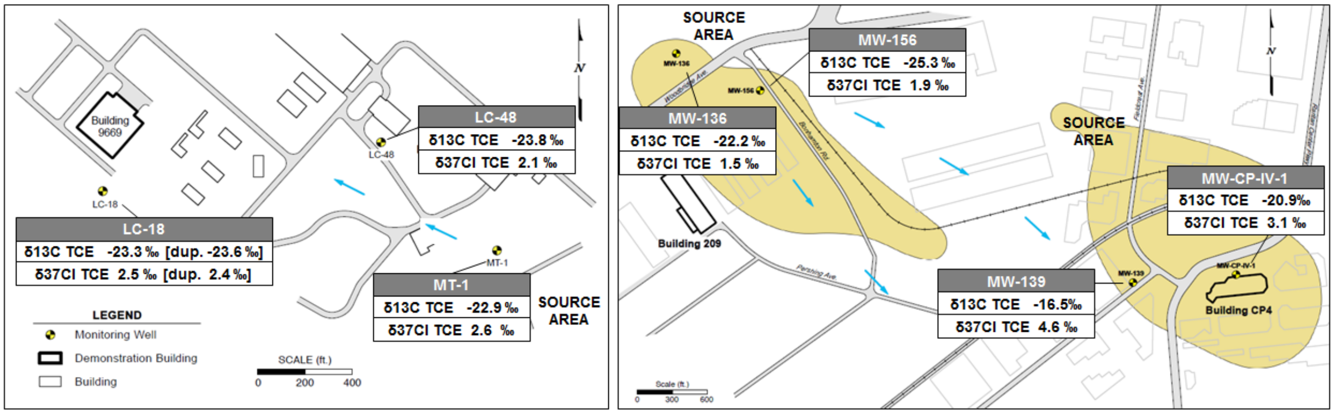
Finding: *Comparisons of groundwater and indoor air results provided the clearest, most conservative interpretations that were also most consistent with the weight of evidence regarding vapor intrusion.*

<u>Location of Groundwater Monitoring Wells</u>

As discussed above, results from groundwater samples appeared to be most useful for characterizing the subsurface source. Three demonstration buildings, Lewis-McChord 9669, Raritan CP4 and Raritan 209, provided the opportunity to evaluate the variability within the groundwater source (Figure 9). At these buildings, more than one shallow zone monitoring well was available for sampling during the demonstration. At Lewis-McChord (Figure 9, left panel), results from different locations in the plume were within ±1‰ for δ^{13}C and δ^{37}Cl, which is on the order of analytical variability. At Raritan (Figure 9, right panel), the differences between plume locations were up to about 4‰. The CSIA protocol was only applicable at Building CP4 in which TCE was found indoor air. The isotope variability observed between monitoring wells made no material difference because, at this building, the indoor air isotope signature was well within the indoor source range and distinct from the groundwater range. Thus, at both of the sites where isotope ratios were measured in samples from multiple wells, the overall interpretation of the results would have been the same using the results from any one of the individual wells.

Finding*: Sampling locations near, and upgradient of, the buildings of interest best characterize the subsurface source. The demonstration results suggest that a sample from one monitoring well located close to the building of interest will often be sufficient to characterize the isotope ratio of the subsurface source. However, sampling two or more wells may increase the confidence in the results.*

Figure 9: Isotope Variability in Groundwater



Lewis-McChord: Only monitoring wells sampled for the demonstration are shown. TCE concentration in shallow groundwater in map area is in the 50 – 100 ug/L range.

Raritan: Only monitoring wells sampled for the demonstration are shown. Groundwater areas of concern are shaded.

6.2.3 Evaluation of Performance Objective 2

The field demonstration has resulted in validation of the CSIA protocol (provided that groundwater samples are used to characterize the subsurface source). For three of four (Lewis-McChord 9669, Selfridge 1533, Tyndall 219) buildings where the CSIA protocol was applied, the source identification provided by the isotope results (i.e., vapor intrusion vs. indoor source) was consistent with the overall determination of the source based on the evaluation of all available information. For one building (Raritan CP4), the VI classification from the CSIA protocol was different from the preliminary classification based on the other two investigation methods (Table 17). However, based on the evaluation of all available information from all three investigation methods combined, the CSIA protocol performed the best. Additionally:

- The CSIA protocol correctly identified the planted source in Tyndall Building 219.
- The CSIA protocol provided a strong evidence of indoor sources in Raritan Building CP4, where the other two investigation methods yielded more tentative and opposite results ("supporting evidence of VI").

These results demonstrate that CSIA is a useful supplement to conventional vapor intrusion investigations for sites where the source (vapor intrusion vs. indoor source) of the primary COC in indoor air is not clear.

Findings from the demonstration were used to refine the draft protocol. Specific recommendations are provided in Section 6.4.3. The revised protocol is provided in Appendix E.

6.3 OBJECTIVE 3: VALIDATION OF DRAFT PROTOCOL FOR IDENTIFICATION OF BOTH INDOOR AND SUBSURFACE SOURCES

6.3.1 Identification of both Indoor and Subsurface Sources

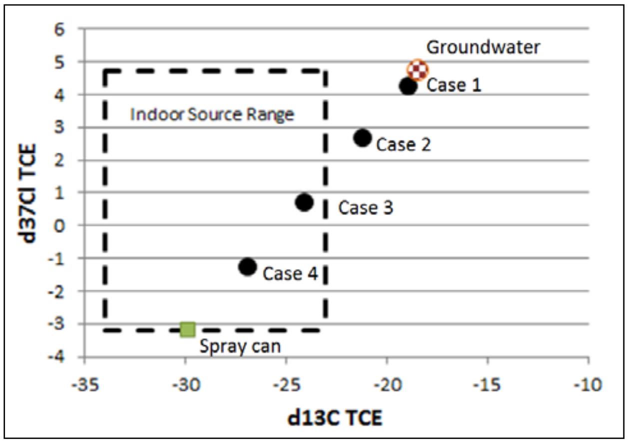
The draft protocol was applied at three buildings with indoor sources (Selfridge 1533, Tyndall 219 [planted indoor source], and Raritan CP4) and one building with subsurface sources of

VOCs (Lewis-McChord 9669). During the course of the demonstration, we were not able to identify a building where indoor air was being impacted by a target VOC originating from both vapor intrusion and an indoor source. Therefore, the resulting demonstration dataset did not allow direct evaluation of the utility of CSIA in buildings with both indoor and subsurface sources. However, based on the well-established theoretical understanding of the impact of mixed sources on isotope ratios, it is clear that the protocol could yield misleading results in some buildings with mixed sources.

To evaluate the impact of mixed sources on the isotope ratios of indoor air samples, we calculated expected isotope ratios in indoor air impacted by both the potential subsurface source at Tyndall Building 219 (as characterized by the groundwater sample from MW-20s) and the planted indoor source at Tyndall Building 219. That is, assuming that the total indoor air TCE concentration is 1 µg/m^3 (0.2 ppb), we calculated indoor air isotope ratios assuming concentrations of i) 95% of the chemical from groundwater and 5% from the indoor source (Case 1); ii) 75% of the chemical from groundwater and 25% from the indoor source (Case 2); iii) 50% from groundwater and 50% from the indoor source (Case 3), and iv) 25% from groundwater and 75% from the indoor source (Case 4). Results are shown in Figure 10 below.

For Case 1, the CSIA protocol would correctly indicate that the subsurface source is the only significant source of TCE in indoor air (i.e., Scenario B in Figure 4). For Case 2, the CSIA protocol would correctly identify mixed subsurface and indoor sources (i.e., Scenario C in Figure 4). For Cases 3 and 4, the CSIA protocol would identify the indoor source as the "primary source" of TCE in indoor air (i.e., Scenario A in Figure 4), however, the protocol would not provide any indication of the contribution from the subsurface source because the results would be consistent with 100% contribution from an indoor source. Thus, it is clear that in some cases, the CSIA protocol cannot distinguish between mixed sources and 100% indoor sources. This limitation is addressed in the revised protocol.

Figure 10: Isotope Ratios for Indoor Air with Mixed VOC Sources



Notes: 1) Starting concentration of 1 µg/m^3 based on measurement in Building 219 hallway; 2) Indoor source isotope ratios (green square) from the planted source at Building 219; 3) Groundwater ratios from MW-20s, adjacent to Building 219.

6.3.2 Evaluation of Performance Objective 3

Based on the demonstration results and a theoretical mixing evaluation, the protocol is likely to be reliable for identifying the primary source of a VOC in indoor air at buildings with contributions from both vapor intrusion and indoor sources. For buildings where the indoor source is the primary source, the potential for vapor intrusion to be a secondary contributing source could be evaluated by finding and removing the indoor source and retesting the building.

6.4 OBJECTIVE 4: IMPLEMENTABILITY AND COST EFFECTIVENESS OF THE PROTOCOL

6.4.1 Demonstration Findings

This objective was evaluated by reviewing the experience gained during the demonstration. The protocol is applicable to buildings which have VOCs in indoor air, as determined by some other investigation method (e.g., historic site data). The protocol is a step-by-step procedure that can be implemented by a typical environmental professional with a few years of general experience and prior experience in sample collection using USEPA Method TO-17. Equipment for sampling is commonly available for rent or purchase (e.g., groundwater sampling equipment, air sampling pumps).

Based on experience gained during the demonstration:

- Communication with the analytical laboratory is important. For example, for sites with low target VOC concentrations, the laboratory can help confirm sampling parameters (e.g., sample collection period). Additionally, for petroleum sites, it may be difficult to obtain clean peaks from the analytical method because of potential high concentrations and interfering compounds.

- At petroleum sites, it may only be practical to analyze for carbon isotope ratios. For hydrogen, collecting enough sample mass may require extended sampling times. Problems with saturating the sorbents may also be encountered.

6.4.2 Evaluation of Performance Objective 4

Based on the results of the investigation, the CSIA protocol is implementable as a separate line of evidence to distinguish between indoor and subsurface sources of VOCs in indoor air. The protocol is cost effective; a detailed cost analysis is presented in Section 7.

The protocol is not a standalone investigation technique. Pre-existing data must indicate that target VOCs are present in indoor air prior to making the decision to use the CSIA protocol for the purpose of source identification.

6.4.3 Modifications to the CSIA Protocol

Based on the experience gained during the demonstration, we recommend the following modifications to the protocol. These recommendations have been incorporated into the protocol instructions provided in Appendix E.

- Extended holding time: As discussed in Section 6.1.2, additional analyses were completed to evaluate the effect of extended holding time on sample results. Based on these analyses, refrigerated tubes can be stored for at least 4 weeks prior to analysis. It is recommended that tubes be frozen for holding time longer than 4 weeks. No isotope fractionation was observed in tubes kept in a freezer for more than 6 months prior to analysis.

- Use of groundwater samples to characterize the subsurface source: Based on experience gained during the demonstration, groundwater samples are not only easier to collect, they are more useful for data interpretation, as compared to soil gas samples.

- Mixed Sources: In cases where the protocol identifies an indoor source as the primary source, additional evaluation may be required in some cases to confirm that vapor intrusion is not a secondary source.

7.0 COST ASSESSMENT

The cost of implementing the field demonstration programs was tracked and used to estimate the expected cost of implementing the CSIA protocol. The following sections summarize the cost for the field demonstrations included in this ESTCP project. It is important to note that the field demonstrations included additional tasks and associated costs in order to validate the protocol, including implementation of a conventional and on-site analysis investigation concurrent with the CSIA investigation. These costs would not be incurred during standard application of the procedure. Therefore, Section 7.1 describes the cost model associated with the demonstration, while Section 7.2 and 7.3 focus on cost considerations for routine application of the procedure.

7.1 COST MODEL

The demonstration included three different site characterization methods, each implemented at four DoD sites. Key cost elements included i) project planning and preparation, ii) field implementation, and iii) data evaluation and reporting (Table 20).

Table 20: Cost Model for the Field Demonstration

Cost Element	Data to be Tracked	Examples
1. Project planning and preparation	Labor hours	Senior Project Scientist/Engineer, Project Scientist / Engineer
	Supplies (On-Site Analysis Protocol only)	Calibration gas, Tedlar bags
2. Field program	Labor hours	Senior Project Scientist/Engineer, Project Scientist / Engineer
	Conventional Program	
	Equipment Rental, Supplies	Hammer drill rental for sub-slab point installation, helium and helium meter rental
	Sample Analysis	Off-site laboratory analysis of air/vapor samples (TO-15)
	CSIA Protocol	
	Equipment Rental/Purchase, Supplies	Pumps, consumables
	Sample Analysis	Off-site laboratory analysis of water and vapor samples
	On-Site Analysis Protocol	
	Equipment Rental, Supplies	HAPSITE rental, operating costs, consumables, fan rental for building pressure manipulation
	Sample Analysis	Off-site laboratory analysis of confirmation samples (TO-15, radon)
3. Data evaluation and reporting	Labor hours	Senior Project Scientist/Engineer, Project Scientist / Engineer

Note: Cost model does not include travel or shipping costs.

7.1.1 Cost Element: Project Planning and Preparation

Project planning included identifying target VOCs for CSIA analysis, estimating VOC concentrations needed to order the correct sample media (Summa canisters vs. sorbent tubes), and obtaining site access.

Labor requirements made up the primary cost in this element (see Table 21). For the demonstration, the time required for project planning varied widely, and depended primarily upon site-specific circumstances such as i) the number of meetings and presentations needed to obtain permission to access sites and buildings, and ii) volume of historic data reviewed to determine the specific buildings for investigation. Field preparation (e.g., calibrating and testing the HAPSITE portable GC/MS, calibrating air sampling pumps) could typically be completed the day before on-site work began.

Table 21: Typical Consultant Labor Requirements for Project Planning

Cost Element	Sub Category	Representative Amount
Project Planning and Preparation	Project Planning (pre-field event)	
	Labor hours: Senior Project Scientist/Engineer	10-15 hours per site
	Labor hours: Project Scientist/Engineer	25-35 hours per site
	Preparation (on location, prior to building investigation)	
	Labor hours: Senior Project Scientist/Engineer	2-4 hours per site
	Labor hours: Project Scientist/Engineer	4-8 hours per site

Note: Labor hours do not include time required for general tasks (shipping, travel, etc.).

7.1.2 Cost Element: CSIA Field Program

Costs for the CSIA field program included labor and costs for equipment, supplies, and laboratory analysis. Representative unit costs are summarized in Table 22.

Table 22: Representative Unit Costs for CSIA Demonstration

Cost Element	Sub Category	Representative Unit Cost	Representative Unit
CSIA Field Program	Labor hours: Senior Project Scientist/Engineer	2-4	Hours per building
	Labor hours: Project Scientist/Engineer	2-4	Hours per building
	Equipment Purchase or Rental (e.g., air sampling pumps, sorbent tube holders; pumps/supplies for groundwater sampling)	\$125[1]	Dollars per day
	Sample Analysis	\$350-400	Dollars per single isotope per sample

Note: 1) GSI owns air sampling equipment used for the demonstration. However, sampling equipment is available for rental (e.g., TO-17 kits). 2) General costs such as travel and shipping are not included.

Although a number of commercial laboratories provide isotope analysis for water or air samples, to our knowledge, the University of Oklahoma service laboratory is the only laboratory that can measure compound-specific isotope ratios of VOCs on adsorbent tube samples. Analytical costs are summarized in Table 23.

Table 23: Analytical Costs for CSIA

Analyte	Carbon	Chlorine	Hydrogen
Adsorbent Tube Samples			
PCE/TCE	$400/sample	$400/sample	$350/sample (TCE)
Benzene	$350/sample	N/A	$350/sample
Water Samples			
PCE/TCE	$350/sample	$400/sample	$350/sample (TCE)
Benzene	$350/sample	N/A	$350/sample

Note: Laboratory requires estimated mass or concentration of target analyte in sample. An additional fee may apply if this information is not provided.

As indicated in Table 23, per-sample costs are based on the sample matrix and the isotopes desired. For example, if TCE is the key COC in a groundwater sample, analyses may be done for carbon and/or chlorine isotope ratios. If both are needed, then the analytical cost would be $750 for that sample. If only chlorine is needed, then the analytical cost would be $400.

7.1.3 Cost Element: Data Evaluation and Reporting

Following completion of the field program, the results were reviewed and organized into a report to document the findings and conclusions. Key elements included CSIA data review and validation, documentation of the results, and review and documentation of the overall findings from the three investigations methods included in the demonstration.

The primary cost for this element is for labor. Typical time required for data review and reporting is summarized in Table 24, and varied based on the number of samples collected.

Table 24: Typical Labor Requirements for Data Evaluation and Reporting

Cost Element	Sub Category	Representative Amount
Data Evaluation and Reporting	Labor hours: Senior Project Scientist/Engineer	2-4 hours per building
	Labor hours: Project Scientist/Engineer	8-12 hours per building

7.2 COST DRIVERS

The CSIA protocol does not require collection of a large number of samples or a time-intensive field effort. Therefore, the cost for implementation of the CSIA protocol is not expected to vary significantly based on specific site characteristics. Instead, key costs drivers relate to mobilization and the number of buildings to be evaluated at the site.

7.3 COST ANALYSIS

Routine implementation of the CSIA protocol will cost less than implementation during the field demonstration because of the additional tasks needed to validate the protocol.

The CSIA protocol is not used as a standalone investigation method. The protocol is appropriate when previously collected data indicate that the concentration of target VOCs in indoor air are near or above risk-based (i.e., regulatory) screening levels and the source (i.e., vapor intrusion vs. indoor source) has not been determined. Application of the CSIA protocol is not likely to directly substitute for conventional sampling; rather, it will primarily be considered at sites where conventional sampling has failed to yield definitive source identification.

7.3.1 Cost Scenarios for the Three Investigation Approaches

Source identification methods include i) conventional methods (intensive manual search and source removal), ii) the on-site GC/MS analysis protocol (ER-201119), and iii) the CSIA protocol.

Conventional Source Identification

Conventional methods include completing a building questionnaire, visual product inventory, and removal. The level of effort for indoor source removal can be significant depending on the amount of materials stored. Additionally, removals may not be feasible in some buildings because they would disrupt critical operations (e.g., Selfridge Building 1533 vehicle maintenance) or because of large volumes of potential sources (e.g., 20,000 sq. ft. Lewis-McChord Building 9669 [warehouse], containing 3-story shelving units).

Estimated costs and assumptions for a conventional source removal program are summarized in Table 25. Because the focus is source removal, this scenario does not include sub-slab or ambient air sampling common in conventional programs. It does include collection of indoor air samples before and after the removal to determine the effectiveness of the removal effort. It also includes an "emission chamber" sample (i.e., isolation of products in a closed container and collection of an air sample of emissions from the products) to evaluate whether the products are significant VOC sources. The time required for a source removal can be significant. A total time of eight hours is assumed because of practical limitations commonly imposed by access agreements.

Table 25: Estimated Cost of Conventional Source Removal for One Building

Cost Element	Category				Unit Cost	Unit	Cost	TOTALS
1. Project planning and preparation	Labor	Senior Project Scientist/Engineer	1	hours	$150	$/hr	$150	$450
	Labor	Project Scientist / Engineer	3	hours	$100	$/hr	$300	
2. Conventional field program	Labor	Senior Project Scientist/Engineer	8	hours	$150	$/hr	$1,200	$2,720
	Labor	Project Scientist / Engineer	8	hours	$100	$/hr	$800	
	Equipment Rental, Supplies	Sub-slab point installation, leak tracer gas (e.g., helium), helium meter	0	buildings	$500	$/bldg.	$0	
	Off-site Sample Analysis	VOCs (1 indoor air before removal, 1 after removal, 1 emission chamber)	3	samples	$240	$/spl (incl. Summa rental)	$720	
3. Data evaluation and reporting	Labor	Senior Project Scientist/Engineer	2	hours	$150	$/hr	$300	$1,100
	Labor	Project Scientist / Engineer	8	hours	$100	$/hr	$800	
							Project Total:	**$4,270**

Note: Estimates do not include shipping, travel, or QA samples (field duplicates). Costs assume implementation in conjunction with a larger sampling program.

On-Site GC/MS Analysis Protocol for Source Identification

This innovative protocol (ER-201119) is designed to distinguish between vapor intrusion and indoor sources of VOCs. The on-site analysis allows collection of a large volume of data in a short period of time. Assuming the same building as in the conventional scenario, the on-site analysis protocol is expected to take less time because the source identification and removal is more efficient (i.e., method allows more selective removals). However, the protocol requires more equipment than a conventional program. Estimated costs (Table 26) assume a limited investigation that is focused on locating current indoor VOC sources. The costs assume that this focused investigation is part of a larger on-site analysis program, so time for equipment QA is not included.

Table 26: Estimated Cost of Focused On-Site GC/MS Analysis Protocol for One Building

Cost Element	**Category**				**Unit Cost**	**Unit**	**Cost**	**TOTALS**
1. Project planning and preparation	Labor	Senior Project Scientist/Engineer	1	hours	$150	$/hr	$150	$450
	Labor	Project Scientist / Engineer	3	hours	$100	$/hr	$300	
2. On-site analysis field program	Labor	Senior Project Scientist/Engineer	4	hours	$150	$/hr	$600	$2,295
	Labor	Project Scientist / Engineer	4	hours	$100	$/hr	$400	
	Equipment Rental	HAPSITE, Floor fan, differential pressure recorder	1	days	$575	$/day	$575	
	Off-site Sample Analysis	VOCs (3 samples x 1 building)	3	samples	$240	$/spl (incl. Summa rental)	$720	
3. Data evaluation and reporting	Labor	Senior Project Scientist/Engineer	2	hours	$150	$/hr	$300	$1,100
	Labor	Project Scientist / Engineer	8	hours	$100	$/hr	$800	
							Project Total:	**$3,845**

Note: Estimates do not include shipping, travel, or QA samples (field duplicates). Costs assume implementation in conjunction with a larger sampling program.

CSIA Protocol for Source Identification

The CSIA protocol is most efficiently implemented as a part of a larger vapor intrusion investigation program. The level of effort in the field is minimal compared to the other methods. A source removal, per se, is not needed to determine the primary sources of VOCs in indoor air. Sample analysis is more expensive, but fewer samples are needed (Table 27).

Table 27: Estimated Cost of CSIA Protocol for One Building

Cost Element	**Category**				**Unit Cost**	**Unit**	**Cost**	**TOTALS**
1. Project planning and preparation	Labor	Senior Project Scientist/Engineer	1	hours	$150	$/hr	$150	$350
	Labor	Project Scientist / Engineer	2	hours	$100	$/hr	$200	
2. On-site analysis field program	Labor	Senior Project Scientist/Engineer	2	hours	$150	$/hr	$300	$2,200
	Labor	Project Scientist / Engineer	2	hours	$100	$/hr	$200	
	Equipment Rental	Pumps, misc supplies	1	days	$100	$/day	$100	
	Off-site Sample Analysis	VOCs (2 samples)	2	samples	$800	$/spl	$1,600	
3. Data evaluation and reporting	Labor	Senior Project Scientist/Engineer	2	hours	$150	$/hr	$300	$700
	Labor	Project Scientist / Engineer	4	hours	$100	$/hr	$400	
							Project Total:	**$3,250**

Note: Estimates do not include shipping, travel, or QA samples (field duplicates). Costs assume implementation in conjunction with a larger sampling program.

7.3.2 Cost Comparison

In the scenarios described in Section 7.3.1 above, implementation of the CSIA protocol is the least expensive on a per-building basis (Table 28).

Table 28: Cost Comparison

Investigation Method	**Cost for One Building**
Conventional Source ID and Removal	$4,270
On-Site GC/MS Analysis Protocol	$3,845
CSIA Protocol	$3,250

8.0 IMPLEMENTATION ISSUES

This project has resulted in development of a new tool to distinguish vapor intrusion from indoor sources of VOCs, one of the major problems with current investigation techniques. Advantages of the CSIA protocol include:

- Less intrusive than an intensive (manual) source removal; and

- Less training needed to implement the CSIA protocol, as compared to the on-site GC/MS protocol.

Limitations to the use of the CSIA protocol include:

- Experience with TO-17 sample collection methods. Sample collection using adsorbent tubes and pumps is slightly more complicated than sample collection using Summa canisters. This limitation can be mitigated by identifying a sampling team with prior experience in sampling using USEPA Method TO-17.

- Potential for inconclusive results. If the isotope composition of subsurface VOCs is within the range commonly observed for VOCs in consumer products, there is more uncertainty in data interpretation. Because of this limitation, the investigation protocol recommends characterization of the subsurface source either prior to collection of indoor air samples or in conjunction with sampling at the first one or two buildings included in a site investigation. The investigation method should be applied as part of a larger indoor air sampling program only when the subsurface source has been found to be distinct from most potential indoor sources.

- Issues with hydrocarbon sites. At petroleum hydrocarbon sites, it may not be practical to analyze for hydrogen isotopes because the large sample mass required may result in an overly long sample collection period. Other potential issues include saturation of the sorbent tubes and matrix interference complicating the laboratory analysis.

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Appendix A: Points of Contact

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

Appendix A: Points of Contact

POINT OF CONTACT Name	ORGANIZATION Name Address	Phone Fax E-mail	Role in Project
Tom McHugh	GSI Environmental Inc. 2211 Norfolk Street Ste 1000 Houston, TX 77098	temchugh@gsi-net.com	Principal Investigator (PI)
Lila Beckley	GSI Environmental Inc. 9600 Great Hills Trail Ste 350E Austin, TX 78759	Ph: 512-346-4474 Fax: 512-346-4476 lmbeckley@gsi-net.com	Project Team Member
Tomasz Kuder	School of Geology and Geophysics, Univ. of Oklahoma 100 E. Boyd St. Rm # A-119 Norman, OK 73019	tkuder@ou.edu	Project Team Member
R. Paul Philp	School of Geology and Geophysics, Univ. of Oklahoma 100 E. Boyd St. Rm # A-119 Norman, OK 73019	pphilp@ou.edu	Project Team Member
Dr. Sam Brock	AFCEC 3300 Sidney Brooks Brooks City-Base TX, 78235	Ph: 210-536-4329 Fax: 210-536-4330 Samuel.Brock@brooks.af.mil	Contracting Officer's Rep.
William Myers	Environmental Restoration Bldg 2012 Liggett AVE RM 313 Box 339500, MS-17 JBLM, WA 98433-9500	Ph: 253-477-3742 william.w.myers@us.army.mil	Site Project Manager (Demonstration Site #1)
Cheryl Neades	Environmental Division, IMMI-PWE U.S. Army Garrison Detroit Arsenal, Michigan	Ph: 586-282-8345 cheryl.l.neades.civ@mail.mil	Site Project Manager (Demonstration Site #2)
Miguel Plaza	Environmental Restoration Flight 325 CES/PMO 119 Alabama Avenue Tyndall AFB, FL 32403	Ph: 850-283-2398 miguel.plaza@tyndall.af.mil	Site Project Manager (Demonstration Site #3)
Sandra Piettro	Environmental Branch U.S. Army Corps of Engineers NY District, Jacob K. Javits Federal Building, 26 Federal Plaza, Room 1811 New York, NY 10278-0098	Ph: 917-790-8487 Sandra.L.Piettro@usace.army.mil	Site Project Manager (Demonstration Site #4)

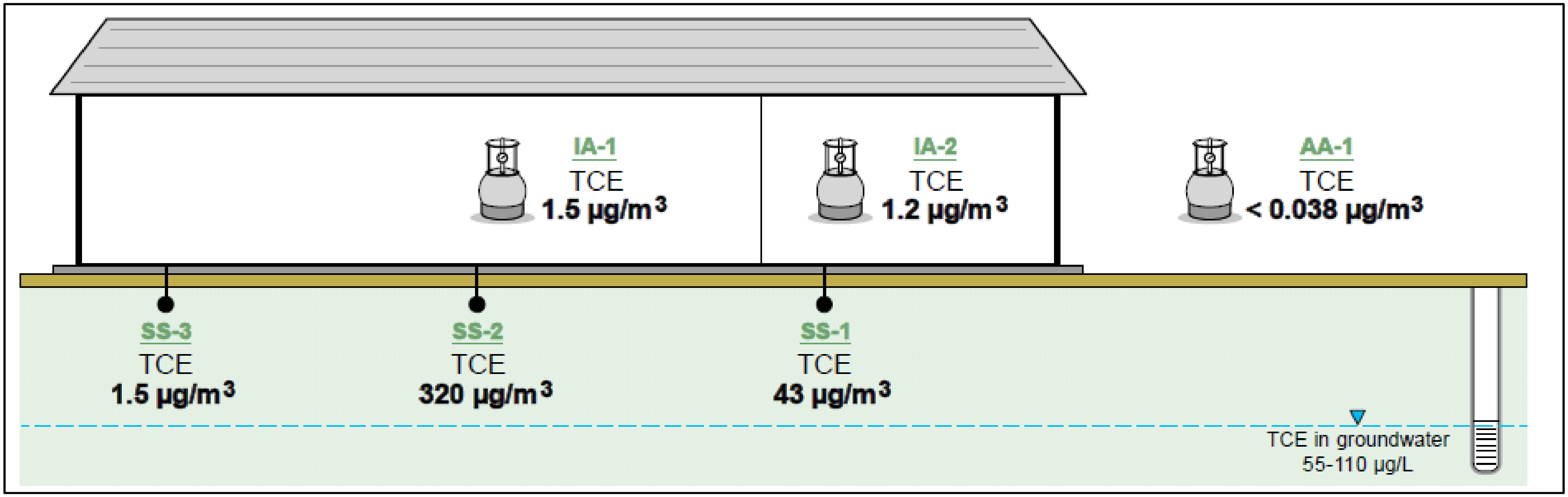
Appendix B: Lines of Evidence Evaluations

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

FIGURE B.1.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Lewis-McChord Building 9669, Washington



Data Interpretation

Line of Evidence	Consistent with VI?	Comment
• Indoor air concentration > outdoor air?	**Yes**	Also consistent with potential indoor source
• Sub-slab >10x indoor air concentration?	**Yes**	At 2 of 3 sub-slab points
• Sub-slab to indoor air concentration ratios consistent with VI?	**Yes**	TCE, PCE, 111TCA are highest conc VOCs in sub-slab; also detected in indoor air, with similar conc ratios.
• Concentration ratios consistent with groundwater (GW) source?	**Inconclusive**	In GW, c12DCE is approx 2% of TCE conc; c12DCE not detected in sub-slab or indoor air, but may not have been detectable because of low conc in GW source; PCE, 111TCA not detected in GW.

FINDING: Supporting evidence of current vapor intrusion

IMPLICATION: Indoor air conc (1.5 ug/m3) is BELOW USEPA screening level (3 ug/m3); however, monitoring may be appropriate to characterize temporal variability.

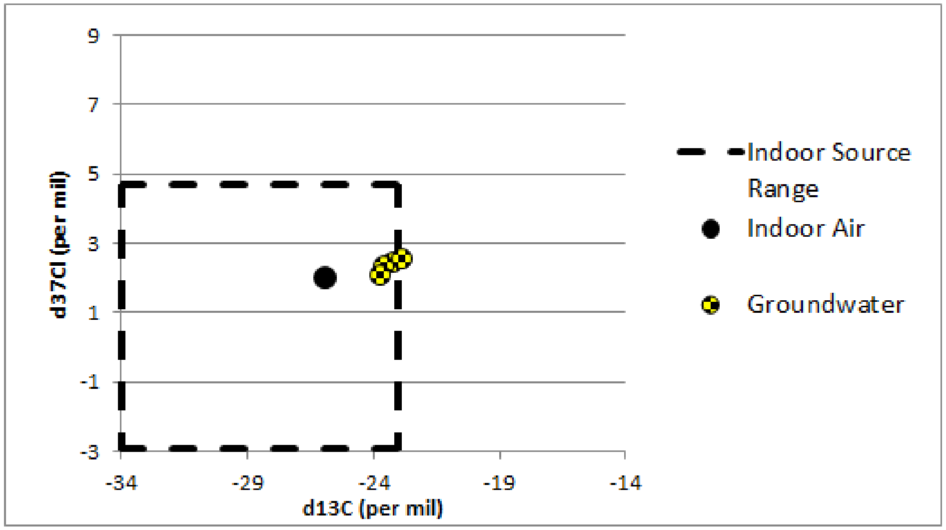
Notes: 1) Building schematic is not to scale. 2) See Section 5.7.1 for decision logic. 3) See Table C.1.1 for all conventional program results.

FIGURE B.1.2: RESULTS FROM CSIA PROTOCOL

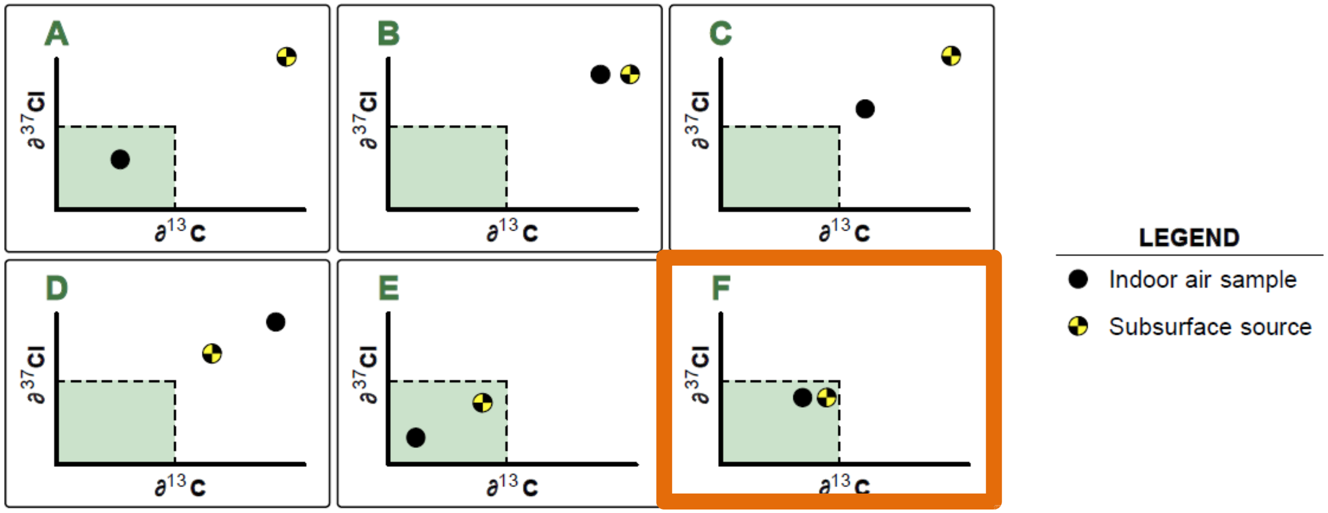
ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Lewis-McChord Building 9669, Washington

Indoor Air vs. Groundwater Isotope Signatures



Data Interpretation



FINDING: Supporting evidence of current vapor intrusion

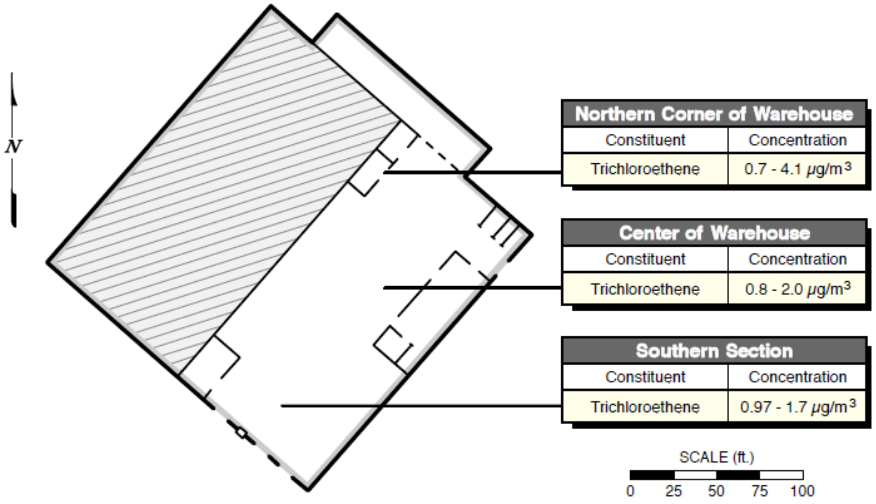
Notes: 1) See Section 5.7.2 for decision logic. 2) See Table C.1.2 for CSIA sample results.

FIGURE B.1.3: RESULTS FROM ON-SITE ANALYSIS PROTOCOL

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Lewis-McChord Building 9669, Washington

Baseline Evaluation



Northern Corner of Warehouse

Constituent	Concentration
Trichloroethene	0.7 - 4.1 μg/m³

Center of Warehouse

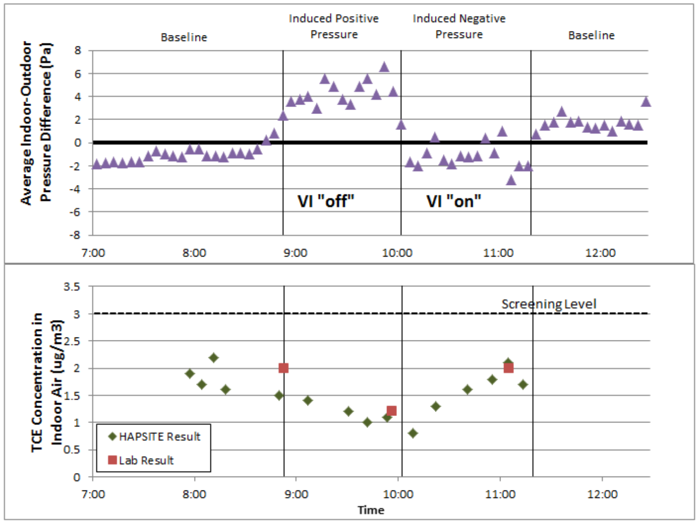
Constituent	Concentration
Trichloroethene	0.8 - 2.0 μg/m³

Southern Section

Constituent	Concentration
Trichloroethene	0.97 - 1.7 μg/m³

Outdoors: TCE not detected

Pressure Control Evaluation



Data Interpretation

Line of Evidence (Baseline)	Consistent with VI?
• Indoor air concentration > outdoor air?	**Yes**
• No indoor sources?	**Yes**
• Baseline building pressure negative?	**Yes**
• Vapor entry point found?	**No**
Baseline Finding: **Supporting evidence of current VI**	

Line of Evidence (Pressure Control)	Consistent with VI?
• Target VOC conc suppressed by building pressurization?	**Yes**
• Target VOC conc enhanced by depressurization?	**Yes**
Pressure Control Finding: **Evidence of potential VI**	

OVERALL FINDING: Evidence of current/potential vapor intrusion

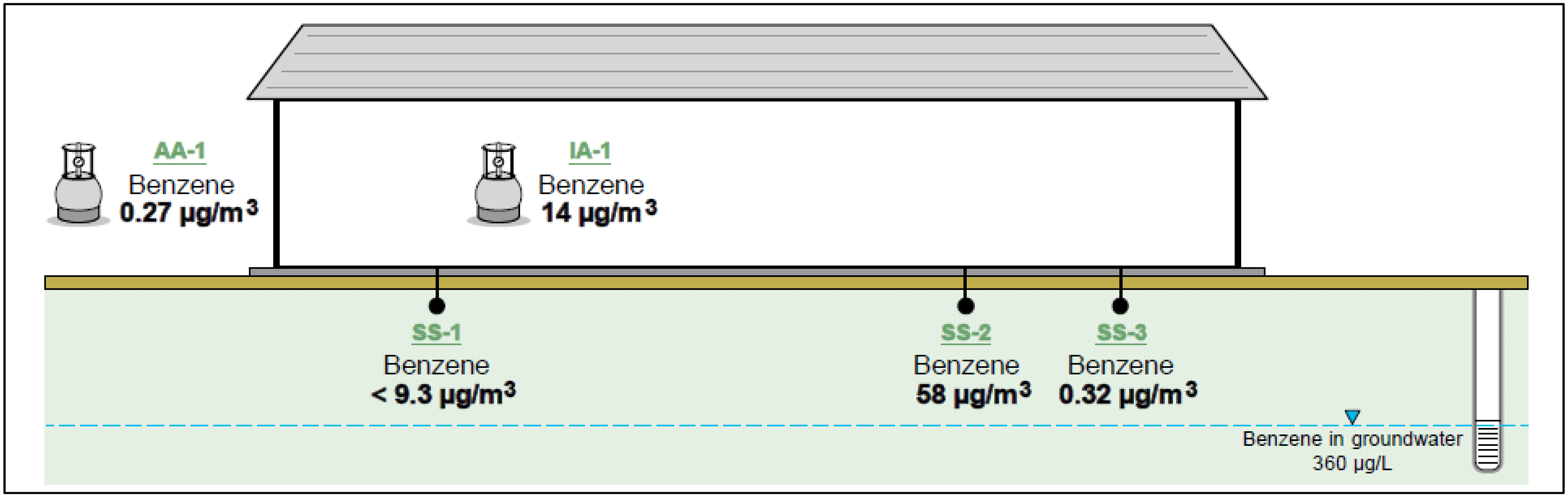
IMPLICATION: Indoor air conc (2 ug/m3) is BELOW USEPA screening level (3 ug/m3). Pressure control evaluation increases confidence in result, and decreases concern with temporal variability.

Notes: 1) See Section 5.7.3 for decision logic. 2) See Table C.1.3 and C.1.4 for on-site analysis protocol results.

FIGURE B.2.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Selfridge Building 1533, Michigan



Data Interpretation

Line of Evidence	Consistent with VI?	Comment
• Indoor air concentration > outdoor air?	**Yes**	Also consistent with identified indoor source (e.g., automobiles being services inside building)
• Sub-slab >10x indoor air concentration?	**No**	
• Sub-slab to indoor air concentration ratios consistent with VI?	**Inconclusive**	Elevated detection limits in indoor air prevent meaningful comparisons
• Concentration ratios consistent with groundwater (GW) source?	**Inconclusive**	In GW, benzene is approx 25% of the ethylbenzene concentration. In sub-slab, ratios vary between sample points. In indoor air, ethylbenzene not detected (<57 ug/m3).

FINDING: Inconclusive, can't distinguish between VI and indoor sources.

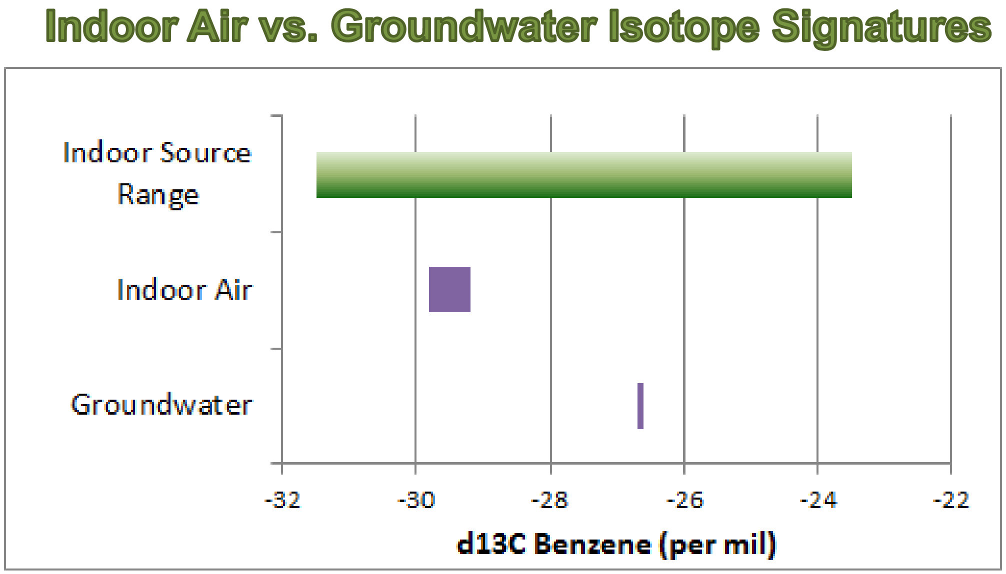
IMPLICATION: Indoor benzene concentration greater than USEPA screening level (1.6 ug/m3). Further study needed to determine source.

Notes: 1) Building schematic is not to scale. 2) See Section 5.7.1 for decision logic. 3) See Table C.2.1 for all conventional program results.

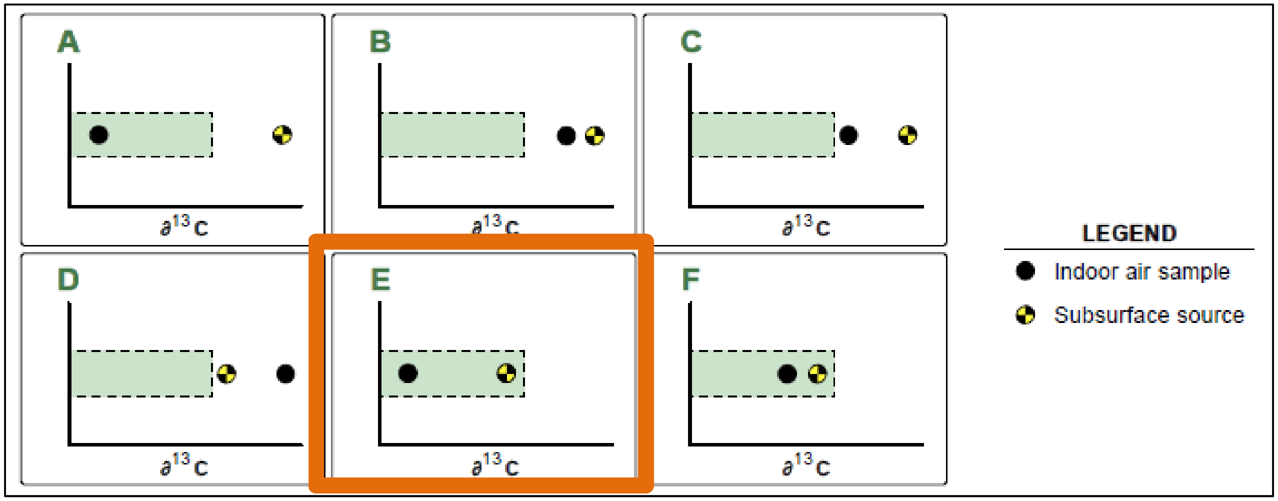
FIGURE B.2.2: RESULTS FROM CSIA PROTOCOL

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Selfridge Building 1533, Michigan



Data Interpretation



FINDING: Supporting evidence of no current vapor intrusion

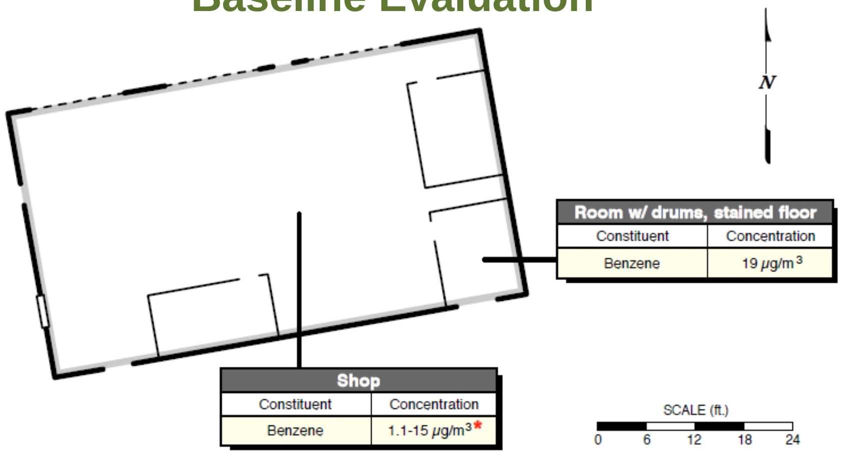
Notes: 1) See Section 5.7.2 for decision logic. 2) See Table C.2.2 for CSIA sample results.

FIGURE B.2.3: RESULTS FROM ON-SITE ANALYSIS PROTOCOL

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Selfridge Building 1533, Michigan

Baseline Evaluation



Room w/ drums, stained floor

Constituent	Concentration
Benzene	19 µg/m³

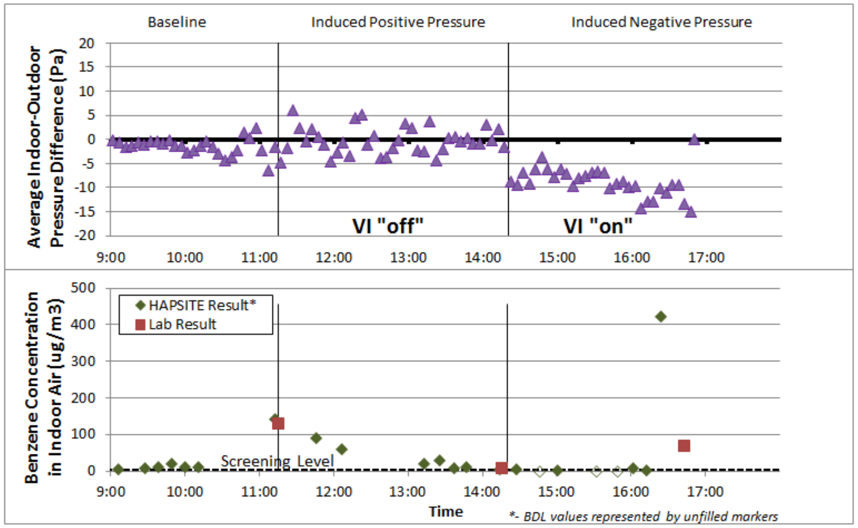
Shop

Constituent	Concentration
Benzene	1.1-15 µg/m³*

* Benzene > 100 µg/m3 when vehicle started briefly.

Outdoors: Benzene 0.38 – 1.2 ug/m3

Pressure Control Evaluation



Data Interpretation

Line of Evidence (Baseline)	Consistent with VI?
• Indoor air concentration > outdoor air?	**Yes**
• No indoor sources?	**No (Sources found and could not be removed from building)**
• Baseline building pressure negative?	**Yes**
• Vapor entry point found?	**No**
Baseline Finding: **Supporting evidence of no current VI**	

Line of Evidence (Pressure Control)	Consistent with VI?
• Target VOC conc suppressed by building pressurization?	**No**
• Target VOC conc enhanced by depressurization?	**No**
Pressure Control Finding: **No evidence of potential VI**	

OVERALL FINDING: No evidence of current/potential vapor intrusion

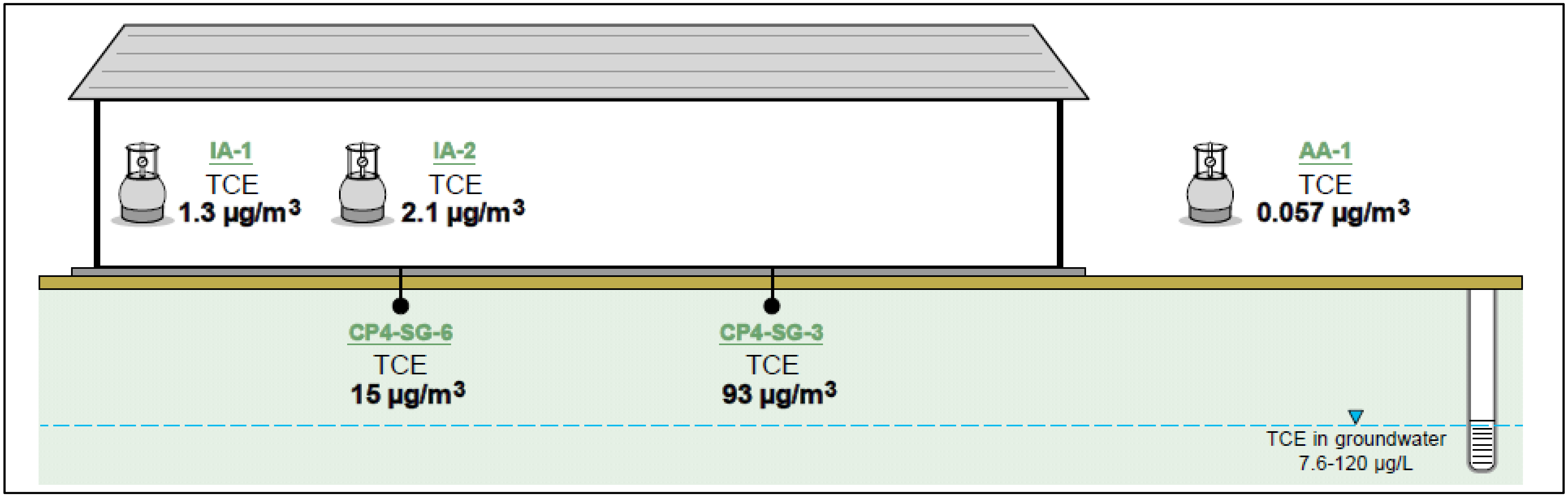
IMPLICATION: Primary sources of benzene are indoors. Indoor air benzene concentration greater than USEPA screening level due to indoor sources. No additional evaluation warranted under current building use.

Notes: 1) See Section 5.7.3 for decision logic. 2) See Table C.2.3 and C.2.4 for on-site analysis protocol results.

FIGURE B.3.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Raritan Building CP4, New Jersey



Data Interpretation

Line of Evidence	Consistent with VI?	Comment
• Indoor air concentration > outdoor air?	**Yes**	Also consistent with potential indoor source.
• Sub-slab >10x indoor air concentration?	**Yes**	
• Sub-slab to indoor air concentration ratios consistent with VI?	**Yes**	TCE, PCE found at highest concentrations in sub-slab; also detected in indoor air. Ratios similar.
• Concentration ratios consistent with groundwater (GW) source?	**Inconclusive**	In GW, c12DCE is 20-75% of the TCE conc. In sub-slab, c12DCE is <1% of the TCE conc. c12DCE not detected in indoor air.

FINDING: Supporting evidence of current vapor intrusion

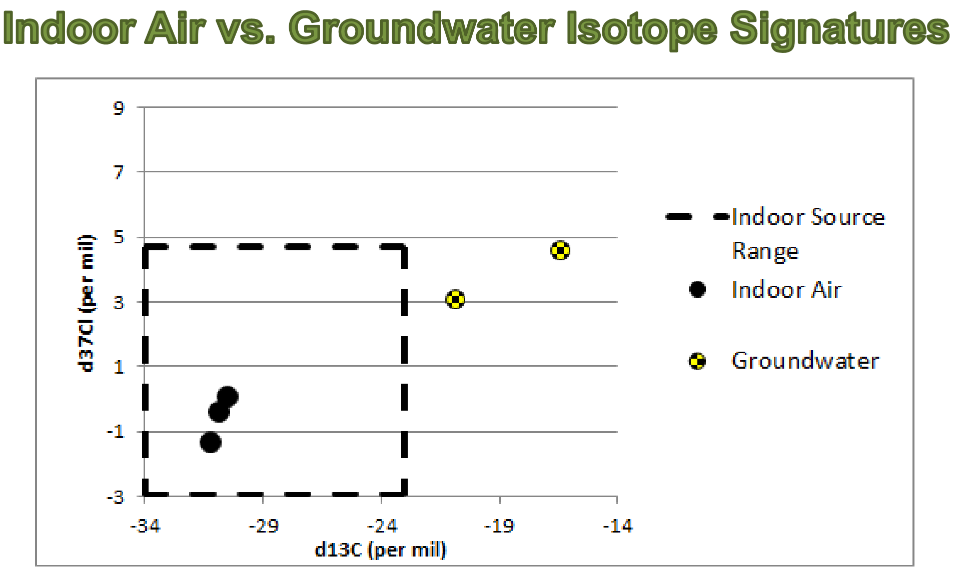
IMPLICATION: Indoor air TCE concentration is within 50% of USEPA screening level (3 ug/m3). Monitoring may be needed to characterize temporal variability.

Notes: 1) Building schematic is not to scale. 2) See Section 5.7.1 for decision logic. 3) See Table C.4.1 for all conventional program results.

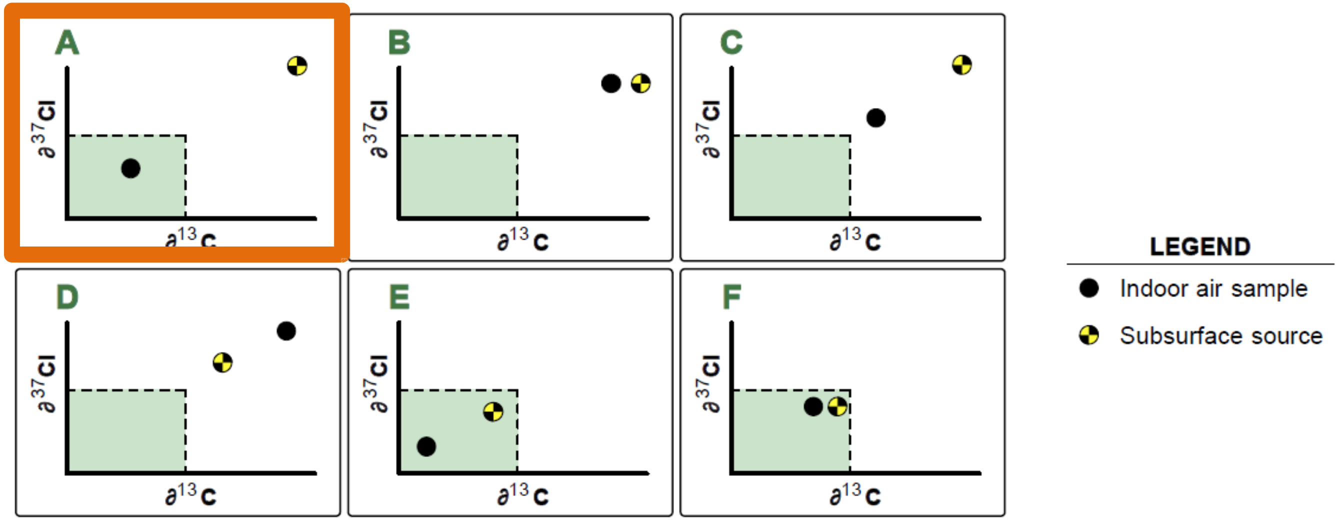
FIGURE B.3.2: RESULTS FROM CSIA PROTOCOL

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Raritan Building CP4, New Jersey



Data Interpretation



FINDING: Strong evidence of indoor source, not vapor intrusion

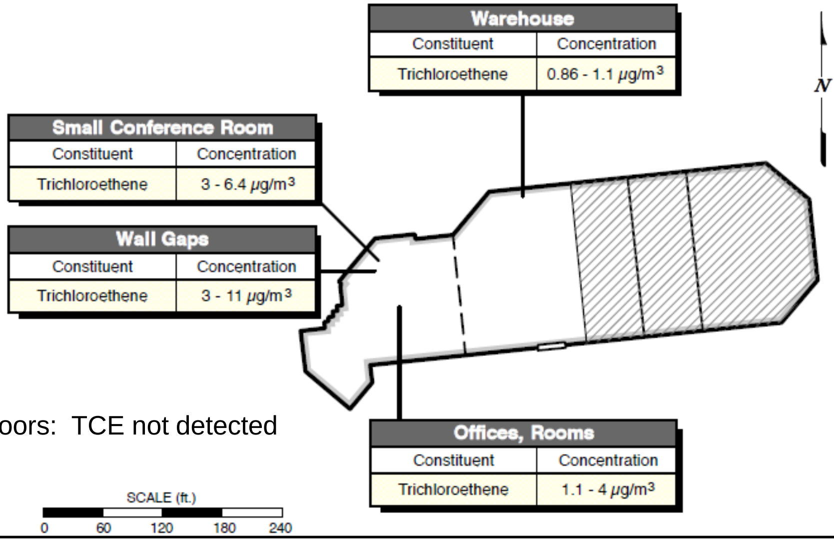
Notes: 1) See Section 5.7.2 for decision logic. 2) See Table C.4.2 for CSIA sample results.

FIGURE B.3.3: RESULTS FROM ON-SITE ANALYSIS PROTOCOL

ESTCP Project ER-201025, Use of CSIA to Distinguish between VI and Indoor Sources of VOCs

Site Data: Raritan Building CP4, New Jersey

Baseline Evaluation



Warehouse

Constituent	Concentration
Trichloroethene	0.86 - 1.1 μg/m³

Small Conference Room

Constituent	Concentration
Trichloroethene	3 - 6.4 μg/m³

Wall Gaps

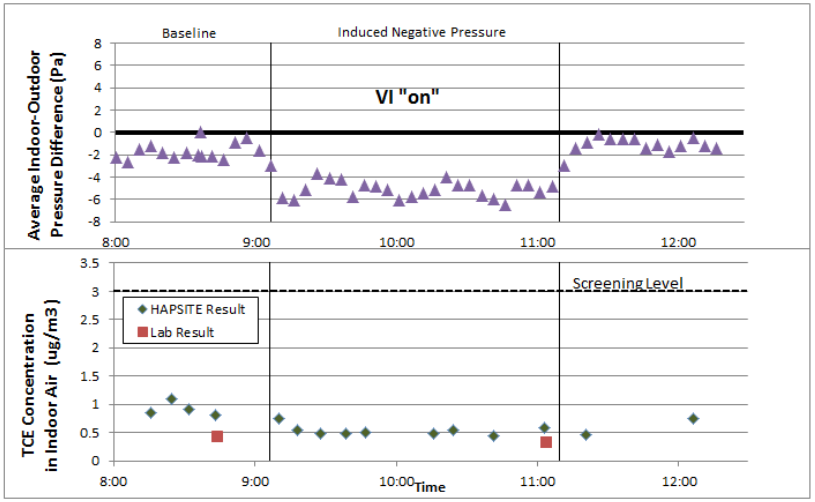
Constituent	Concentration
Trichloroethene	3 - 11 μg/m³

Offices, Rooms

Constituent	Concentration
Trichloroethene	1.1 - 4 μg/m³

Outdoors: TCE not detected

Pressure Control Evaluation



Note: Access for pressure control test available only in warehouse.

Data Interpretation

Line of Evidence (Baseline)	Consistent with VI?
• Indoor air concentration > outdoor air?	**Yes**
• No indoor sources?	**Yes**
• Baseline building pressure negative?	**Yes**
• Vapor entry point found?	**Inconclusive (conf room wall gap conc. 2-3x higher than indoor air; one warehouse expansion joint 5x higher than indoor air)**
Baseline Finding: **Supporting evidence of current VI**	

Line of Evidence (Pressure Control)	Consistent with VI?
• Target VOC conc suppressed by building pressurization?	**Not tested**
• Target VOC conc enhanced by depressurization?	**No**
Pressure Control Finding: **Pressure variation does not enhance VI (warehouse)**	

OVERALL FINDING: Office Area: Supporting evidence of VI. Warehouse: Suggestive of VI.

IMPLICATION: Indoor air conc (0.43 ug/m3 in warehouse) is BELOW USEPA screening level (3 ug/m3). Controlled depressurization did not enhance vapor intrusion reducing concern regarding temporal variability.

Notes: 1) See Section 5.7.3 for decision logic. 2) See Table C.4.3 and C.4.4 for on-site analysis protocol results.

Appendix C: Results from Individual Demonstration Sites

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

Appendix C.1: Joint Base Lewis-McChord, Washington

TABLES

FIGURES

TABLE C.1.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119
Joint Base Lewis-McChord, Washington

Location ID:	**GROUNDWATER**		
Field Sample ID:	**LC-18 (Note 4)**	**LC-48 (Note 4)**	**MT-1 (Note 4)**
Sample Location ID:	**LC-18**	**LC-48**	**MT-1**
Description:	**South of Building 9669**	**West of Building 9674**	**Upgradient well, closer to source (landfill area)**
Matrix:	**GW**	**GW**	**GW**
Sample Type:	**N**	**N**	**N**
Sample Collection Date:	**6/21/2012**	**6/21/2012**	**5/30/2012**
Analytical Method (units):	**8260 (ug/L)**	**8260 (ug/L)**	**8260 (ug/L)**
Key Analyte for VI Evaluation			
Trichloroethene (TCE)	**55**	**110 H**	**96**
Other Reported Compounds			
Dichloroethane, 1,2-	-	-	-
Dichloroethene, 1,1- (1,1-DCE)	-	-	-
Dichloroethene, cis-1,2-	**0.73**	**2.1**	**1.4**
Dichloroethene, trans-1,2-	-	-	-
Tetrachloroethene (PCE)	<0.5	<0.5	<0.5
Trichloroethane, 1,1,1- (TCA)	<0.5	<0.5	<0.5
Vinyl chloride (VC)	<0.5	<0.5	<0.5

Notes:

1. Vapor samples analyzed by ALS/Columbia Analytical Services, Simi Valley, CA.
2. Sub-slab soil gas collected as grab samples (without flow controller). Indoor and outdoor air samples collected with 8-hour flow controller.
3. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed.
4. Results from May/June 2012 groundwater monitoring event, provided by base personnel. VOC analysis of groundwater samples was not conducted as part of the ESTCP VI Study.

TABLE C.1.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119
Joint Base Lewis-McChord, Washington

Location ID:	**BUILDING 9669**					
Field Sample ID:	**1-SS-1-CON**	**1-SS-2-CON**	**1-SS-3-CON**	**1-IA-1-CON**	**1-IA-2-CON**	**1-AA-1-CON**
Sample Location ID:	**1-SS-1**	**1-SS-2**	**1-SS-3**	**1-IA-1**	**1-IA-2**	**1-AA-1**
Description:	**Sub-slab, front, near battery recycling area**	**Sub-slab, middle, near 1-IA-1**	**Sub-slab, back of building**	**Indoor air, center of warehouse**	**Indoor air, shelf in product storage area**	**Outdoors**
Matrix:	**SS**	**SS**	**SS**	**IA**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date:	**7/24/2012 10:46**	**7/24/2012 11:06**	**7/24/2012 11:27**	**7/24/2012 15:57**	**7/24/2012 15:58**	**7/24/2012 16:00**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation						
Trichloroethene (TCE)	**43**	**320**	**1.5**	**1.5**	**1.2**	<0.038
Other Reported Compounds						
Dichloroethane, 1,2-	**0.65**	<0.55	**3.2**	**0.053**	**0.05**	<0.038
Dichloroethene, 1,1- (1,1-DCE)	<0.13	<0.55	<0.91	<0.037	<0.036	<0.038
Dichloroethene, cis-1,2-	<0.13	<0.55	<0.91	<0.037	<0.036	<0.038
Dichloroethene, trans-1,2-	<0.13	**0.57**	<0.91	**2.3**	**1.6**	<0.038
Tetrachloroethene (PCE)	**17**	**22**	**21**	**0.18**	**0.15**	**0.052**
Trichloroethane, 1,1,1- (TCA)	**3.4**	**6.2**	**9**	**0.042**	**0.039**	<0.038
Vinyl chloride (VC)	<0.13	<0.55	<0.91	<0.037	<0.036	<0.038

Notes:

1. Vapor samples analyzed by ALS/Columbia Analytical Services, Simi Valley, CA.
2. Sub-slab soil gas collected as grab samples (without flow controller). Indoor and outdoor air samples collected with 8-hour flow controller.
3. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed.

TABLE C.1.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119
Joint Base Lewis-McChord, Washington

Location ID:	**BUILDING 9674**				
Field Sample ID:	**2-SS-1-CON**	**2-SS-2-CON**	**2-SS-3-CON-Resample**	**2-IA-1-CON**	**2-AA-1-CON**
Sample Location ID:	**2-SS-1**	**2-SS-2**	**2-SS-3**	**2-IA-1**	**2-AA-1**
Description:	**Sub-slab, north side of building**	**Sub-slab, near center**	**Sub-slab, south side of building**	**Indoor air, center of warehouse**	**Outdoors**
Matrix:	**SS**	**SS**	**SS**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**
Sample Collection Date:	**7/24/2012 14:49**	**7/24/2012 15:05**	**7/26/2012 8:08**	**7/24/2012 15:21**	**7/24/2012 15:25**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation					
Trichloroethene (TCE)	**0.034**	**1.8**	**1.7**	**0.072**	<0.033
Other Reported Compounds					
Dichloroethane, 1,2-	**0.24**	**0.3**	**0.096**	<0.038	**0.038**
Dichloroethene, 1,1- (1,1-DCE)	**0.035**	<0.063	<0.033	<0.038	<0.033
Dichloroethene, cis-1,2-	<0.033	<0.063	<0.033	<0.038	<0.033
Dichloroethene, trans-1,2-	<0.033	<0.063	<0.033	<0.038	<0.033
Tetrachloroethene (PCE)	**18**	**48**	**35 D**	**0.24**	**0.053**
Trichloroethane, 1,1,1- (TCA)	**1.7**	**0.73**	**1.5**	<0.038	<0.033
Vinyl chloride (VC)	<0.033	<0.063	<0.033	<0.038	<0.033

Notes:

1. Vapor samples analyzed by ALS/Columbia Analytical Services, Simi Valley, CA.
2. Sub-slab soil gas collected as grab samples (without flow controller). Indoor and outdoor air samples collected with 8-hour flow controller.
3. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed; "D" indicates result is from a dilution.

TABLE C.1.2: RESULTS FROM ISOTOPE PROGRAM
ESTCP Project ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Location ID:	**GROUNDWATER**				**BUILDING 9669**		
Field Sample ID:	**LC-18**	**DUP-1**	**LC-48**	**MT-1**	**1-SS-2-CSI**	**3-SS-2-CSI**	**1-IA-1-CSI**
Sample Location ID:	**LC-18**	**LC-18**	**LC-48**	**MT-1**	**1-SS-2**	**1-SS-2**	**1-IA-1**
Description:	**near Building 9669**	**near Building 9669**	**near Building 9674**	**upgradient of 9669/9674**	**middle, near 1-IA-1**	**middle, near 1-IA-1**	**center of warehouse**
Matrix:	**GW**	**GW**	**GW**	**GW**	**SS**	**SS**	**IA**
Sample Type:	**N**	**FD**	**N**	**N**	**N**	**FD**	**N**
Sample Collection Date/Time:	**7/24/2012 10:50:00 AM**	**7/24/2012 10:50:00 AM**	**7/24/2012 11:35:00 AM**	**7/24/2012 10:15:00 AM**	**7/25/2012 9:34:00 AM**	**7/25/2012 9:57:00 AM**	**7/24/2012 9:41:00 AM**
Analytical Method (units):	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**
Analyte							
d13C TCE	**-23.3 H**	**-23.6 H**	**-23.8 H**	**-22.9 H**	**-18.5 H**	**-18.8 H**	**-25.9 HJ**
d37Cl TCE	**2.5 H**	**2.4 H**	**2.1 H**	**2.6 H**	**5.8 H**	**5.5 H**	**2.0 H**

Notes:

1. Isotope analysis was completed by the University of Oklahoma.
2. Groundwater samples collected by Versar.
3. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed;
   H = samples analyzed outside of validated holding time period of 2 weeks; J = estimated result.
4. Indoor air TCE concentrations were too low in Building 9674 to allow collection of sufficient mass for isotope analysis.

TABLE C.1.3: RESULTS FROM ON-SITE ANALYSIS PROGRAM CONFIRMATION SAMPLES
ESTCP Project ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Location ID:	**BUILDING 9669**			
Field Sample ID:	**1-IA-3-BL**	**1-IA-3-PP**	**1-IA-3-NP**	**1-AA-1**
Sample Location ID:	**1-IA-3**	**1-IA-3**	**1-IA-3**	**1-AA-1**
Description:	**near battery/ recycling area**	**near battery/ recycling area**	**near battery/ recycling area**	**outdoors**
Matrix:	**IA**	**IA**	**IA**	**AA**
Pressure Condition	**BL**	**PP**	**NP**	**BL**
Sample Type:	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**7/25/2012 8:53**	**7/25/2012 9:57**	**7/25/2012 11:06**	**7/25/2012 9:25**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation				
Trichloroethene (TCE)	**2**	**1.2**	**2**	-
Other Reported VOCs				
Dichloroethane, 1,2-	**0.051**	**0.05**	**0.047**	-
Dichloroethene, 1,1- (1,1-DCE)	<0.031	<0.031	<0.031	-
Dichloroethene, cis-1,2-	<0.031	<0.031	<0.031	-
Dichloroethene, trans-1,2-	**2.2**	**1.5**	**1**	-
Tetrachloroethene (PCE)	**0.22**	**0.17**	**0.16**	-
Trichloroethane, 1,1,1- (TCA)	**0.041**	**0.038**	**0.035**	-
Vinyl chloride (VC)	<0.031	<0.031	<0.031	-
Radon (pCi/L)				
Radon	**0.36**	**0.3**	**0.2**	**0.01**

Notes:

1. VOC analysis of vapor samples by ALS/Columbia Analytical Services, Simi Valley, California. Radon analysis by University of Southern California.
2. Samples collected as grab (i.e., without flow controller). Samples for VOC analysis were collected in 6-L Summa canisters. Samples for Radon analysis were collec in 1-L Tedlar bags.
3. Pressure Condition: BL = baseline (uncontrolled); NP = negative pressure (building depressurized); PP = positive pressure (building pressurized)
4. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed.

TABLE C.1.3: RESULTS FROM ON-SITE ANALYSIS PROGRAM CONFIRMATION SAMPLES
ESTCP Project ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Location ID:	**BUILDING 9674**			
Field Sample ID:	**2-IA-1-BL**	**DUP-1**	**2-IA-1-NP**	**2-AA-1**
Sample Location ID:	**2-IA-1**	**2-IA-1**	**2-IA-1**	**2-AA-1**
Description:	**center of warehouse**	**center of warehouse**	**center of warehouse**	**outdoors**
Matrix:	**IA**	**IA**	**IA**	**AA**
Pressure Condition	**BL**	**BL**	**NP**	**BL**
Sample Type:	**N**	**FD**	**N**	**N**
Sample Collection Date/Time:	**7/26/2012 8:36**	**7/26/2012 8:36**	**7/26/2012 10:15**	**7/26/2012 8:45**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation				
Trichloroethene (TCE)	**0.032**	<0.031	<0.03	-
Other Reported VOCs				
Dichloroethane, 1,2-	**0.036**	**0.035**	**0.035**	-
Dichloroethene, 1,1- (1,1-DCE)	<0.03	<0.031	<0.03	-
Dichloroethene, cis-1,2-	<0.03	<0.031	<0.03	-
Dichloroethene, trans-1,2-	<0.03	<0.031	<0.03	-
Tetrachloroethene (PCE)	<0.03	<0.031	<0.03	-
Trichloroethane, 1,1,1- (TCA)	<0.03	<0.031	<0.03	-
Vinyl chloride (VC)	<0.03	<0.031	<0.03	-
Radon (pCi/L)				
Radon	**0.09**	**0.1**	**0.12**	**0.09**

Notes:
1. VOC analysis of vapor samples by ALS/Columbia Analytical Services, Simi Valley, California. Radon analysis by University of Southern California.
2. Samples collected as grab (i.e., without flow controller). Samples for VOC analysis were collected in 6-L Summa canisters. Samples for Radon analysis were collected in 1-L Tedlar bags.
3. Pressure Condition: BL = baseline (uncontrolled); NP = negative pressure (building depressurized); PP = positive pressure (building pressurized)
4. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed.

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TABLE C.1.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Sample Date/Time	Description	Matrix	DCE12T	TCE
			ug/m3	ug/m3
SCREENING SAMPLES				
7/23/2012 10:56	Workroom air, door open	AI	U	U
7/23/2012 11:06	09522 IA (Tedlar)	AI	U	U
7/23/2012 11:13	09671 IA (Tedlar)	AI	U	0.12 J
7/23/2012 11:21	09666 IA (Tedlar)	AI	U	U
7/23/2012 11:28	Workroom air, door open	AI	U	U
7/23/2012 11:35	09679 IA (Tedlar)	AI	U	U
7/23/2012 11:43	09674 IA (Tedlar)	AI	U	U
7/23/2012 11:50	09669 IA (Tedlar)	AI	1.4 J	1.7 J
7/23/2012 12:44	09522 IA (re-run Tedlar)	AI	U	U
7/23/2012 12:52	Workroom air, door open	AI	U	U
7/23/2012 14:27	09564 IA (Tedlar)	AI	U	0.097 J
7/23/2012 14:35	09673 IA (Tedlar)	AI	U	U
7/23/2012 16:15	9669-SS-1 (Tedlar)	SS	U	45
7/23/2012 16:23	9669-SS-2 (Tedlar)	SS	U	210 JE
7/23/2012 16:30	Workroom air, door open	AI	U	0.4 J
7/23/2012 16:38	9669-SS-3	SS	U	4
7/23/2012 16:49	9669-SS-2 (repeat Tedlar)	SS	U	210 JE
7/24/2012 10:15	9674 SS-1 (Tedlar)	SS	U	0.22 J
7/24/2012 10:28	9674 SS-2 (Tedlar)	SS	U	1.8 J
7/24/2012 10:35	9674 SS-3 (Tedlar)	SS	U	U
7/24/2012 10:43	rerun 9674 SS-3 Tedlar	SS	U	1.6 J
BUILDING 9669				
7/24/2012 10:07	1-IA-1 location; next to 8-hr Summa	AI	2.4	2 J
7/24/2012 10:51	1-IA-1 repeat	AI	2.2	U
7/24/2012 11:33	Outdoors on loading dock	AA	U	U
7/24/2012 13:45	Near battery center	AI	0.48 J	2 J
7/24/2012 13:53	Center back	AI	1.7 J	0.97 J
7/24/2012 14:00	Center (1-IA-1)	AI	21	0.91 J
7/24/2012 14:09	Center of offices (room with cubicles)	AI	1.5 J	0.81 J
7/24/2012 14:16	Office front corner (design demonstration room)	AI	0.91 J	0.91 J
7/24/2012 14:24	Repeat front corner near battery center/recycling area	AI	0.48 J	4.1

TABLE C.1.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Sample Date/Time	Description	Matrix	DCE12T	TCE
			ug/m3	ug/m3
	BUILDING 9669			
7/24/2012 14:32	Inside cage	AI	0.63 J	0.75 J
7/24/2012 14:39	Between counter and front door/main entrance	AI	0.79 J	0.91 J
7/24/2012 14:47	Near 1-IA-2	AI	0.59 J	0.7 J
7/24/2012 14:54	Repeat front corner near battery center	AI	U	2.8
7/25/2012 7:57	BL 1-IA-1 center of building	AI	2.1	1.9 J
7/25/2012 8:04	BL Center back	AI	1.9 J	1.7 J
7/25/2012 8:11	BL Front corner	AI	1.7 J	2.2 J
7/25/2012 8:18	BL Front, near counter	AI	2 J	1.6 J
7/25/2012 8:50	BL Repeat front corner (1-IA-3)	AI	1.6 J	1.5 J
7/25/2012 9:07	PP Repeat front corner (1-IA-3)	AI	1.5 J	1.4 J
7/25/2012 9:23	Outdoors at 1-AA-1.	AA	U	U
7/25/2012 9:31	PP Repeat front corner (1-IA-3)	AI	1.3 J	1.2 J
7/25/2012 9:42	PP Repeat front corner (1-IA-3)	AI	1.1 J	1 J
7/25/2012 9:54	PP Repeat front corner (1-IA-3)	AI	1.1 J	1.1 J
7/25/2012 10:08	NP Repeat front corner (1-IA-3)	AI	0.95 J	0.81 J
7/25/2012 10:22	NP Repeat front corner (1-IA-3)	AI	1.2 J	1.3 J
7/25/2012 10:41	NP Repeat front corner (1-IA-3)	AI	0.95 J	1.6 J
7/25/2012 10:55	NP Repeat front corner (1-IA-3)	AI	0.91 J	1.8 J
7/25/2012 11:05	NP Repeat front corner (1-IA-3)	AI	0.71 J	2.1 J
7/25/2012 11:13	NP Repeat front corner (1-IA-3)	AI	0.91 J	1.7 J
7/25/2012 11:27	Flux crack near SS-2. Sampled after 5 minutes.	AF	1.2 J	1 J
7/25/2012 11:35	Flux same crack near SS-2. Sampled after 15 minutes total. Fan off.	AF	1.3 J	U
7/25/2012 13:25	Flux second crack, in floor of cage. Sampled after approx 1 hr 20 min	AF	0.79 J	2.8
7/25/2012 13:36	BL Indoor air in cage	AI	1.2 J	1.8 J
7/25/2012 13:43	BL 1-IA-3	AI	1.2 J	2.9
7/25/2012 13:50	BL Center back	AI	1.3 J	1.2 J
7/25/2012 14:01	BL Center, near 1-IA-1	AI	2.3	1.1 J
7/25/2012 14:09	BL Near shelf with trans12DCE source	AI	87	0.97 J
7/25/2012 14:21	BL Center of other half of building (haz mat storage)	AI	U	0.23 J
7/25/2012 14:33	Floor flux through carpet 1. Bowl set approx 1 hr 10 min prior to sampling.	AF	1 J	5.4

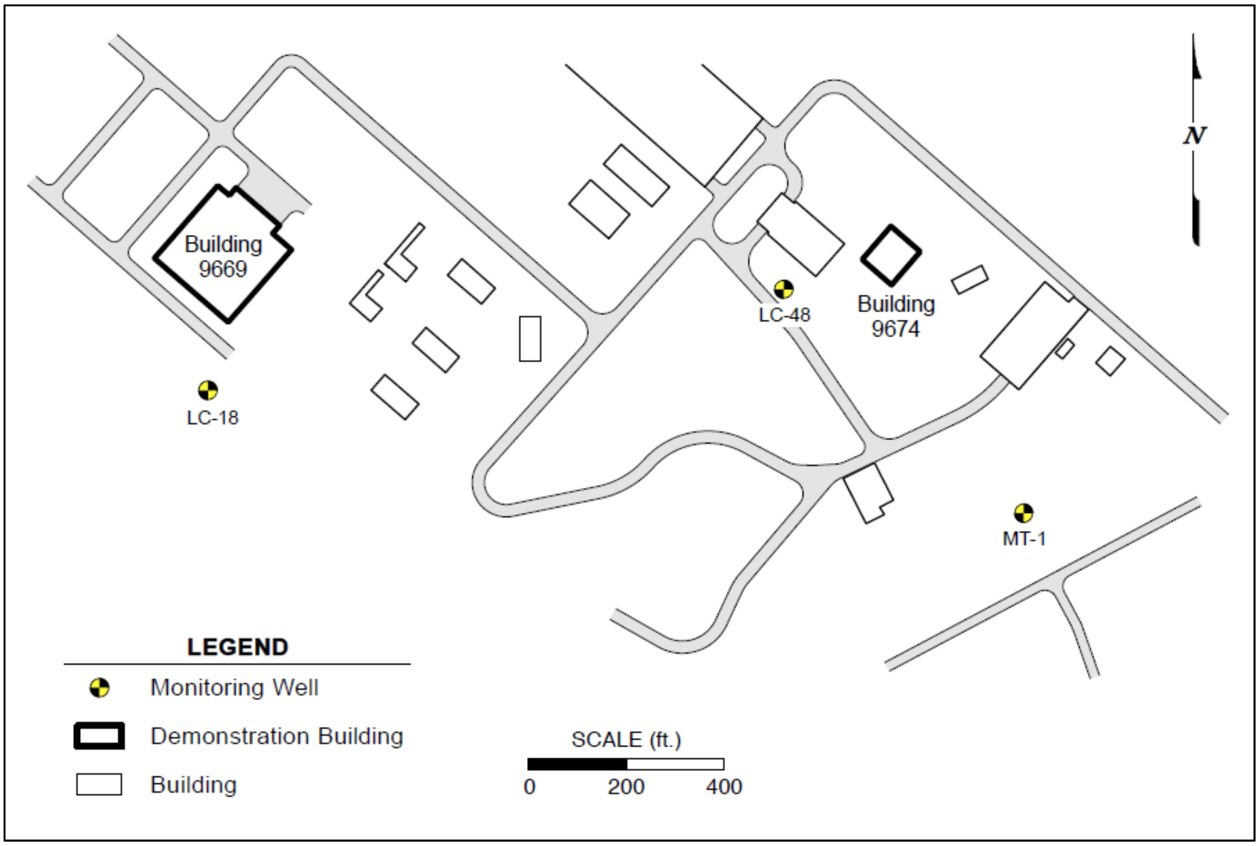
TABLE C.1.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Sample Date/Time	Description	Matrix	DCE12T	TCE
			ug/m3	ug/m3
BUILDING 9669				
7/25/2012 14:41	Floor flux through carpet 2	AF	0.59 J	1.3 J
7/25/2012 14:53	Floor flux through carpet 3, closer to wall	AF	0.56 J	4.5
7/25/2012 15:01	Floor flux through carpet 4, closer to cage	AF	U	3.8
7/25/2012 15:08	Repeat floor flux through carpet 1. Bowl set <5 min prior to sampling	AF	0.63 J	2.6 J
7/25/2012 15:15	Floor flux through carpet 5, further from wall	AF	0.67 J	3.1
7/25/2012 15:22	Floor flux through carpet 6	AF	0.59 J	3.6
7/25/2012 15:29	Indoor air approx 2 ft above carpet 6	AI	U	5.9
7/25/2012 15:39	Indoor air approx 2 ft above floor, near closed bay door	AI	0.63 J	4
BUILDING 9674				
7/26/2012 7:47	Outdoors near 2-AA-1	AA	U	U
7/26/2012 7:58	BL 2-IA-1 center of building	AI	U	U
7/26/2012 8:05	BL in front of hazmat containers	AI	U	U
7/26/2012 8:25	BL in front of back / bondcote shelves (repeat location)	AI	U	U
7/26/2012 8:56	NP 2-IA-1	AI	U	U
7/26/2012 9:15	NP 2-IA-1	AI	U	U
7/26/2012 9:45	NP 2-IA-1	AI	U	U
7/26/2012 10:13	NP 2-IA-1	AI	U	U

Notes:
1. Samples analyzed using an Inficon HAPSITE ER portable GC/MS instrument. Calibration curve 7/22/2012.
2. Samples are grouped by building, and sorted chronologically.
3. J = estimated (result less than lower calibration limit); JE = estimated (result higher than upper calibration limit); U = not detected.
4. Matrix: AI = Indoor air; AF = Flux chamber; AA = Ambient (outdoor) air; SS = Sub-slab

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

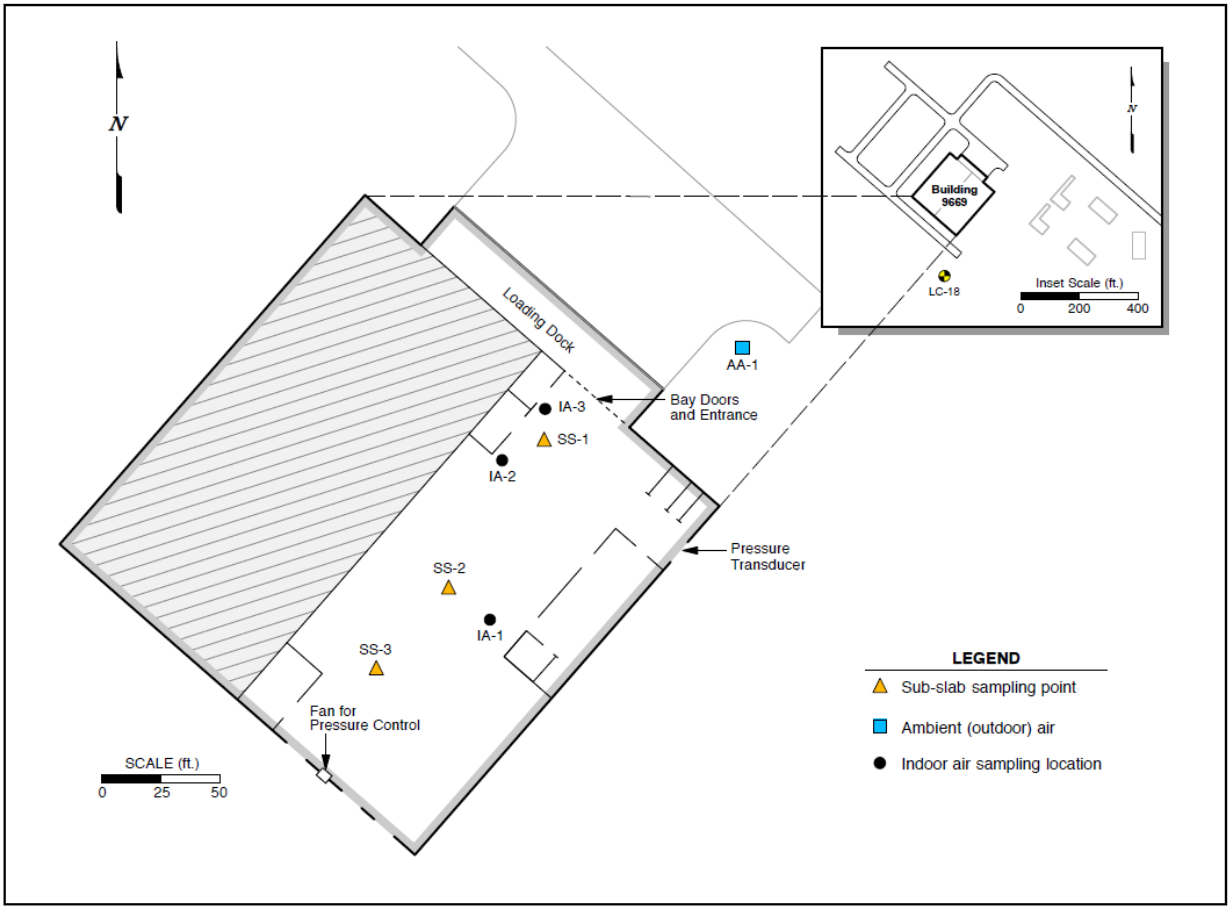
Figure C.1.1: Site Map



Note: Only monitoring wells sampled for the demonstration are shown. Groundwater gradient is to the northwest. TCE concentration in shallow groundwater in map area is in the 50 – 100 ug/L range.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

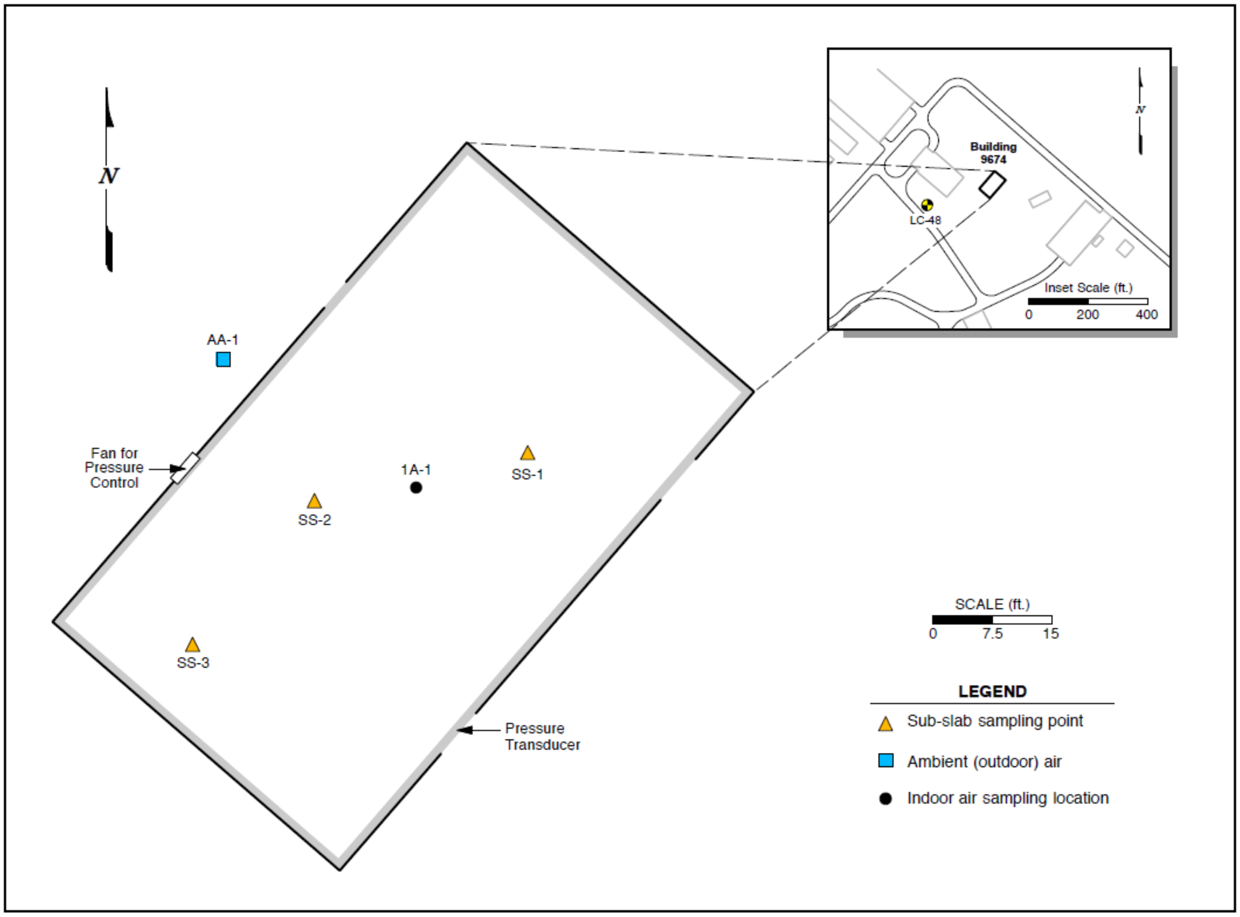
Figure C.1.2: Building 9669 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Joint Base Lewis-McChord, Washington

Figure C.1.3: Building 9674 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

Appendix C.2: Selfridge Air National Guard Base, Michigan

TABLES

FIGURES

TABLE C.2.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	**BUILDING 1533**					
Field Sample ID:	**MW-16**	**SS-1C**	**SS-2C**	**SS-3C**	**INDOOR-C1**	**OUTDOOR-C1**
Sample Location ID:	**MW-16**	**SS-1**	**SS-2**	**SS-3**	**IA-1**	**AA-1**
Description:	**East of building, between building and fmr UST cavity**	**Sub-slab, west bay of building**	**Sub-slab, inside storeroom on east side of building**	**Sub-slab, northeast corner outside office door**	**Indoor Air, southwest side of building**	**Outdoors, west of building**
Matrix:	**GW**	**SS**	**SS**	**SS**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**9/18/2012 15:20**	**9/18/2012 13:23**	**9/18/2012 13:43**	**9/18/2012 14:00**	**9/18/2012 16:30**	**9/18/2012 16:30**
Analytical Method (units):	**8260C (ug/L)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**
Key Analyte for VI Evaluation						
Benzene	**360**	<9.3	**58**	**0.32**	**14**	**0.27**
Other Reported Compounds						
Acetone	<200	**510**	**3300**	**250**	**54000**	**14**
Acetonitrile	-	<46	<32	<0.69	<57	<0.73
Acrolein	-	<190	<130	<2.8	<230	<2.9
Acrylonitrile	<200	<46	<32	<0.69	<57	<0.73
Benzyl Chloride	-	<46	<32	<0.69	<57	<0.73
Bromobenzene	<100	-	-	-	-	-
Bromochloromethane	<100	-	-	-	-	-
Bromodichloromethane	<20	<9.3	<6.4	<0.14	<11	<0.15
Bromoform	<80	<46	<32	<0.69	<57	<0.73
Bromomethane	<40	<9.3	<6.4	<0.14	<11	<0.15
Butadiene, 1,3-	-	<19	<13	<0.28	<23	<0.29
Butanone, 2- (MEK)	<200	<460	<320	<6.9	<570	<7.3
Butyl Acetate, n-	-	<46	<32	<0.69	<57	<0.73
Butylbenzene, n-	**32**	-	-	-	-	-
Butylbenzene, sec-	<20	-	-	-	-	-
Butylbenzene, tert-	<100	-	-	-	-	-
Carbon disulfide	<200	<460	<320	<6.9	<570	<7.3
Carbon tetrachloride	<20	<9.3	<6.4	<0.14	<11	**0.48**
Chloro-1-propene, 3- (Allyl Chloride)	-	<9.3	<6.4	<0.14	<11	<0.15
Chlorobenzene	<20	<9.3	<6.4	<0.14	<11	<0.15
Chloroethane	<40	<9.3	<6.4	<0.14	<11	<0.15
Chloroform	<30	<9.3	<6.4	**0.2**	<11	<0.15
Chloromethane	<100	<19	<13	<0.28	<23	**0.37**
Chlorotoluene, o-	<100	-	-	-	-	-
Chlorotoluene, p-	<100	-	-	-	-	-
Cyclohexane	-	<93	**480**	<1.4	<110	<1.5
Dibromo-3-chloropropane, 1,2- (DBCP)	<100	<46	<32	<0.69	<57	<0.73

TABLE C.2.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	**BUILDING 1533**					
Field Sample ID:	**MW-16**	**SS-1C**	**SS-2C**	**SS-3C**	**INDOOR-C1**	**OUTDOOR-C1**
Sample Location ID:	**MW-16**	**SS-1**	**SS-2**	**SS-3**	**IA-1**	**AA-1**
Description:	**East of building, between building and fmr UST cavity**	**Sub-slab, west bay of building**	**Sub-slab, inside storeroom on east side of building**	**Sub-slab, northeast corner outside office door**	**Indoor Air, southwest side of building**	**Outdoors, west of building**
Matrix:	**GW**	**SS**	**SS**	**SS**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**9/18/2012 15:20**	**9/18/2012 13:23**	**9/18/2012 13:43**	**9/18/2012 14:00**	**9/18/2012 16:30**	**9/18/2012 16:30**
Analytical Method (units):	**8260C (ug/L)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**
Dibromochloromethane	<20	<9.3	<6.4	<0.14	<11	<0.15
Dibromoethane, 1,2-	<80	<9.3	<6.4	<0.14	<11	<0.15
Dibromomethane	<200	-	-	-	-	-
Dichloro-1,1,2,2-tetrafluoroethane, 1,2- (CF	-	<46	<32	<0.69	<57	<0.73
Dichloro-2-butene, trans-1,4-	<100	-	-	-	-	-
Dichlorobenzene, 1,2-	<100	<9.3	<6.4	<0.14	<11	<0.15
Dichlorobenzene, 1,3-	<100	<9.3	<6.4	<0.14	<11	<0.15
Dichlorobenzene, 1,4-	<100	<9.3	<6.4	**0.14**	<11	<0.15
Dichlorobutane, 1,4-	<200	-	-	-	-	-
Dichlorodifluoromethane (CFC 12)	<200	<46	<32	**2.2**	<57	**2.2**
Dichloroethane, 1,1- (1,1-DCA)	<30	<9.3	<6.4	<0.14	<11	<0.15
Dichloroethane, 1,2-	<20	<9.3	<6.4	<0.14	<11	<0.15
Dichloroethene, 1,1- (1,1-DCE)	<20	<9.3	<6.4	<0.14	<11	<0.15
Dichloroethene, cis-1,2-	<20	<9.3	<6.4	<0.14	<11	<0.15
Dichloroethene, trans-1,2-	<30	<9.3	<6.4	<0.14	<11	<0.15
Dichloropropane, 1,2-	<70	<9.3	<6.4	<0.14	<11	<0.15
Dichloropropane, 1,3-	<100	-	-	-	-	-
Dichloropropane, 2,2-	<100	-	-	-	-	-
Dichloropropene, 1,1-	<100	-	-	-	-	-
Dichloropropene, cis-1,3-	<20	<46	<32	<0.69	<57	<0.73
Dichloropropene, trans-1,3-	<20	<46	<32	<0.69	<57	<0.73
Dioxane, 1,4-	-	<46	<32	<0.69	<57	<0.73
Ethanol	-	<460	<320	<6.9	<570	<7.3
Ethyl Acetate	-	<93	<64	<1.4	<110	**3.1**
Ethyl ether	<100	-	-	-	-	-
Ethyl methacrylate	<200	-	-	-	-	-
Ethylbenzene	**1400**	<46	**430**	**0.92**	<57	<0.73
Ethyltoluene, 4-	-	<46	**260**	**1.2**	<57	<0.73
Heptane, n-	-	<46	**960**	**11**	**5700**	**0.91**
Hexachlorobutadiene	<20	<46	<32	<0.69	<57	<0.73

TABLE C.2.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	**BUILDING 1533**					
Field Sample ID:	**MW-16**	**SS-1C**	**SS-2C**	**SS-3C**	**INDOOR-C1**	**OUTDOOR-C1**
Sample Location ID:	**MW-16**	**SS-1**	**SS-2**	**SS-3**	**IA-1**	**AA-1**
Description:	**East of building, between building and fmr UST cavity**	**Sub-slab, west bay of building**	**Sub-slab, inside storeroom on east side of building**	**Sub-slab, northeast corner outside office door**	**Indoor Air, southwest side of building**	**Outdoors, west of building**
Matrix:	**GW**	**SS**	**SS**	**SS**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**9/18/2012 15:20**	**9/18/2012 13:23**	**9/18/2012 13:43**	**9/18/2012 14:00**	**9/18/2012 16:30**	**9/18/2012 16:30**
Analytical Method (units):	**8260C (ug/L)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**
Hexane, n-	-	<46	**1200**	**1.2**	**240**	<0.73
Hexanone, 2-	<200	<46	<32	<0.69	<57	<0.73
Isopropylbenzene (Cumene)	**68**	<46	**34**	<0.69	<57	<0.73
Isopropyltoluene, p-	<20	-	-	-	-	-
Limonene, d-	-	<46	<32	<0.69	<57	<0.73
Methyl Methacrylate	-	<93	<64	<1.4	<110	<1.5
Methyl tert-Butyl Ether	<40	<9.3	<6.4	**0.45**	<11	<0.15
Methyl-2-pentanone, 4-	<200	<46	<32	<0.69	<57	<0.73
Methylene Chloride	<120	<46	<32	<0.69	<57	<0.73
Naphthalene	**680**	<46	<32	**11**	<57	<0.73
Nonane, n-	-	<46	**51**	<0.69	<57	<0.73
Octane, n-	-	<46	**210**	**0.91**	<57	<0.73
Pinene, alpha-	-	<46	<32	**2.8**	<57	<0.73
Propanol, 2- (Isopropyl Alcohol)	-	<460	<320	<6.9	<570	**14**
Propene	-	<46	<32	**2.2**	<57	**4.8**
Propylbenzene, n-	**210**	<46	**130**	<0.69	<57	<0.73
Styrene	<40	<46	<32	<0.69	<57	<0.73
Tetrachloroethane, 1,1,1,2-	<20	-	-	-	-	-
Tetrachloroethane, 1,1,2,2-	<20	<9.3	<6.4	<0.14	<11	<0.15
Tetrachloroethene	<20	**8000**	**5000**	**610 D**	<11	**0.52**
Tetrahydrofuran (THF)	<200	<46	<32	<0.69	<57	<0.73
Toluene	**41**	<46	**52**	**1.5**	<57	**1.2**
Trichlorobenzene, 1,2,3-	<100	-	-	-	-	-
Trichlorobenzene, 1,2,4-	<100	<46	<32	<0.69	<57	<0.73
Trichloroethane, 1,1,1-	<20	<9.3	<6.4	<0.14	<11	<0.15
Trichloroethane, 1,1,2-	<30	<9.3	<6.4	<0.14	<11	<0.15
Trichloroethene	<20	**9.4**	**26**	**0.63**	**48**	**0.3**
Trichlorofluoromethane (CFC 11)	<100	<9.3	<6.4	**0.88**	<11	**1.2**
Trichloropropane, 1,2,3-	<200	-	-	-	-	-
Trichlorotrifluoroethane, 1,1,2-	-	<9.3	<6.4	**0.45**	<11	**0.48**

TABLE C.2.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	**BUILDING 1533**					
Field Sample ID:	**MW-16**	**SS-1C**	**SS-2C**	**SS-3C**	**INDOOR-C1**	**OUTDOOR-C1**
Sample Location ID:	**MW-16**	**SS-1**	**SS-2**	**SS-3**	**IA-1**	**AA-1**
Description:	**East of building, between building and fmr UST cavity**	**Sub-slab, west bay of building**	**Sub-slab, inside storeroom on east side of building**	**Sub-slab, northeast corner outside office door**	**Indoor Air, southwest side of building**	**Outdoors, west of building**
Matrix:	**GW**	**SS**	**SS**	**SS**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**9/18/2012 15:20**	**9/18/2012 13:23**	**9/18/2012 13:43**	**9/18/2012 14:00**	**9/18/2012 16:30**	**9/18/2012 16:30**
Analytical Method (units):	**8260C (ug/L)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**
Trimethylbenzene, 1,2,4-	**1800**	<46	**860**	**25**	<57	<0.73
Trimethylbenzene, 1,3,5-	**570**	<46	**220**	**7.4**	<57	<0.73
Vinyl acetate	<200	<460	<320	<6.9	<570	<7.3
Vinyl chloride	<40	<9.3	<6.4	<0.14	<11	<0.15
Xylene, o-	<40	<46	<32	**2.2**	<57	<0.73
Xylenes, m,p-	**4800**	<46	**770**	**3**	<57	<0.73

Notes:

1. Groundwater sample analyzed by Alpha Analytical, Mansfield, MA. Vapor samples analyzed by ALS/Columbia Analytical Services, Simi Valley, California.
2. Sub-slab soil gas collected as grab samples (without flow controller). Indoor and outdoor air sample collected with 8-hour flow controller.
3. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed.

TABLE C.2.2: RESULTS FROM ISOTOPE PROGRAM
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	**BUILDING 1533**						
Field Sample ID:	**MW-16**	**SS-1**	**SS-2 1 HOUR**	**SS-2 HIGH**	**SS-2 LOW**	**INDOOR-1**	**INDOOR-1 OVERNIGHT**
Sample Location ID:	**MW-16**	**SS-1**	**SS-2**	**SS-2**	**SS-2**	**IA-1**	**IA-1**
Description:	**East of building**	**at IA-2; near IA-1**	**Inside storeroom**	**Inside storeroom**	**Inside storeroom**	**Southwest side of building**	**Southwest side of building**
Matrix:	**GW**	**SS**	**SS**	**SS**	**SS**	**IA**	**IA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**9/18/2012 15:20**	**9/19/2012 16:40**	**9/19/2012 10:49**	**9/18/2012 16:44**	**9/18/2012 16:56**	**9/18/2012 16:22**	**9/20/2012 8:17**
Units:	**per mil**	**per mil**	**per mil**	**per mil**	**per mil**	**per mil**	**per mil**
Analyte							
d13C BEN	**-26.6 H**	**-29.9 H**	**-29.4 H**	**-31.1 H**	**-28.9 JH**	**-29.1 H**	**-30.0 H**
d13C TCE	-	**-18.8 H**	**-26.0 H**	**-25.5 H**	-	**-32.5 H**	**-30.7 JH**
d13C PCE	-	**-26.7 H**	**-25.3 H**	**-25.5 H**	**-25.7 H**	**-27.8 JH**	**-27.8 JH**

Notes:

1. Isotope analysis was completed by the University of Oklahoma.
2. Bold font = detected result; Dash ("-") indicates compound not analyzed;
   H = samples analyzed outside of validated holding time period of 2 weeks; J = estimated result.

TABLE C.2.3: RESULTS FROM ON-SITE ANALYSIS PROGRAM CONFIRMATION SAMPLES
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	**BUILDING 1533**			
Field Sample ID:	**INDOOR-1-BL**	**INDOOR-1-PP (RE)**	**INDOOR-1-NP**	**AMBIENT-1-BL**
Sample Location ID:	**IA-2**	**IA-2**	**IA-2**	**AA-1**
Description:	**Indoor air from center of western bay; sample collected 5 min after SUV in bay was started briefly**	**Center of western bay**	**Center of western bay; sample collected after truck in bay started briefly**	**Outdoors, west of building**
Matrix:	**IA**	**IA**	**IA**	**AA**
PressureCondition	**BL**	**PP**	**NP**	**BL**
Sample Type:	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**9/19/2012 11:15**	**9/19/2012 14:16**	**9/19/2012 16:43**	**9/19/2012 11:10**
Analytical Method (units):	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**	**TO-15 (ug/m3)**
Key Analyte for VI Evaluation				
Benzene	**130**	**5.3 RE**	**69**	-
Other Reported VOCs				
Acetone	**1100**	**18000 RE E**	**9400 D**	-
Acetonitrile	**2.4**	<2.5 RE	<6.5	-
Acrolein	<5	<9.9 RE	<26	-
Acrylonitrile	<1.2	<2.5 RE	<6.5	-
Benzyl Chloride	<1.2	<2.5 RE	<6.5	-
Bromodichloromethane	<0.25	<0.5 RE	<1.3	-
Bromoform	<1.2	<2.5 RE	<6.5	-
Bromomethane	<0.25	<0.5 RE	<1.3	-
Butadiene, 1,3-	**33**	<0.99 RE	**14**	-
Butanone, 2- (MEK)	<12	<25 RE	<65	-
Butyl Acetate, n-	**2.1**	<2.5 RE	<6.5	-
Carbon disulfide	<12	<25 RE	<65	-
Carbon tetrachloride	**0.55**	<0.5 RE	<1.3	-
Chloro-1-propene, 3- (Allyl Chloride)	<0.25	<0.5 RE	<1.3	-
Chlorobenzene	<0.25	<0.5 RE	<1.3	-
Chloroethane	<0.25	<0.5 RE	<1.3	-
Chloroform	**0.27**	<0.5 RE	<1.3	-
Chloromethane	**0.86**	<0.99 RE	<2.6	-
Cyclohexane	**12**	**27 RE**	**33**	-
Dibromo-3-chloropropane, 1,2- (DBCP)	<1.2	<2.5 RE	<6.5	-
Dibromochloromethane	<0.25	<0.5 RE	<1.3	-
Dibromoethane, 1,2-	<0.25	<0.5 RE	<1.3	-
Dichloro-1,1,2,2-tetrafluoroethane, 1,2- (	<1.2	<2.5 RE	<6.5	-
Dichlorobenzene, 1,2-	<0.25	<0.5 RE	<1.3	-
Dichlorobenzene, 1,3-	<0.25	<0.5 RE	<1.3	-
Dichlorobenzene, 1,4-	<0.25	<0.5 RE	<1.3	-
Dichlorodifluoromethane (CFC 12)	**2.3**	<2.5 RE	<6.5	-
Dichloroethane, 1,1- (1,1-DCA)	<0.25	<0.5 RE	<1.3	-
Dichloroethane, 1,2-	<0.25	<0.5 RE	<1.3	-
Dichloroethene, 1,1- (1,1-DCE)	<0.25	<0.5 RE	<1.3	-
Dichloroethene, cis-1,2-	<0.25	<0.5 RE	<1.3	-
Dichloroethene, trans-1,2-	<0.25	<0.5 RE	<1.3	-
Dichloropropane, 1,2-	<0.25	<0.5 RE	<1.3	-
Dichloropropene, cis-1,3-	<1.2	<2.5 RE	<6.5	-
Dichloropropene, trans-1,3-	<1.2	<2.5 RE	<6.5	-
Dioxane, 1,4-	<1.2	<2.5 RE	<6.5	-
Ethanol	**77**	**25 RE**	**80**	-
Ethyl Acetate	<2.5	<5 RE	**27**	-
Ethylbenzene	**84**	**6 RE**	**50**	-
Ethyltoluene, 4-	**36**	**3.3 RE**	**29**	-
Heptane, n-	**130**	**1800 RE E**	**1100**	-

TABLE C.2.3: RESULTS FROM ON-SITE ANALYSIS PROGRAM CONFIRMATION SAMPLES
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Location ID:	BUILDING 1533			
Field Sample ID:	INDOOR-1-BL	INDOOR-1-PP (RE)	INDOOR-1-NP	AMBIENT-1-BL
Sample Location ID:	IA-2	IA-2	IA-2	AA-1
Description:	Indoor air from center of western bay; sample collected 5 min after SUV in bay was started briefly	Center of western bay	Center of western bay; sample collected after truck in bay started briefly	Outdoors, west of building
Matrix:	IA	IA	IA	AA
PressureCondition	BL	PP	NP	BL
Sample Type:	N	N	N	N
Sample Collection Date/Time:	9/19/2012 11:15	9/19/2012 14:16	9/19/2012 16:43	9/19/2012 11:10
Analytical Method (units):	TO-15 (ug/m3)	TO-15 (ug/m3)	TO-15 (ug/m3)	TO-15 (ug/m3)
Hexachlorobutadiene	<1.2	<2.5 RE	<6.5	-
Hexane, n-	**68**	**10 RE**	**120**	-
Hexanone, 2-	<1.2	<2.5 RE	<6.5	-
Isopropylbenzene (Cumene)	**4.3**	<2.5 RE	<6.5	-
Limonene, d-	**23**	**19 RE**	**100**	-
Methyl Methacrylate	<2.5	<5 RE	<13	-
Methyl tert-Butyl Ether	<0.25	<0.5 RE	<1.3	-
Methyl-2-pentanone, 4-	**20**	**6 RE**	**9.5**	-
Methylene Chloride	**23**	**9.7 RE**	<6.5	-
Naphthalene	**19**	**2.7 RE**	**47**	-
Nonane, n-	**46**	**3.7 RE**	**14**	-
Octane, n-	**25**	<2.5 RE	**15**	-
Pinene, alpha-	<1.2	<2.5 RE	<6.5	-
Propanol, 2- (Isopropyl Alcohol)	**21**	<25 RE	<65	-
Propene	**86**	**3.4 RE**	**39**	-
Propylbenzene, n-	**16**	<2.5 RE	**12**	-
Styrene	**31**	<2.5 RE	**21**	-
Tetrachloroethane, 1,1,2,2-	<0.25	<0.5 RE	<1.3	-
Tetrachloroethene	**1.8**	**0.57 RE**	**1.8**	-
Tetrahydrofuran (THF)	<1.2	<2.5 RE	<6.5	-
Toluene	**410 D**	**18 RE**	**170**	-
Trichlorobenzene, 1,2,4-	<1.2	<2.5 RE	<6.5	-
Trichloroethane, 1,1,1-	<0.25	<0.5 RE	<1.3	-
Trichloroethane, 1,1,2-	<0.25	<0.5 RE	<1.3	-
Trichloroethene	**140**	**54 RE**	**15**	-
Trichlorofluoromethane (CFC 11)	**1.2**	**1.2 RE**	**1.8**	-
Trichlorotrifluoroethane, 1,1,2-	**0.49**	<0.5 RE	<1.3	-
Trimethylbenzene, 1,2,4-	**120**	**13 RE**	**110**	-
Trimethylbenzene, 1,3,5-	**38**	**3.8 RE**	**34**	-
Vinyl acetate	<12	<25 RE	<65	-
Vinyl chloride	<0.25	<0.5 RE	<1.3	-
Xylene, o-	**100**	**8.2 RE**	**70**	-
Xylenes, m,p-	**290**	**21 RE**	**180**	-
Radon (pCi/L)				
Radon	**0.42**	**0.19**	**0.28**	**0.08**

Notes:

1. VOC analysis of vapor samples by ALS/Columbia Analytical Services, Simi Valley, California. Radon analysis by University of Southern Calif
2. Samples collected as grab (i.e., without flow controller). Samples for VOC analysis were collected in 6-L Summa canisters. Samples for Rad in 1-L Tedlar bags.
3. Pressure Condition: BL = baseline (normal operating conditions); NP = negative pressure (building depressurized); PP = positive pressure (
4. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; Dash ("-") indicates compound not analyzed.
5. INDOOR-1-PP Summa canister sample was re-analyzed to report lower concentrations. This was done by re-running the sample with a large

TABLE C.2.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Sample Date/Time	Description	Matrix	Benzene ug/m3
BUILDING 1533			
9/18/2012 8:39	Center of garage	AI	1.1 J
9/18/2012 8:52	Outside, near Summa	AA	0.23 J
9/18/2012 9:07	Center of west wall	AI	4.5
9/18/2012 9:17	Repeat	AI	8.9
9/18/2012 9:32	Repeat	AI	15
9/18/2012 9:56	Repeat	AI	12
9/18/2012 10:10	Outdoors near AA-1	AA	0.25 J
9/18/2012 11:52	Corner near office	AI	U
9/18/2012 13:47	Screening SS-1	SS	6.4
9/18/2012 13:59	Screening SS-2	SS	38
9/18/2012 14:10	Screening SS-3	SS	2.7
9/18/2012 14:49	Repeat SS-3 bag	SS	2.1
9/19/2012 8:55	AA-1 west of building	AA	1.2 J
9/19/2012 9:05	IA-1 southwest corner	AI	6.1
9/19/2012 9:16	Tedlar SS-2	SS	15
9/19/2012 9:27	Repeat IA-1	AI	7
9/19/2012 9:38	At refrigerator opposite corner	AI	9.6
9/19/2012 9:49	Room with SS-2	AI	19
9/19/2012 9:59	Bathroom door cracked	AI	9.6
9/19/2012 10:10	Shop near used oil/workbench	AI	9.9
9/19/2012 11:12	Center of shop after vehicle started briefly	AI	141 JE
9/19/2012 11:35	Tedlar SS-1	SS	4.8
9/19/2012 11:45	IA-2/Shop (near lift)	AI	89
9/19/2012 11:56	Tedlar SS-3	SS	3.5
9/19/2012 12:06	IA-2/Shop (near lift)	AI	58
9/19/2012 13:12	Repeat IA-2	AI	19
9/19/2012 13:25	Inside store room with SS-2	AI	30
9/19/2012 13:36	In front of fan	AI	8
9/19/2012 13:47	Near fridge. Repeat 014	AI	9.6
9/19/2012 14:00	Outside AA-1	AA	0.38 J

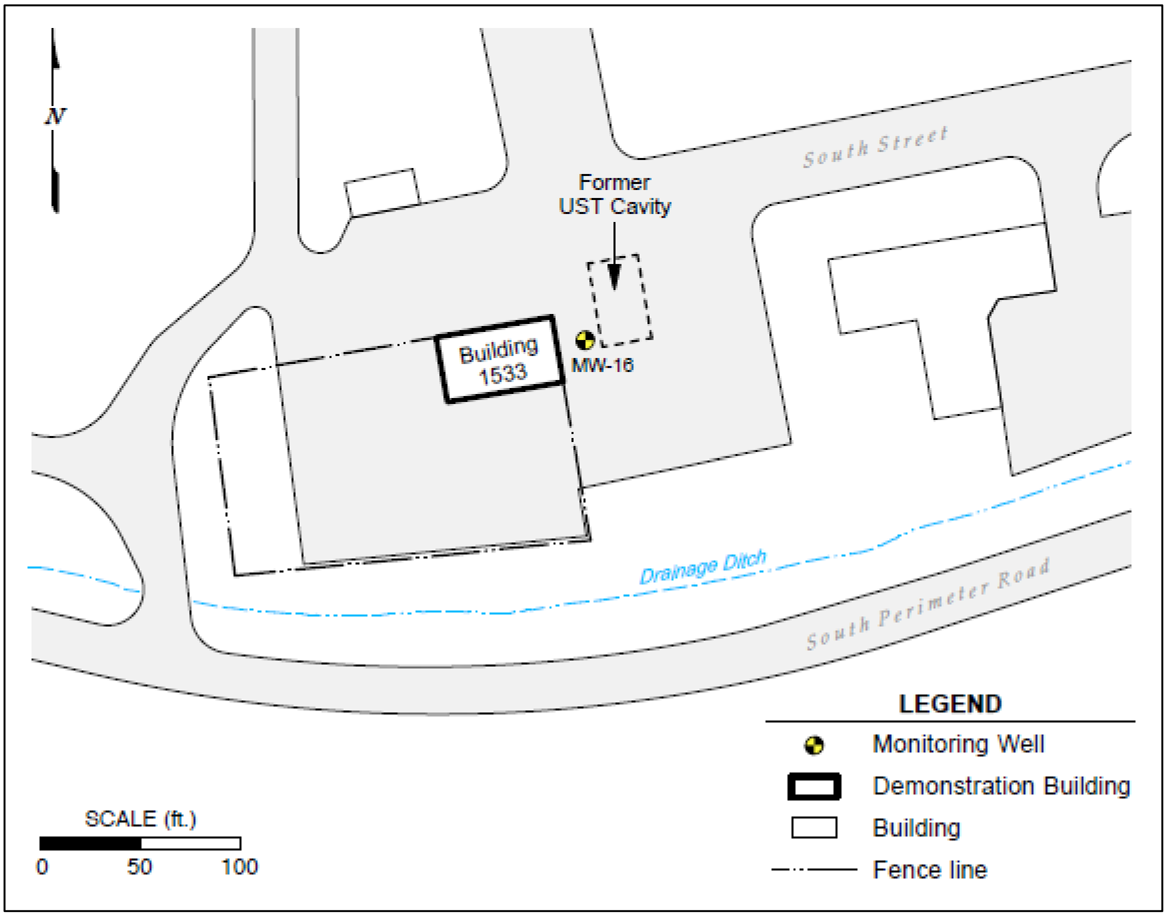
TABLE C.2.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Sample Date/Time	Description	Matrix	Benzene
			ug/m3
BUILDING 1533			
9/19/2012 14:13	IA-2	AI	5.1
9/19/2012 14:27	IA2	AI	4.8
9/19/2012 14:46	IA2	AI	U
9/19/2012 15:00	IA2	AI	2
9/19/2012 15:31	IA2	AI	U
9/19/2012 15:48	Across room at fridge	AI	U
9/19/2012 16:01	Above SS-2 room indoor air	AI	8.6
9/19/2012 16:12	IA2	AI	2.6
9/19/2012 16:24	IA2	AI	422 JE

Notes:
1. Samples analyzed using an Inficon HAPSITE ER portable GC/MS instrument. Calibration curve 9/19/2012.
2. Samples are sorted chronologically.
3. J = estimated (result less than lower calibration limit); JE = estimated (result higher than upper calibration limit); U = not detected.
4. Matrix: AI = Indoor air; AA = Ambient (outdoor) air; SS = Sub-slab

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

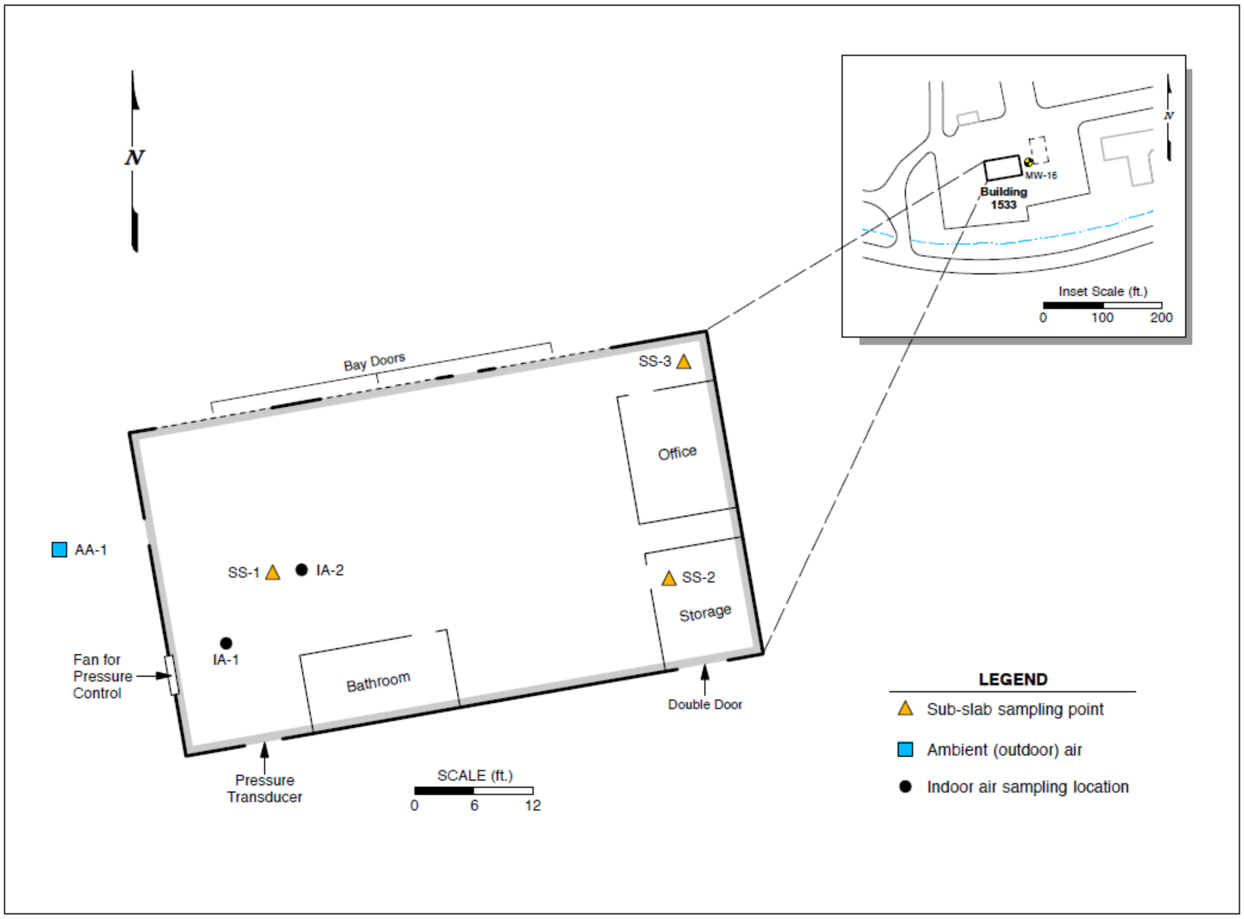
Figure C.2.1: Site Map



Note: Only monitoring wells sampled for the demonstration are shown.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Selfridge Air National Guard Base, Michigan

Figure C.2.2: Building 1533 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

Appendix C.3: Tyndall Air Force Base, Florida

TABLES

FIGURES

TABLE C.3.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Location ID:	**GROUNDWATER**	
Field Sample ID:	**MW-5** [1]	**MW-20s** [1]
Sample Location ID:	**SA-150-MW-5**	**264/280-MW-20s**
Description:	**North of Building 156**	**South of Building 219**
Matrix:	**GW**	**GW**
Sample Type:	**N**	**N**
Sample Collection Date/Time:	**2008**	**2010**
Analytical Method (units):	**8260 (ug/L)**	**8260 (ug/L)**
Key Analyte for VI Evaluation		
Trichloroethene	**299**	**6.4**
Other Reported Compounds		
Dichloroethene, 1,1- (1,1-DCE)	-	-
Dichloroethene, cis-1,2-	**21.4**	**2200**
Dichloroethene, trans-1,2-	-	-
Tetrachloroethene	-	-
Vinyl chloride	-	-

Notes:
1. Groundwater samples were collected as part of normal site investigation/monitoring (i.e., not part of ESTCP VI Study).
2. Bold font = detected result

TABLE C.3.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Location ID:	**BUILDING 156 (HANGER)**					
Field Sample ID:	**156-SS-1**	**156-SS-2**	**156-SS-3**	**156-IA-1**	**156-IA-2**	**156-IA-3**
Sample Location ID:	**1-SS-1**	**1-SS-2**	**1-SS-3**	**1-IA-1**	**1-IA-2**	**1-IA-3**
Description:	**Paired with IA-1**	**Paired with IA-2**	**Paired with IA-3**	**Shop at N side of building**	**Wood shop in north-central part of building**	**Paint booth room at NW corner of building**
Matrix:	**SS**	**SS**	**SS**	**IA**	**IA**	**IA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**2/21/2013**	**2/21/2013**	**2/21/2013**	**2/20/2013**	**2/20/2013**	**2/20/2013**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation						
Trichloroethene	**0.37**	**1.2**	**24**	<0.036	<0.046	<0.041
Other Reported Compounds						
Dichloroethene, 1,1- (1,1-DCE)	<0.032	<0.032	<0.034	<0.036	<0.046	<0.041
Dichloroethene, cis-1,2-	<0.032	<0.032	**0.085**	<0.036	<0.046	<0.041
Dichloroethene, trans-1,2-	<0.032	<0.032	**0.051**	<0.036	<0.046	<0.041
Tetrachloroethene	**0.26**	**0.16**	**0.45**	**0.054**	**0.063**	**0.6**
Vinyl chloride	<0.032	<0.032	<0.034	<0.036	<0.046	<0.041

Notes:
1. Vapor samples analyzed by ALS/Columbia Analytical Services, Simi Valley, California using USEPA Method TO-15 SIM.
2. Sub-slab soil gas collected as grab samples (without flow controller). Indoor and outdoor air sample collected with 8-hour flow controller.
3. All samples collected in 6-L Summa canisters.
4. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit.
5. Ambient air sample 219-AA-1 used for Building 156 and 219.

TABLE C.3.1: RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Location ID:	**BUILDING 219 (OFFICE)**					
Field Sample ID:	**219-SS-1**	**219-SS-2**	**219-SS-3**	**219-IA-1**	**219-IA-3**	**219-AA-1**
Sample Location ID:	**2-SS-1**	**2-SS-2**	**2-SS-3**	**2-IA-1**	**2-IA-3**	**2-AA-1**
Sample Location Description:	**Paired with IA-1**	**Center of building**	**Paired with IA-3**	**Southern half of building in central hallway**	**Northern half of building in janitor closet**	**Outside southwest entrance**
Matrix:	**SS**	**SS**	**SS**	**IA**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**2/21/2013**	**2/21/2013**	**2/21/2013**	**2/20/2013**	**2/20/2013**	**2/20/2013**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation						
Trichloroethene	**0.083**	**0.31**	**1.3**	**0.086**	**0.087**	<0.039
Other Reported Compounds						
Dichloroethene, 1,1- (1,1-DCE)	<0.032	<0.13	<0.063	<0.039	<0.041	<0.039
Dichloroethene, cis-1,2-	<0.032	<0.13	<0.063	<0.039	<0.041	<0.039
Dichloroethene, trans-1,2-	**0.14**	**0.41**	<0.063	<0.039	<0.041	<0.039
Tetrachloroethene	**4.5**	**7.5**	**0.97**	**0.048**	<0.041	<0.039
Vinyl chloride	<0.032	<0.13	<0.063	<0.039	<0.041	<0.039

Notes:
1. Vapor samples analyzed by ALS/Columbia Analytical Services, Simi Valley, California using USEPA Method TO-15 SIM.
2. Sub-slab soil gas collected as grab samples (without flow controller). Indoor and outdoor air sample collected with 8-hour flow controller.
3. All samples collected in 6-L Summa canisters.
4. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit.
5. Ambient air sample 219-AA-1 used for Building 156 and 219.

TABLE C.3.2: RESULTS FROM ISOTOPE PROGRAM
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Location ID:	**BUILDING 156 (HANGER)**		**BUILDING 219 (OFFICE)**			
Field Sample ID:	**MW-5**	**156-SS-3**	**MW-20s**	**219-SS-3**	**219-IA-3 P1**	**219-IA-3-P2**
Sample Location ID:	**MW-5**	**1-SS-3**	**MW-20s**	**2-SS-3**	**2-IA-3**	**2-IA-3**
Description:	**North of Building 156**	**Paired with IA-3**	**South of building**	**Paired with IA-3 (sample collected approx 9 hours after planted source was removed)**	**Northern half of building in janitor closet (planted source)**	**Northern half of building in janitor closet (planted source)**
Matrix:	**GW**	**SS**	**GW**	**SS**	**IA**	**IA**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**FD**
Sample Collection Date/Time:	**2/22/2013 12:10**	**2/21/2013 13:49**	**2/22/2013 12:30**	**2/22/2013 8:26**	**2/21/2013 8:00**	**2/21/2013 8:00**
Analytical Method (units):	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**
Analyte						
d13C TCE	**13.8 H**	**-9.6 H**	**-18.4 H**	**-1.9 H**	**-29 H**	**-28.8 H**
d37Cl TCE	**10.1**	**6.3 H**	**4.7**	**6.3 H**	**-3.5 H**	**-3.2 H**

Notes:

1. Isotope analysis was completed by the University of Oklahoma.
2. Bold font = detected result
   H = samples analyzed outside of validated holding time period of 2 weeks
3. Indoor air TCE concentrations were too low in Building 156 and 219 to allow collection of sufficient mass for isotope analysis. An indoor VOC source was planted in Building 219 for evaluation in ESTCP Project ER-201025.

TABLE C.3.3: RESULTS FROM ON-SITE ANALYSIS PROGRAM CONFIRMATION SAMPLES
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Location ID:	**BUILDING 156 (HANGER)**			
Sample Location ID:	**156-IA-4**	**156-IA-4**	**156-IA-5**	**156-AA-1**
Description:	**Small room adjacent to wood shop**	**Small room adjacent to wood shop**	**Small room adjacent to wood shop**	**Outdoors, north of Building 156**
Matrix:	**IA**	**IA**	**IA**	**AA**
Field Sample ID:	**156-IA-4-BL**	**156-IA-4-NP**	**156-IA-5-NP**	**156-AA-1**
Pressure Condition:	**BL**	**NP**	**NP**	**BL**
Sample Type:	**N**	**N**	**FD**	**N**
Sample Collection Date/Time:	**2/22/13 8:04**	**2/21/13 16:05**	**2/21/13 16:05**	**2/21/13 16:05**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation				
Trichloroethene	<0.032	<0.031	<0.033	-
Other Reported Compounds				
Dichloroethene, 1,1- (1,1-DCE)	<0.032	<0.031	<0.033	-
Dichloroethene, cis-1,2-	<0.032	<0.031	<0.033	-
Dichloroethene, trans-1,2-	<0.032	<0.031	<0.033	-
Tetrachloroethene	**0.077**	**0.061**	**0.062**	-
Vinyl chloride	<0.032	<0.031	<0.033	-
Radon (pCi/L)				
Radon	**0.07**	U	-	**0.03**

Notes:

1. VOC analysis by ALS/Columbia Analytical Services, Simi Valley, California using USEPA Method TO-15 SIM.
2. Samples for VOC analysis were collected in 6-L Summa canisters without flow controllers.
3. Radon analysis by the University of Southern California.
4. Samples for radon analysis were collected in 1-L Tedlar bags.
5. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit.
6. BL = Baseline (uncontrolled) conditions; NP = Negative Pressure induced in building.

TABLE C.3.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Sample Date/Time	Description	Matrix	TCE ug/m3
SCREENING SAMPLES			
2/19/2013 11:03	Building 246 Tedlar bag screening sample (indoor air)	AI	0.21 J
2/19/2013 11:11	Building 258 Tedlar bag screening sample (indoor air)	AI	0.32 J
2/19/2013 11:20	Building 522 Tedlar bag screening sample (indoor air)	AI	0.19 J
2/19/2013 11:30	Building 560 Tedlar bag screening sample (indoor air)	AI	U
BUILDING 156 (HANGER)			
2/19/2013 10:37	Building 156 north end, Tedlar bag screening sample (indoor air)	AI	0.19 J
2/19/2013 10:46	Building 156 south end, Tedlar bag screening sample (indoor air)	AI	U
2/20/2013 13:47	Building 156 NW work shop	AI	0.2 J
2/20/2013 13:57	Building 156 floor grate, N of NW workshop	AI	0.11 J
2/20/2013 14:06	Building 156 wood shop	AI	0.15 J
2/20/2013 14:15	Building 156 painting room	AI	0.11 J
2/21/2013 9:11	Building 156 small room adjacent to wood shop	AI	U
2/21/2013 10:32	Building 156 156-SS-3	SS	23
2/21/2013 10:40	Building 156 156-SS-2	SS	8.1
2/21/2013 10:48	Building 156 156-SS-1	SS	1.6 J
2/21/2013 14:27	Building 156 small room adjacent to wood shop	AI	U
2/21/2013 14:35	Building 156 small room adjacent to wood shop	AI	0.14 J
2/21/2013 15:09	Building 156 painting room	AI	0.081 J
2/21/2013 15:17	Building 156 small room adjacent to wood shop	AI	U
2/21/2013 15:37	Building 156 small room adjacent to wood shop	AI	0.086 J
2/21/2013 15:47	Building 156 painting room	AI	0.086 J
2/21/2013 15:56	Building 156 small room adjacent to wood shop	AI	U
BULDING 219			
2/19/2013 10:54	Building 219 Tedlar bag screening sample (indoor air)	AI	0.18 J
2/20/2013 9:21	Building 219 hallway, south end	AI	0.26 J
2/20/2013 9:31	Building 219 hallway, center	AI	0.14 J
2/20/2013 9:40	Building 219 hallway, north end	AI	0.12 J
2/20/2013 10:02	Building 219 south end of hallway, under the door to secure area	AI	0.38 J
2/21/2013 7:55	Building 219 Outside front door of building	AA	0.18 J
2/21/2013 8:07	Building 219 Intersection of front door hallway and main hallway	AI	0.34 J
2/21/2013 8:15	Building 219 Hallway, in front of janitor's closet	AI	1 J

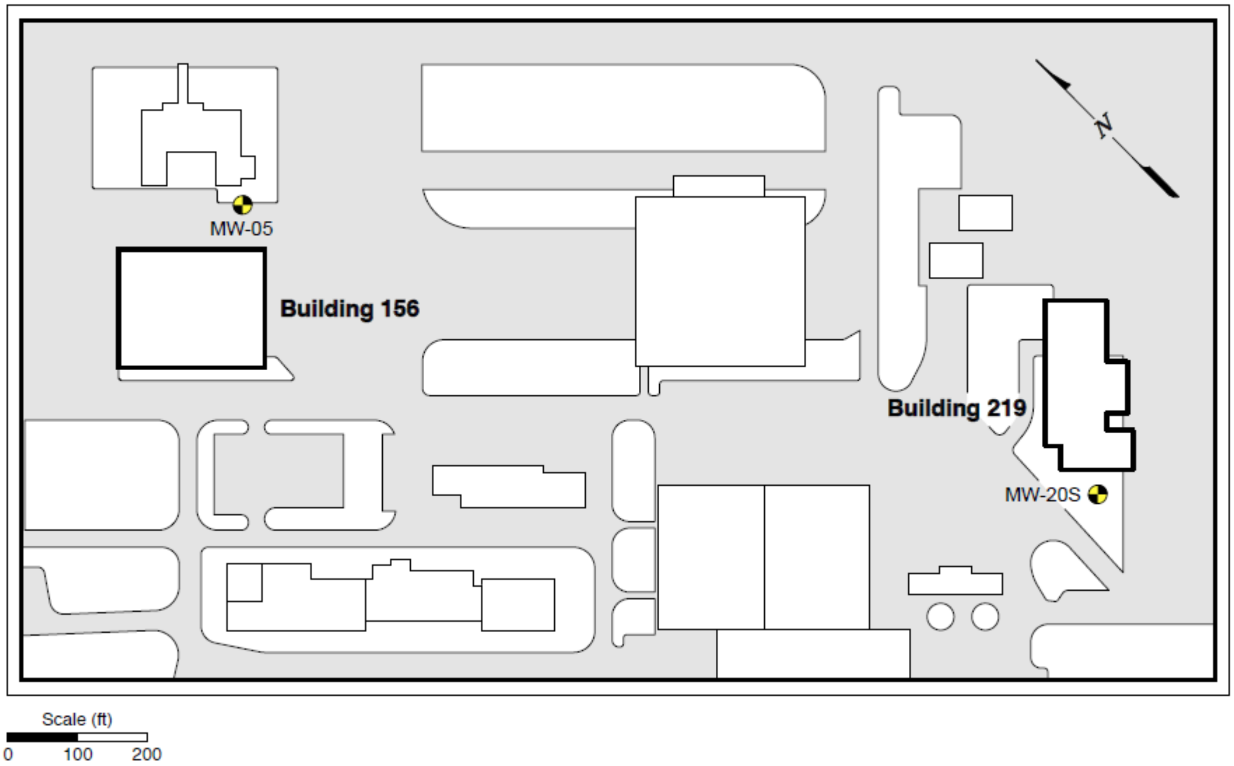
TABLE C.3.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Sample Date/Time	Description	Matrix	TCE
			ug/m3
2/21/2013 8:23	Building 219 with tube, beneath door of janitor's closet	AI	54
2/21/2013 8:33	Building 219 main hallway, around corner of janitor's closer	AI	0.81 J
2/21/2013 14:45	Building 219 South end of building, 219-SS-1	SS	0.27 J
2/21/2013 14:53	Building 219 Building Center, 219-SS-2	SS	0.54 J
2/21/2013 15:01	Building 219 Janitor's closent at north end, 219-SS-3	SS	4.9

Notes:
1. Samples analyzed using a HAPSITE SMART portable GC/MS instrument. Calibration curve 2/19/2013.
2. Samples are grouped by building, and sorted chronologically.
3. J = estimated (result less than lower calibration limit); U = not detected.
4. Matrix: AI = Indoor air; AA = Ambient (outdoor) air; SS = Sub-slab

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Tyndall Air Force Base, Florida

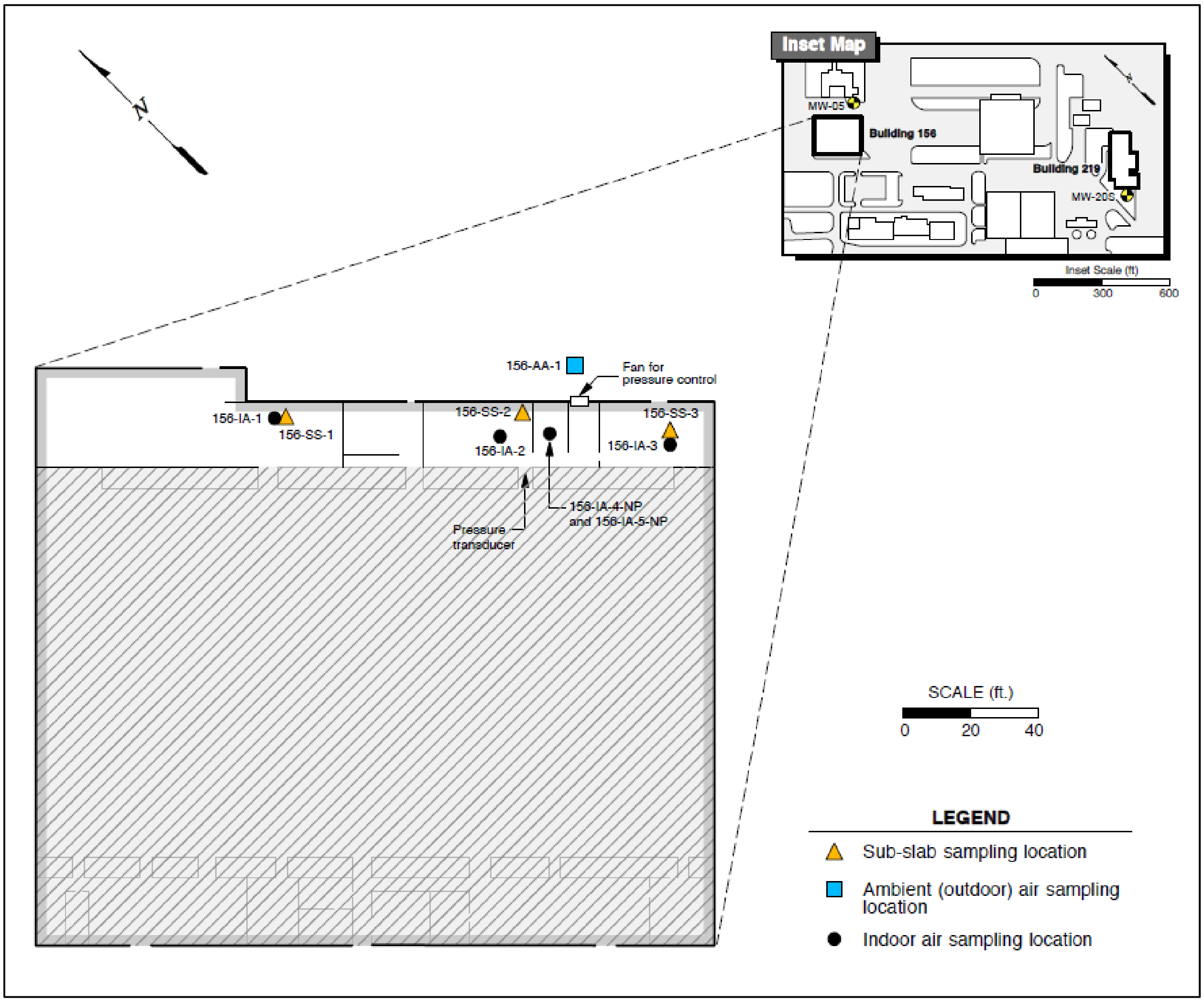
Figure C.3.1: Site Map



Note: Only monitoring wells sampled for the demonstration are shown.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Tyndall Air Force Base, Florida

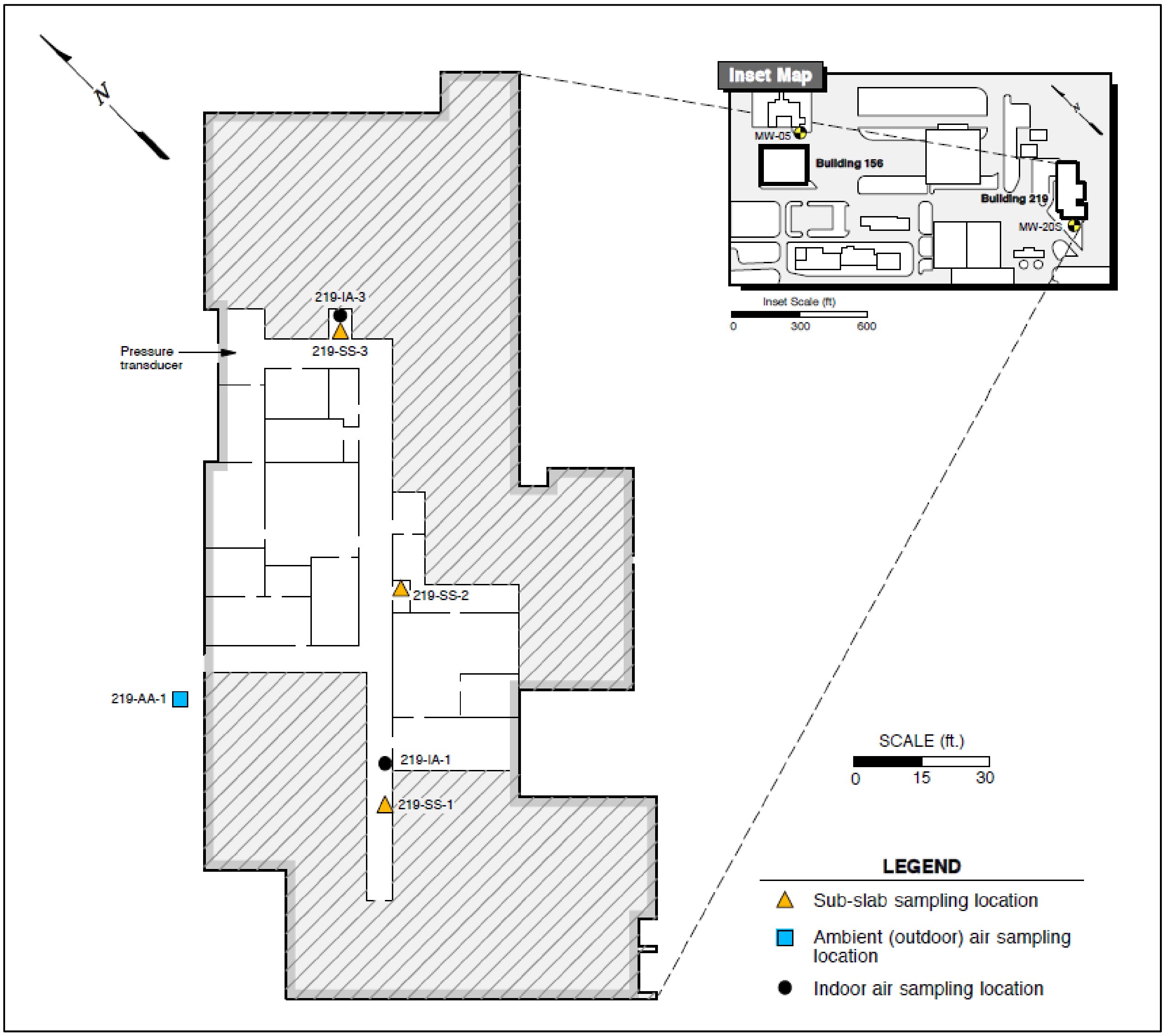
Figure C.3.2: Building 156 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and ER-201025
Tyndall Air Force Base, Florida

Figure C.3.3: Building 219 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

Appendix C.4: Former Raritan Arsenal Site, New Jersey

TABLES

FIGURES

TABLE C.4.1 RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Former Raritan Arsenal Site, New Jersey

Location ID:	**GROUNDWATER**			
Field Sample ID:	**MW-CP-IV-1 [3]**	**MW-139 [3]**	**MW-136 [3]**	**MW-156 [3]**
Sample Location ID:	**MW-CP-IV-1**	**MW-139**	**MW-136**	**MW-156**
Description:	**Well located north of CP4 building**	**Well located west of CP4 building**	**Well located north of Building 209**	**Well located northeast of Building 209**
Matrix:	**GW**	**GW**	**GW**	**GW**
Sample Type:	**N**	**N**	**N**	**N**
Sample Collection Date:	**5/23/2012**	**5/23/2012**	**5/22/2012**	**5/22/2012**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation				
Trichloroethene	**7.6**	**120**	**39**	**240**
Other Reported Compounds				
Dichloroethene, 1,1- (1,1-DCE)	<0.09	**1**	<0.09	**0.28 J**
Dichloroethene, cis-1,2-	**1.5**	**91**	<0.18	**3.6**
Dichloroethene, trans-1,2-	<0.13	**0.79 J**	<0.13	**0.41 J**
Tetrachloroethene	**0.71 J**	**5.7**	<0.1	<0.1
Vinyl chloride	<0.14	**24**	<0.14	<0.14

Notes:

1. Bold font = detected result; "<" = not detected above detection limit
2. J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
3. Results from May 2012 groundwater monitoring event were provided by site personnel. VOC analysis of groundwater samples was not conducted as part of the ESTCP VI study.

TABLE C.4.1 RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Former Raritan Arsenal Site, New Jersey

Location ID:	**BUILDING 209**				
Field Sample ID:	**209-SG-09**	**209-SG-06**	**209-IA-09**	**209-IA-10**	**209-AA-1**
Sample Location ID:	**2-SS-1**	**2-SS-2**	**2-IA-1**	**2-IA-2**	**2-AA-1**
Description:	**Permanent point in Room L306 Organic Prep/TCLP Extraction Lab**	**Permanent point in Bay D**	**Paired with permanent subslab point 209-SG-09**	**Opposite end of Bay C**	**North of entrance**
Matrix:	**SS**	**SS**	**IA**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**3/27/2013 10:00**	**3/27/2013 10:50**	**3/27/2013 16:09**	**3/27/2013 16:08**	**3/27/2013 16:10**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation					
Trichloroethene	**8.1**	**0.55**	<0.05	**0.064**	**0.017 J**
Other Reported Compounds					
Dichloroethene, 1,1- (1,1-DCE)	**0.05 J**	**0.028 J**	**0.063 J**	<0.0053	<0.0051
Dichloroethene, cis-1,2-	<0.07	<0.014	<0.084	<0.017	<0.016
Dichloroethene, trans-1,2-	<0.079	<0.016	<0.094	<0.019	<0.018
Tetrachloroethene	**6.4**	**13**	**0.073 J**	**0.058**	**0.042**
Vinyl chloride	<0.018	<0.0036	<0.021	<0.0043	<0.0041

Notes:
1. "<" = not detected above method detection limit
2. J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
3. D = The reported result is from a dilution.

TABLE C.4.1 RESULTS FROM CONVENTIONAL VAPOR INTRUSION PROGRAM
ESTCP Project ER-201119 and ER-201025
Former Raritan Arsenal Site, New Jersey

Location ID:	**BUILDING CP4**				
Field Sample ID:	**CP4-SG-6**	**CP4-SG-3**	**CP4-IA-1**	**CP4-IA-2**	**CP4-AA-1**
Sample Location ID:	**1-SS-1**	**1-SS-3**	**1-IA-1**	**1-IA-2**	**1-AA-1**
Description:	**Permanent point in Warehouse 1 on west side closest to offices**	**Permanent point in 280 Raritan**	**At end of the hall in the engineering section, on top of cabinet**	**In financial services area, on cubicle cabinet**	**Outside back door**
Matrix:	**SS**	**SS**	**IA**	**IA**	**AA**
Sample Type:	**N**	**N**	**N**	**N**	**N**
Sample Collection Date/Time:	**3/26/2013 15:00**	**3/26/2013 9:00**	**3/26/2013 16:44**	**3/26/2013 16:45**	**3/26/2013 16:42**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation					
Trichloroethene	**15**	**93 D**	**1.3**	**2.1**	**0.057**
Other Reported Compounds					
Dichloroethene, 1,1- (1,1-DCE)	<0.0042	<0.0042	<0.0055	<0.0044	<0.005
Dichloroethene, cis-1,2-	**0.014 J**	**1.1**	<0.017	<0.014	<0.016
Dichloroethene, trans-1,2-	**0.023 J**	**0.3**	<0.019	**0.018 J**	<0.018
Tetrachloroethene	**7.3**	**12**	**0.3**	**0.27**	**0.096**
Vinyl chloride	<0.0034	<0.0034	<0.0044	<0.0036	<0.004

Notes:
1. "<" = not detected above method detection limit
2. J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
3. D = The reported result is from a dilution.

TABLE C.4.2: RESULTS FROM ISOTOPE PROGRAM
ESTCP Project ER-201119 and ER-201025
Former Raritan Arsenal Site, New Jersey

Location ID:	**CAMPUS PLAZA 4**					
Description:	**MW-139**	**MW-CP-IV-1**	**Permanent point; Warehouse 1 on west side closest to offices.**	**In 1st conference room wall behind ethernet outlet**	**In kitchen between conference rooms**	**In kitchen between conference rooms**
Matrix:	**GW**	**GW**	**SS**	**IA**	**IA**	**IA**
Field Sample ID:	**MW-139**	**MW-CP-IV-1**	**CP4-SG-6**	**CP4-IA-3**	**CP4-IA-4B**	**CP4-IA-4**
Sample Type:	**N**	**N**	**N**	**N**	**N**	**FD**
Sample Collection Date/Time:	**3/28/2013**	**3/28/2013**	**3/28/2013 12:12**	**3/27/2013 9:05**	**3/28/2013 9:45**	**3/27/2012 9:05**
Analytical Method (units):	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**
Analyte						
d13C TCE	**-16.5**	**-20.9**	**-5.4**	**-31.2**	**-30.5**	**-30.9**
d37Cl TCE	**4.6**	**3.1**	**3.4**	**-1.3**	**0.1**	**-0.4**

Location ID:	**BUILDING 209**		
Description:	**MW-136**	**MW-156**	**Permanent point; in Room L306 Organic Prep/TCLP Extraction Lab**
Matrix:	**GW**	**GW**	**SS**
Field Sample ID:	**MW-136**	**MW-156**	**209-SG-09**
Sample Type:	**N**	**N**	**N**
Sample Collection Date/Time:	**3/28/2013**	**3/28/2013**	**3/27/2013 15:30**
Analytical Method (units):	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**	**TCE C/Cl (per mil)**
Analyte			
d13C TCE	**-22.2**	**-25.3**	**-10.6**
d37Cl TCE	**1.5**	**1.9**	**3.3**

Notes:
1. Isotope analysis was completed by the University of Oklahoma.
2. Bold font = detected result

TABLE C.4.3: RESULTS FROM ON-SITE ANALYSIS PROGRAM CONFIRMATION SAMPLES

ESTCP Project ER-201119 and ER-201025

Former Raritan Arsenal Site, New Jersey

Location ID:	**BUILDING CP4**				
Field Sample ID:	**CP4-IA-3**	**CP4-IA-5-BL**	**CP4-IA-5-NP**	**CP4-IA-5-NP**	**CP1-AA-2**
Sample Location ID:	**1-IA-3**	**1-IA-5**	**1-IA-5**	**1-IA-5**	**1-AA-2**
Description:	**In 1st conference room wall behind ethernet outlet**	**Warehouse 1**	**Warehouse 1**	**Warehouse 1**	**Behind warehouse**
Matrix:	**IA**	**IA**	**IA**	**IA**	**AA**
Pressure Condition:	**BL**	**BL**	**NP**	**NP**	**BL**
Sample Type:	**N**	**N**	**N**	**FD**	**N**
Sample Collection Date/Time:	**3/26/2013 16:30**	**3/28/2013 8:45**	**3/28/2013 11:05**	**3/28/2013 11:05**	**3/28/2013 8:50**
Analytical Method (units):	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**	**TO-15 SIM (ug/m3)**
Key Analyte for VI Evaluation					
Trichloroethene	**2.4**	**0.43**	**0.32**	**0.33**	-
Other Reported Compounds					
Dichloroethene, 1,1- (1,1-DCE)	<0.0039	<0.0037	<0.019	<0.019	-
Dichloroethene, cis-1,2-	<0.012	<0.012	<0.061	<0.059	-
Dichloroethene, trans-1,2-	<0.014	**0.041**	<0.069	**0.25**	-
Tetrachloroethene	**0.16**	**0.066**	**0.097 J**	**0.17**	-
Vinyl chloride	<0.0032	<0.003	<0.016	<0.015	-
Radon (pCi/L)					
Radon	-	**0.23**	**0.11**	**0.15**	**0.03**

Notes:

1. VOC analysis of vapor samples by ALS/Columbia Analytical Services, Simi Valley, California. Radon analysis by University of Southern California.
2. Samples collected as grab (i.e., without flow controller). Samples for VOC analysis were collected in 6-L Summa canisters. Samples for Radon analysis were collected in 1-L Tedlar bags.
3. Pressure Condition: BL = baseline (uncontrolled); NP = negative pressure (building depressurized).
4. Bold font = detected result; Less-than symbol ("<") = analyte not found at indicated limit; J-flag ("J") indicates the result is an estimated concentration that is less than the method reporting limit but greater than or equal to the method detection limit. Dash ("-") indicates compound not analyzed.

TABLE C.4.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Former Raritan Arsenal Site, New Jersey

Sample Date/Time	Description	Matrix	PCE	TCE
			ug/m3	ug/m3
SCREENING SAMPLES				
3/25/2013 8:59	274 Raritan (bag)	AI	0.26 J	U
3/25/2013 9:08	280 Raritan (bag)	AI	0.24 J	0.81 J
3/25/2013 9:32	278/284 Raritan (bag). Odors in building (equipment cleaned recently?)	AI	0.26 J	U
3/25/2013 9:51	Re-run 280 Raritan bag	AI	0.34 J	1.1 J
3/25/2013 9:59	Re-run 280 Raritan bag (duplicate)	AI	0.29 J	1.1 J
3/25/2013 10:27	Bldg 209 Bay A (bag	AI	0.25 J	U
3/25/2013 10:35	Bldg 209 Bay B (bag)	AI	0.24 J	U
3/25/2013 10:43	Bldg 209 Bay C (bag)	AI	0.48 J	U
3/25/2013 11:35	Bldg 209 Bay D (bag) - retry	AI	0.37 J	U
3/25/2013 11:43	Bldg 209 Bay E (bag)	AI	0.37 J	U
3/25/2013 11:51	Bldg 209 Bay F (bag)	AI	0.25 J	U
BUILDING CP4				
3/25/2013 8:21	300 Raritan CPIV conference room	AI	0.34 J	6.4
3/25/2013 8:52	Repeat 300 Raritan CPIV conference room. Sampled with probe	AI	0.2 J	4.7
3/25/2013 9:16	300 Raritan Warehouse (bag), sample collected near spray cans	AI	0.24 J	0.52 J
3/25/2013 9:24	300 Raritan Warehouse 2 (bag)	AI	0.25 J	0.86 J
3/25/2013 10:11	repeat 300 Raritan CPIV conference room. Sampled with probe	AI	0.24 J	6.4
3/25/2013 11:01	CPIV conference room air, repeat	AI	0.26 J	5.9
3/25/2013 11:27	Repeat conference room (after restart, autotune, conc cleanout)	AI	0.23 J	6.4
3/26/2013 8:30	conference room air, sampled with probe	AI	0.22 J	3.3
3/26/2013 9:12	280 Raritan (bag)	AI	0.18 J	0.97 J
3/26/2013 9:20	280 Raritan Subslab (CP4-SG-3)	SS	8.1	91
3/26/2013 9:49	conference room	AI	0.24 J	3
3/26/2013 9:58	300-1 (bag)	AI	0.39 J	3
3/26/2013 10:06	300-2 (bag)	AI	0.29 J	2.3 J
3/26/2013 10:14	300-3 (bag)	AI	0.35 J	2 J
3/26/2013 10:48	conference room (after reboot)	AI	0.24 J	3.4
3/26/2013 10:56	retry 300-4 (bag)	AI	0.26 J	2.4 J
3/26/2013 11:06	300-5 (bag)	AI	0.38 J	2.8
3/26/2013 11:14	300-6 (bag)	AI	0.24 J	1.1 J
3/26/2013 11:25	300-7 (bag)	AI	0.31 J	3.9
3/26/2013 11:33	300-8 (bag)	AI	0.28 J	3.7
3/26/2013 11:42	conference room air, sampled with probe	AI	0.23 J	3.2
3/26/2013 11:59	Outdoor air at AA-1 (bag)	AA	U	U
3/26/2013 12:13	conference room kitchen (bag)	AI	0.28 J	3.3
3/26/2013 12:26	janitorial closet (bag)	AI	0.32 J	3.3
3/26/2013 12:34	mail room 1 (bag)	AI	0.3 J	4
3/26/2013 12:42	mail room 2 (bag)	AI	0.29 J	3
3/26/2013 13:07	Conference room, sampled with probe	AI	0.25 J	3.1
3/26/2013 14:03	Conference room, before reboot	AI	0.27 J	3.7
3/26/2013 14:21	Repeat conference room after reboot	AI	0.26 J	3.5
3/26/2013 14:29	Men's room off central hallway (bag)	AI	0.29 J	2.7
3/26/2013 14:38	Women's room off central hallway (bag). Strong perfume/air freshener odors.	AI	0.29 J	2.6 J
3/26/2013 14:58	Hallway outside conference room	AI	0.27 J	3.3
3/26/2013 15:10	300-7 location sampled with probe (M/W restroom near conference rooms)	AI	0.26 J	3.3
3/26/2013 15:18	300-9 pass-through hall between conference room 1 and mailroom. Sampled with probe.	AI	0.26 J	3.1
3/26/2013 15:26	Upstairs composite (bag)	AI	0.28 J	2.8
3/26/2013 15:39	Vent in ceiling of conference room (bag)	AI	0.35 J	3.5
3/26/2013 15:47	Warehouse 1 (bag)	AI	0.29 J	1.7 J
3/26/2013 15:56	In wall, behind ethernet/outlet cover. Sampled with probe.	AI	0.25 J	11
3/26/2013 16:09	Plumbing wall gap under bathroom sink by 300-7	AI	0.27 J	3
3/26/2013 16:17	Wall outlet near 300-1	AI	0.28 J	3.1
3/26/2013 16:25	Wall outlet outside Conference Room 1	AI	0.26 J	3
3/26/2013 16:33	resample ethernet/wall outlet (same as run 38 location). Collected after Summa/grab sample CP4-IA-3.	AI	0.27 J	4

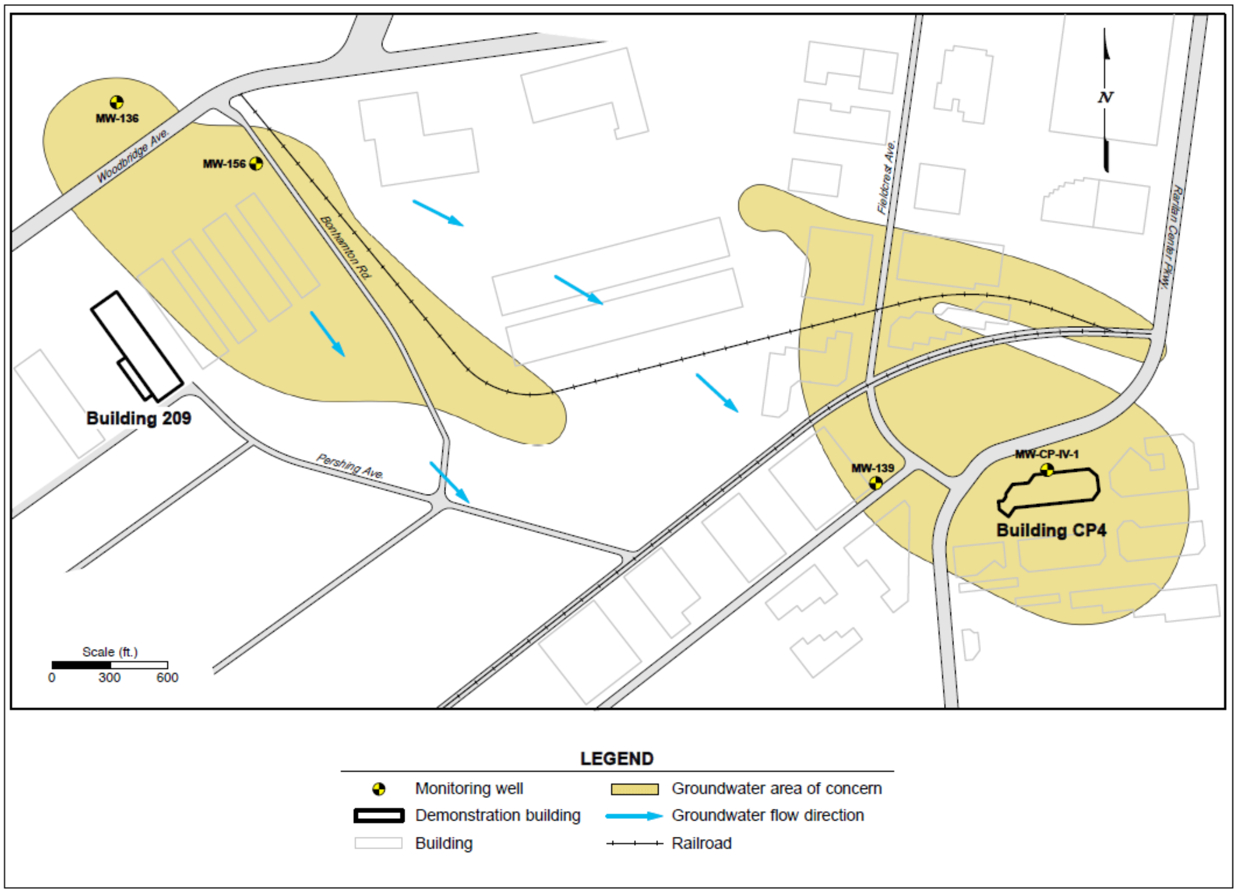
TABLE C.4.4: RESULTS FROM ON-SITE GC/MS ANALYSIS
ESTCP Project ER-201119 and ER-201025
Former Raritan Arsenal Site, New Jersey

Sample Date/Time	Description	Matrix	PCE	TCE
			ug/m3	ug/m3
3/26/2013 17:23	CP4-SG-2 screening (bag)	SS	2.3 J	24
3/26/2013 17:57	CP4-SG-6 (bag)	SS	7.5	20
3/28/2013 8:16	BL; warehouse near Omniguard	AI	U	0.86 J
3/28/2013 8:25	Center of Warehouse 2	AI	U	1.1 J
3/28/2013 8:32	Warehouse 1 north end, near building materials storage	AI	U	0.91 J
3/28/2013 8:44	End of BL; Warehouse 1, paired with CP4-IA-5-BL summa and radon	AI	U	0.81 J
3/28/2013 9:11	NP; Repeat Run 4 location, fan on 10 minutes	AI	U	0.75 J
3/28/2013 9:18	NP; Inside hallway leading to offices; fan on 15 minutes	AI	U	0.54 J
3/28/2013 9:28	NP: Run 4 location; sample collected after bay door opened and closed for delivery	AI	U	0.49 J
3/28/2013 9:39	NP; Warehouse 1 center (same location as Run 7)	AI	U	0.48 J
3/28/2013 9:47	NP; inside door/hall (same as Run 9 location)	AI	U	0.5 J
3/28/2013 10:16	NP; Warehouse 1 at Run 4 location. Fan on 70 min.	AI	U	0.49 J
3/28/2013 10:24	NP; resample Warehouse 2 run 5 location	AI	U	0.54 J
3/28/2013 10:34	NP; sub-slab, sampled with 3/8" tubing inserted in gap at expansion joint	SS	0.81 J	7
3/28/2013 10:42	NP; indoor air above crack sampled in run 16	AI	U	0.45 J
3/28/2013 10:52	NP; slab expansion joint sampled through tubing	SS	0.22 J	1.4 J
3/28/2013 11:03	NP; last NP sample, paired with summa/tedlar and dups CP4-IA-5-NP and DUP-1	AI	U	0.59 J
3/28/2013 11:13	Conference room kitchen (bag). Sample collected into Tedlar bag approx 10:00	AI	0.88 J	2.2 J
3/28/2013 11:21	BL. Repeat run 4 location	AI	U	0.46 J
3/28/2013 11:59	BL; resample crack (run 16 location)	SS	1.2 J	9.1
3/28/2013 12:07	BL; resample indoor air above crack	AI	U	0.75 J
3/28/2013 12:16	Outdoors behind warehouse	AA	U	0.45 J
BUILDING 209				
3/27/2013 8:31	Hall outside EPA/ESAT Balance and Drying Oven Lab	AI	U	U
3/27/2013 8:46	In hall by copy machine (across from Summa canister 209-IA-10)	AI	U	U
3/27/2013 8:59	Store room on south end	AI	U	U
3/27/2013 9:09	Outside, between Building 209 and 207	AA	U	U
3/27/2013 9:19	By 209-IA-09	AI	U	U
3/27/2013 9:26	In lab washroom	AI	U	U
3/27/2013 9:38	Bay C construction area. Sampled with probe using tubing inserted under door.	AI	U	U
3/27/2013 9:47	Resample run 011 location (by 209-IA-09)	AI	U	U
3/27/2013 9:56	Near entrance of organic prep/TCLP extraction lab (room with IA/SG-09 point)	AI	U	U
3/27/2013 10:05	Warehouse IA above subslab probe 209-SG-06	AI	0.24 J	U
3/27/2013 10:16	209-SG-09 (bag)	SS	4.6	7.5
3/27/2013 10:44	Retry run 018 location.	AI	U	U
3/27/2013 10:53	209-SG-06 (middle point)	SS	15	1.3 J
3/27/2013 11:23	209-SG-04 southeastern most point (bag)	SS	4.8	U

Notes:
1. Samples analyzed using an Inficon HAPSITE ER portable GC/MS instrument. Calibration curve 3/24/2013.
2. Samples are grouped by building, and sorted chronologically.
3. J = estimated (result less than lower calibration limit); JE = estimated (result higher than upper calibration limit); U = not detected.
4. Matrix: AI = Indoor air; AA = Ambient (outdoor) air; SS = Sub-slab

APPENDIX C FIGURES
ESTCP Projects ER-201119 and 201025
Former Raritan Arsenal Site, New Jersey

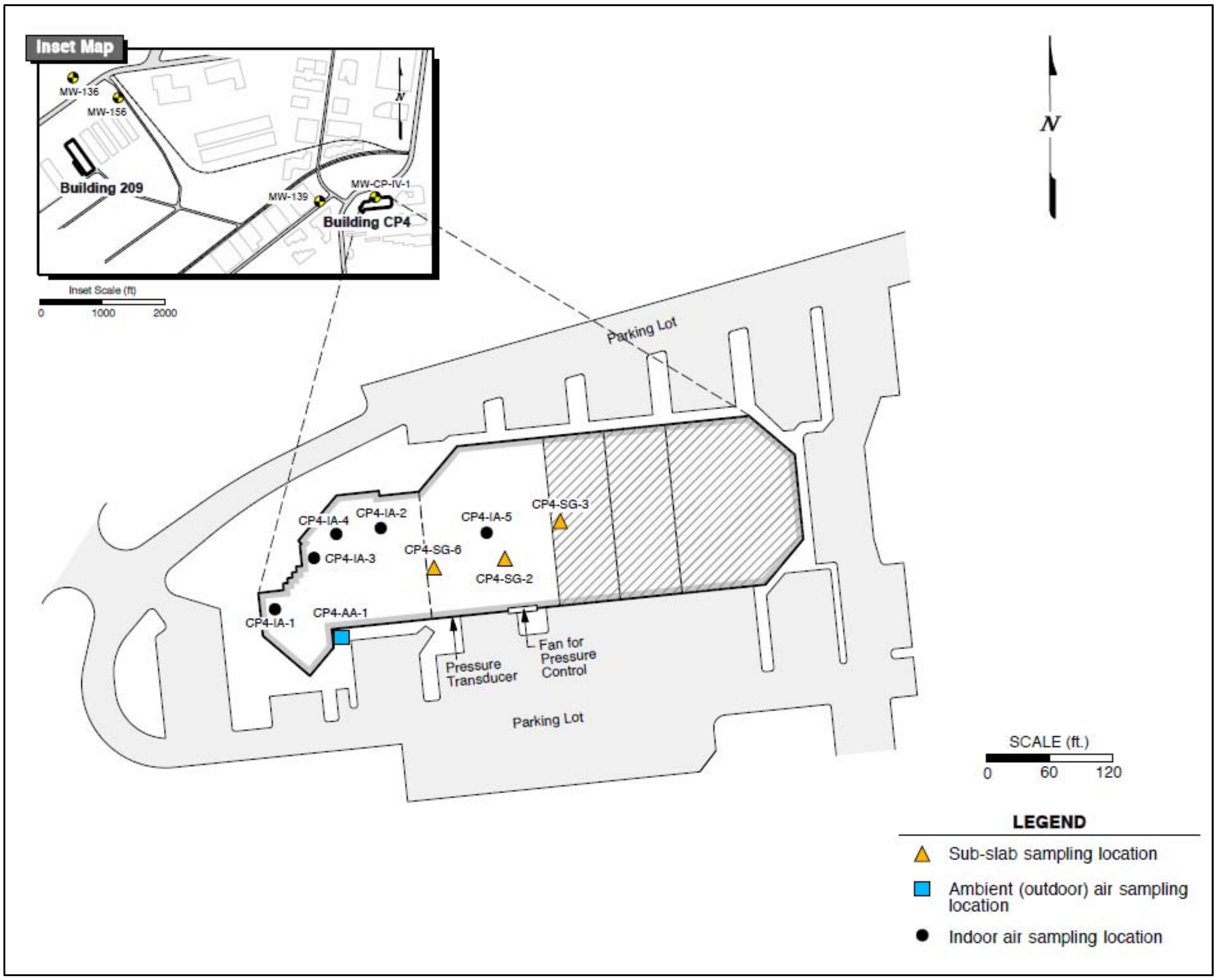
Figure C.4.1: Site Map



Note: Only monitoring wells sampled for the demonstration are shown.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and 201025
Former Raritan Arsenal Site, New Jersey

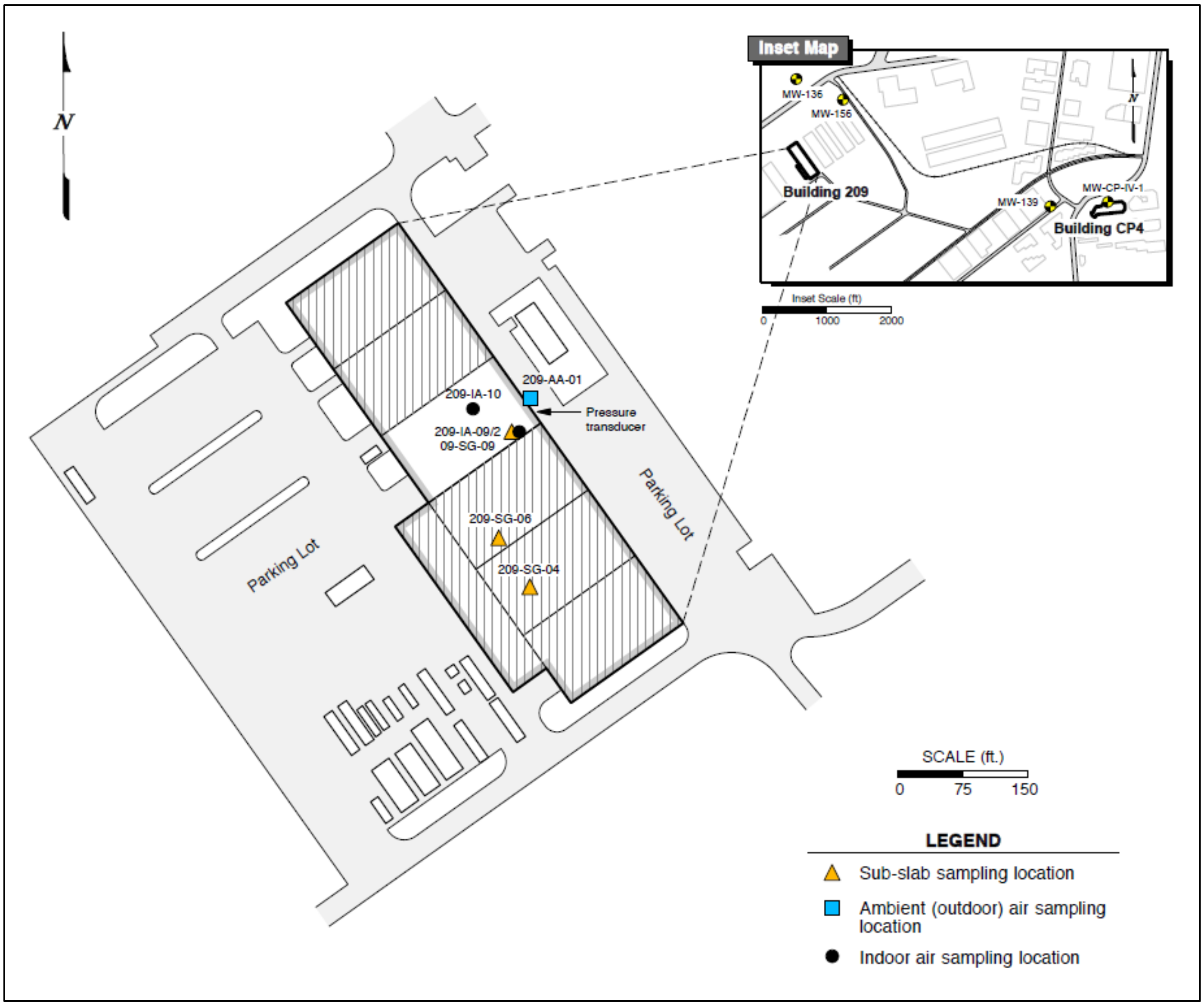
Figure C.4.2: Building CP4 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

APPENDIX C FIGURES
ESTCP Projects ER-201119 and 201025
Former Raritan Arsenal Site, New Jersey

Figure C.4.3: Building 209 Floorplan



Note: Figure illustrates sample locations for off-site laboratory analysis. HAPSITE sample locations are not shown.

Appendix D: Data Quality Review and Laboratory Reports

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

Appendix D.1	Data Quality Review
Appendix D.2	Laboratory Reports

Appendix D.1: Data Quality Review

TABLES

GSI Job No. 3585
Issued: 24 June 2013
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TABLE D.1.1: HOLDING TIME EVALUATION
ESTCP Project ER-201025

Demonstration Site	Sample ID	Sample Collection Date	Run Number	Date Analyzed	original tube #	Individual Tube Result (per mil)	Initial Results (per mil)	Average of all runs (per mil)	Difference (%)
d13C TCE									
Lewis-McChord (OU #613)	1-IA-1-CSI	7/24/2012	8959	8/27/2012	C16_K08436	-25.9	-25.9	-26.1	1%
			9071	10/22/2012	C16_J07242	peak coelutes			
			9480	4/17/2013	C16_J03141	-26.0			
			9483	4/17/2013	C16_J03141	-26.4			
Lewis-McChord (OU #613)	1-SS-2-CSI	7/25/2012	8957	8/27/2012	C16_K08430	-18.2	-18.5	n/a	n/a
			8960	8/27/2012	C16_J06979	-18.8			
			9069	10/22/2012	C16_J07342	no peak			
			9482	4/17/2013	C16_J07342	no peak			
Lewis-McChord (OU #613)	3-SS-2-CSI	7/25/2012	8958	8/27/2012	C16_J03697	-18.8	-18.8	-19.0	1%
			9068	10/22/2012	C16_J03553	-19.5			
			9481	4/17/2013	C16_J03553	-18.8			
Selfridge (OU #631)	Indoor-1	9/18/2012	9072	10/22/2012	C16_K08440	-32.5	-32.6	-32.2	1%
			9077	10/23/2012	C16_K08448	-32.6			
			9485	4/17/2013	C16_K08457	-31.8			
			9488	4/18/2013	C16_J03146	-31.8			
Selfridge (OU #631)	SS-2 HIGH	9/18/2012	9065	10/21/2012	C16_J03770	-25.2	-25.5	-25.2	1%
			9066	10/21/2012	C16_J03770	-25.8			
			9484	4/17/2013	C16_J07356	-24.6			
d37Cl TCE									
Tyndall (OU #677)	156-SS-3	2/21/2013	3298	3/20/2013	M17818 (via C16_M17	6.1	6.3	6.3	0%
			3302	3/20/2013	M17818 (via C16_M17	6.4			
			3583	5/22/2013	C16_M17853	6.3			
			3592	5/23/2013	C16_M17853	6.2			
Tyndall (OU #677)	219-IA-3 Pump 1	2/21/2013	3289	3/20/2013	_M17787 (via C16_M16	-3.5	-3.5	-3.4	2%
			3305	3/20/2013	_M17787 (via C16_M17	-3.5			
			3585	5/22/2013	_M17787 (via C16_M17	-3.3			
Tyndall (OU #677)	219-IA-3 Pump 2	2/21/2013	3291	3/20/2013	_M17688 (via C16_M17	-2.9	-3.15	-3.19	1.2%
			3292	3/20/2013	_M17688 (via C16_J03	-2.9			
			3306	3/20/2013	_M17688 (via C16_M17	-3.7			
			3586	5/22/2013	_M17688 (via C16_M17	-3.3			
d13C Benzene									
Selfridge (OU #631)	Indoor-1	9/18/2012	9042	10/16/2012	C16_K08448	-29.1	-29.0	-28.9	0.3%
			9038	10/15/2012	C16_K08440	-29.0			
			9498	4/24/2013	C16_K08421	-28.9			
			9500	4/24/2013	C16_K08421	-28.8			
Selfridge (OU #631)	SS-1	9/19/2012	9023	10/10/2012	C16_J03973	-29.9	-29.8	-29.8	0.1%
			9030	10/11/2012	C16_J03738	-29.8			
			9491	4/19/2013	C16_K08431	-29.7			
			9493	4/19/2013	C16_K08431	-29.8			
Selfridge (OU #631)	SS-2 1 hr	9/19/2012	9024	10/10/2012	C16_K08430	-29.4	-29.4	-29.4	0.0%
			9496	4/23/2013	C16_J03150	-29.4			
			9499	4/24/2013	C16_J03150	-29.3			
Selfridge (OU #631)	SS-2 Low	9/18/2012	9020	10/9/2012	C16_J04853	-28.9	-28.9	-30.2	4.7% (Note 1)
			9492	4/19/2013	C16_J07661	-30.2			

NOTE:

1. Only 10-20 ng of benzene on "SS-2 low". Possible problems caused by low level carryover or adsorbent pyrolysis byproduct
2. Difference calculated as the absolute value of ([initial result minus average] / initial result).

TABLE D.1.2: FIELD DUPLICATE EVALUATION
ESTCP Project ER-201025

LocID	Sample Location Description	Matrix	Analyte	Normal Sample ID	Result (per mil)	Duplicate ID	Dup Result (per mil)	Precision (per mil)
Air/Vapor								
Lewis-McChord 9669	middle, near 1-IA-1	SS	d13C TCE	1-SS-2-CSI	-18.5 H	3-SS-2-CSI	-18.8 H	0.3
			d37Cl TCE	1-SS-2-CSI	5.8 H	3-SS-2-CSI	5.5 H	0.3
Selfridge 1533	Inside storeroom	SS	d13C Benzene	SS-2 Low	-28.9 JH	SS-2 1 Hour	-29.4 H	0.5
			d13C PCE	SS-2 Low	-25.7 H	SS-2 1 Hour	-25.3 H	-0.4
Tyndall 219	Northern half of building in janitor closet	IA	d13C TCE	219-IA-3 P1	-29 H	219-IA-3 P2	-28.8 H	-0.2
			d37Cl TCE	219-IA-3 P1	-3.5 H	219-IA-3 P2	-3.2 H	-0.3
Raritan CP4	CP4-IA-4 In kitchen between conference rooms	IA	d13C TCE	CP4-IA-4B	-30.5	CP4-IA-4	-30.9	0.4
			d37Cl TCE	CP4-IA-4B	0.1	CP4-IA-4	-0.4	0.5
Groundwater								
Lewis-McChord 9669	near Building 9669	GW	d13C TCE	LC-18	-23.3 H	DUP-1	-23.6 H	0.3
			d37Cl TCE	LC-18	2.5 H	DUP-1	2.4 H	0.1

Notes:
1. Indoor Air (IA)/sub-slab (SS) vapor samples collected onto sorbent tubes. Groundwater (GW) samples collected in VOA vials.

TABLE D.1.3: SORBENT TUBE TRIP BLANKS
ESTCP Project ER-201025

	Submitted to Lab	Date Analyzed	Key Analyte	Result	Notes
Location					
Lewis-McChord	7/25/2012	1/10-11/2013	TCE	0 ng	two sorbent tubes analyzed
Selfridge	2/20/2012	1/10-11/2013	TCE	0 - 0.2 ng	three tubes analyzed
			Benzene	0.4 - 1.2 ng	three tubes analyzed
Tyndall	2/22/2013	3/22/2013	TCE	0 ng	two sorbent tubes analyzed
Raritan	3/28/2013	4/15/2013	TCE	0.1 - 1.3 ng	three tubes analyzed

Note:

1. Trip blanks collected per QAPP for ER-201025

Appendix D.2: Laboratory Analytical Reports

Laboratory Analytical Reports

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

ER-201025

Use of On-Site GC/MS Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

ER-201119

Joint Base Lewis-McChord, Washington

LABORATORY REPORT

August 10, 2012

Tom McHugh
GSI Environmental Inc.
2211 Norfolk, Suite 1000
Houston, TX 77098

RE: ESTCP / JBLM Long Center / G-3585 / 3669

Dear Tom:

Enclosed are the results of the samples submitted to our laboratory on July 27, 2012. For your reference, these analyses have been assigned our service request number P1203080.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA200007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L11-203; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-12-3; Minnesota Department of Health, NELAP Certificate No. 362188; Washington State Department of Ecology, ELAP Lab ID: C946, State of Utah Department of Health, NELAP Certificate No. CA01527Z012-Z; Los Angeles Department of Building and Safety, Approval No: TA00001. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Sue Anderson

Digitally Signed By Sue Anderson at 3:06 pm, Aug 10, 2012

Sue Anderson
Project Manager

Client:	GSI Environmental Inc.	Service Request No:	P1203080
Project:	ESTCP / JBLM Long Center / G-3585 / 3669		

CASE NARRATIVE

The samples were received intact under chain of custody on July 27, 2012 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Volatile Organic Compound Analysis

The samples were analyzed in SIM mode for selected volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of Columbia Analytical Services, Inc. dba ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to AALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

DETAIL SUMMARY REPORT

Client: GSI Environmental Inc.
Service Request: P1203080
Project ID: ESTCP / JBLM Long Center / G-3585 / 3669

Date Received: 7/27/2012
Time Received: 09:45

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-15 - VOC SIM
1-AA-1-CON	P1203080-001	Air	7/24/2012	16:00	AC00717	-2.63	3.55	X
1-IA-1-CON	P1203080-002	Air	7/24/2012	15:57	AC01368	-2.17	3.63	X
1-IA-2-CON	P1203080-003	Air	7/24/2012	15:58	AC00081	-1.86	3.54	X
1-SS-1-CON	P1203080-004	Air	7/24/2012	10:46	AC01782	-3.38	3.58	X
1-SS-2-CON	P1203080-005	Air	7/24/2012	11:06	AC00480	-0.97	3.56	X
1-SS-3-CON	P1203080-006	Air	7/24/2012	11:27	AC01637	-5.17	2.56	X
2-AA-1-CON	P1203080-007	Air	7/24/2012	15:25	AC01154	-0.75	3.52	X
2-IA-1-CON	P1203080-008	Air	7/24/2012	15:21	AC01900	-2.57	3.69	X
2-SS-1-CON	P1203080-009	Air	7/24/2012	14:49	AS00103	-0.93	3.56	X
2-SS-2-CON	P1203080-010	Air	7/24/2012	15:05	AC01190	-0.21	3.55	X
1-IA-3-BL	P1203080-011	Air	7/25/2012	08:53	AC00714	0.33	3.72	X
1-IA-3-PP	P1203080-012	Air	7/25/2012	09:57	AC00229	0.31	3.55	X
2-SS-3-CON-Resample	P1203080-013	Air	7/26/2012	08:08	AC01034	-0.90	3.50	X
2-IA-1-BL	P1203080-014	Air	7/26/2012	08:36	AC00748	0.33	3.56	X
2-IA-1-NP	P1203080-015	Air	7/26/2012	10:15	AC01165	0.41	3.56	X
DUP-1	P1203080-016	Air	7/26/2012	00:00	AC00822	0.38	3.75	X
1-IA-3-NP	P1203080-017	Air	7/25/2012	11:06	AC01327	0.37	3.65	X

Columbia Analytical Services™

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 2

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1203080

CAS Contact: Sue Anderson

Company Name & Address (Reporting Information)
GSI Environmental
2211 Norfolk Ste 1000
Houston TX 77098

Project Manager: T. McHugh / L. Beckley

Phone: 713-522-6300

Fax:

Email Address for Result Reporting: temchugh@gsi-net.com, lmbeckley@gsi-net.com

Project Name: ESTCP / JBLM Log Center

Project Number: G-3585/3669

P.O. # / Billing Information:

Sampler (Print & Sign): LMB/ TEM / TTT

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method: TO-15 5 cVOCs TO-15 SIM + trans 1,2 DCE, 12DCA, 11 DCE	Analysis Method	Comments e.g. Actual Preservative or specific instructions
1-AA-1-CON	①-.276	7/24/12	0824-1600	AC00717	FCA00473	-30	-5.5	6-L	✓		
1-IA-1-CON	②-.223	7/24/12	0830-1557	AC01368	FCA00556	-29.5	-5				
1-IA-2-CON	③-1.94	7/24/12	0835-1558	AC00081	FCA00561	-30	-4				
1-SS-1-CON	④-.344	7/24/12	1040-1046	AC01782	None	-29.5	-7.5				subslab, grab
1-SS-2-CON	⑤-1.02	7/24/12	1103-1106	AC00480	none	-30	-2				"
1-SS-3-CON	⑥-5.23	7/24/12	1119-1127	AC01637	none	-30	-11				"
2-AA-1-CON	⑦-1.14	7/24/12	0802-1525	AC01154	FCA00496	-30	-2				
2-IA-1-CON	⑧-.262	7/24/12	0758-1521	AC01900	FCA00196	-30	-5.5				
2-SS-1-CON	⑨-0.98	7/24/12	1448-1449	AS00103	none	-30	-1.5				subslab, grab
2-SS-2-CON	⑩-0.20	7/24/12	1502-1505	AC01190	none	-30	0				"
~~2-SS-3-CON~~		~~7/24/12~~	~~1515-1518~~	~~AC01871~~	~~none~~	~~-30~~	~~-20~~				Do NOT ANALYZE
1-IA-3-BL	⑪+0.32	7/25/12	0851-0853	AC00714	none	-30	0				grab (indoor air)
1-IA-3-PP	⑫+0.25	7/25/12	0955-0957	AC00229	none	-30	0				"
2-SS-3-CON-resample	⑬-0.98	7/26/12	0898	AC01034	none	-30	-2	↓	↓		subslab, grab

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ✓
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required [✓ Yes] No
Type: ug/m3

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date: 7/26/12	Time: 1150	Received by: (Signature)	Date: 7/27/12	Time: 0845
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ✓ °C

COC AIR REV 3-11

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Air - Chain of Custody Record & Analytical Service Request

Page 2 of 2

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1203050

CAS Contact: Sue Anderson

Company Name & Address (Reporting Information)
GSI
2211 Norfolk Ste
Houston TX 77098

Project Name: ESTCP / JBLM Log Center

Project Number:

Project Manager: T McHugh / L Beckley

P.O. # / Billing Information:

Phone: 713 522 6300

Fax:

Email Address for Result Reporting: tcmchugh@gsi-net.com, lmbeckley@gsi-net.com

Sampler (Print & Sign): Wooten / TTT

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method: TO 15 SIM 5 VOCs + DIBROMETHANE, 12DCA, 11DCE	Analysis Method	Comments e.g. Actual Preservative or specific instructions
2-IA-1-BL	⑭ +0.30	7/26/12	0836	AC00748	n/a	-29.5	0	6 L	✓		indoor air grab
2-IA-1-NP	⑮ +0.37	7/26/12	1015	AC01165	n/a	-29.5	0	↓	↓		" "
DUP-1	⑯ +0.33	7/26/12		AC00822	n/a	-29.5	0	↓	↓		
1-IA-3-NP	⑰ +0.22	7/25/12	1106	AC01327	n/a	-30	0	↓	↓		
	-13.84 -120.52 -9.52										
18 samples + 2 returned cans											

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ✓
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required [✓ Yes] / No
Type: [illegible]

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature) [illegible] Date: 7/26/12 Time: 1150
Received by: (Signature) [illegible] Date: 7/27/12 Time: 0945

Relinquished by: (Signature) Date: Time:
Received by: (Signature) Date: Time:

Cooler / Blank Temperature ____ °C

COC AIR REV 3-11

Sample Acceptance Check Form

Client: GSI Environmental Inc. Work order: P1203080
Project: ESTCP / JBLM Long Center / G-3585 / 3669
Sample(s) received on: 7/27/12 Date opened: 7/27/12 by: MZAMORA

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by CAS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? ________ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? ________ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **<u>VOA vials</u>** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and <u>if necessary</u> alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1203080-001.01	6.0 L Ambient Can					
P1203080-002.01	6.0 L Ambient Can					
P1203080-003.01	6.0 L Ambient Can					
P1203080-004.01	6.0 L Ambient Can					
P1203080-005.01	6.0 L Ambient Can					
P1203080-006.01	6.0 L Ambient Can					
P1203080-007.01	6.0 L Ambient Can					
P1203080-008.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers): ________

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

Sample Acceptance Check Form

Client: GSI Environmental Inc. Work order: P1203080
Project: ESTCP / JBLM Long Center / G-3585 / 3669
Sample(s) received on: 7/27/12 Date opened: 7/27/12 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1203080-009.01	6.0 L Silonite Can					
P1203080-010.01	6.0 L Ambient Can					
P1203080-011.01	6.0 L Ambient Can					
P1203080-012.01	6.0 L Ambient Can					
P1203080-013.01	6.0 L Ambient Can					
P1203080-014.01	6.0 L Ambient Can					
P1203080-015.01	6.0 L Ambient Can					
P1203080-016.01	6.0 L Ambient Can					
P1203080-017.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

Page 1 of 1

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**1-AA-1-CON**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P1203080-001
Test Code:	EPA TO-15 SIM	Date Collected:	7/24/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	7/27/12
Analyst:	Wida Ang	Date Analyzed:	8/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AC00717		

Initial Pressure (psig): -2.63 Final Pressure (psig): 3.55

Canister Dilution Factor: 1.51

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.038	ND	0.015	
75-35-4	1,1-Dichloroethene	ND	0.038	ND	0.0095	
156-60-5	trans-1,2-Dichloroethene	ND	0.038	ND	0.0095	
156-59-2	cis-1,2-Dichloroethene	ND	0.038	ND	0.0095	
107-06-2	1,2-Dichloroethane	ND	0.038	ND	0.0093	
71-55-6	1,1,1-Trichloroethane	ND	0.038	ND	0.0069	
79-01-6	Trichloroethene	ND	0.038	ND	0.0070	
127-18-4	Tetrachloroethene	**0.052**	0.038	**0.0077**	0.0056	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**1-IA-1-CON**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P1203080-002
Test Code:	EPA TO-15 SIM	Date Collected:	7/24/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	7/27/12
Analyst:	Wida Ang	Date Analyzed:	8/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AC01368		

Initial Pressure (psig): -2.17 Final Pressure (psig): 3.63

Canister Dilution Factor: 1.46

CAS #	**Compound**	**Result** **μg/m³**	MRL μg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.037	ND	0.014	
75-35-4	1,1-Dichloroethene	ND	0.037	ND	0.0092	
156-60-5	trans-1,2-Dichloroethene	**2.3**	0.037	**0.59**	0.0092	
156-59-2	cis-1,2-Dichloroethene	ND	0.037	ND	0.0092	
107-06-2	1,2-Dichloroethane	**0.053**	0.037	**0.013**	0.0090	
71-55-6	1,1,1-Trichloroethane	**0.042**	0.037	**0.0077**	0.0067	
79-01-6	Trichloroethene	**1.5**	0.037	**0.28**	0.0068	
127-18-4	Tetrachloroethene	**0.18**	0.037	**0.026**	0.0054	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**1-IA-2-CON**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P1203080-003
Test Code:	EPA TO-15 SIM	Date Collected:	7/24/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	7/27/12
Analyst:	Wida Ang	Date Analyzed:	8/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AC00081		

Initial Pressure (psig): -1.86 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.42

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.036	ND	0.014	
75-35-4	1,1-Dichloroethene	ND	0.036	ND	0.0090	
156-60-5	trans-1,2-Dichloroethene	**1.6**	0.036	**0.39**	0.0090	
156-59-2	cis-1,2-Dichloroethene	ND	0.036	ND	0.0090	
107-06-2	1,2-Dichloroethane	**0.050**	0.036	**0.012**	0.0088	
71-55-6	1,1,1-Trichloroethane	**0.039**	0.036	**0.0072**	0.0065	
79-01-6	Trichloroethene	**1.2**	0.036	**0.23**	0.0066	
127-18-4	Tetrachloroethene	**0.15**	0.036	**0.021**	0.0052	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **1-SS-1-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-004

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01782

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 0.30 Liter(s)

Initial Pressure (psig): -3.38 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.61

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.13	ND	0.053	
75-35-4	1,1-Dichloroethene	ND	0.13	ND	0.034	
156-60-5	trans-1,2-Dichloroethene	ND	0.13	ND	0.034	
156-59-2	cis-1,2-Dichloroethene	ND	0.13	ND	0.034	
107-06-2	1,2-Dichloroethane	**0.65**	0.13	**0.16**	0.033	
71-55-6	1,1,1-Trichloroethane	**3.4**	0.13	**0.61**	0.025	
79-01-6	Trichloroethene	**43**	0.13	**8.1**	0.025	
127-18-4	Tetrachloroethene	**17**	0.13	**2.5**	0.020	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **1-SS-2-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-005

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00480

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 0.060 Liter(s)

Initial Pressure (psig): -0.97 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.33

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.55	ND	0.22	
75-35-4	1,1-Dichloroethene	ND	0.55	ND	0.14	
156-60-5	trans-1,2-Dichloroethene	**0.57**	0.55	**0.14**	0.14	
156-59-2	cis-1,2-Dichloroethene	ND	0.55	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.55	ND	0.14	
71-55-6	1,1,1-Trichloroethane	**6.2**	0.55	**1.1**	0.10	
79-01-6	Trichloroethene	**320**	0.55	**60**	0.10	
127-18-4	Tetrachloroethene	**22**	0.55	**3.3**	0.082	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **1-SS-3-CON** CAS Project ID: P1203080
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669** CAS Sample ID: P1203080-006

Test Code: EPA TO-15 SIM Date Collected: 7/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7 Date Received: 7/27/12
Analyst: Wida Ang Date Analyzed: 8/1/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.050 Liter(s)
Test Notes:
Container ID: AC01637

Initial Pressure (psig): -5.17 Final Pressure (psig): 2.56

Canister Dilution Factor: 1.81

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.91	ND	0.35	
75-35-4	1,1-Dichloroethene	ND	0.91	ND	0.23	
156-60-5	trans-1,2-Dichloroethene	ND	0.91	ND	0.23	
156-59-2	cis-1,2-Dichloroethene	ND	0.91	ND	0.23	
107-06-2	1,2-Dichloroethane	**3.2**	0.91	**0.78**	0.22	
71-55-6	1,1,1-Trichloroethane	**9.0**	0.91	**1.7**	0.17	
79-01-6	Trichloroethene	**1.5**	0.91	**0.28**	0.17	
127-18-4	Tetrachloroethene	**21**	0.91	**3.1**	0.13	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **2-AA-1-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-007

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01154

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -0.75 Final Pressure (psig): 3.52

Canister Dilution Factor: 1.31

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.033	ND	0.013	
75-35-4	1,1-Dichloroethene	ND	0.033	ND	0.0083	
156-60-5	trans-1,2-Dichloroethene	ND	0.033	ND	0.0083	
156-59-2	cis-1,2-Dichloroethene	ND	0.033	ND	0.0083	
107-06-2	1,2-Dichloroethane	**0.038**	0.033	**0.0093**	0.0081	
71-55-6	1,1,1-Trichloroethane	ND	0.033	ND	0.0060	
79-01-6	Trichloroethene	ND	0.033	ND	0.0061	
127-18-4	Tetrachloroethene	**0.053**	0.033	**0.0079**	0.0048	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **2-IA-1-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-008

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01900

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.57 Final Pressure (psig): 3.69

Canister Dilution Factor: 1.52

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.038	ND	0.015	
75-35-4	1,1-Dichloroethene	ND	0.038	ND	0.0096	
156-60-5	trans-1,2-Dichloroethene	ND	0.038	ND	0.0096	
156-59-2	cis-1,2-Dichloroethene	ND	0.038	ND	0.0096	
107-06-2	1,2-Dichloroethane	ND	0.038	ND	0.0094	
71-55-6	1,1,1-Trichloroethane	ND	0.038	ND	0.0070	
79-01-6	Trichloroethene	**0.072**	0.038	**0.013**	0.0071	
127-18-4	Tetrachloroethene	**0.24**	0.038	**0.035**	0.0056	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**2-SS-1-CON**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P1203080-009
Test Code:	EPA TO-15 SIM	Date Collected:	7/24/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	7/27/12
Analyst:	Wida Ang	Date Analyzed:	8/2/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AS00103		

Initial Pressure (psig): -0.93 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.33

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.033	ND	0.013	
75-35-4	1,1-Dichloroethene	**0.035**	0.033	**0.0087**	0.0084	
156-60-5	trans-1,2-Dichloroethene	ND	0.033	ND	0.0084	
156-59-2	cis-1,2-Dichloroethene	ND	0.033	ND	0.0084	
107-06-2	1,2-Dichloroethane	**0.24**	0.033	**0.059**	0.0082	
71-55-6	1,1,1-Trichloroethane	**1.7**	0.033	**0.31**	0.0061	
79-01-6	Trichloroethene	**0.034**	0.033	**0.0063**	0.0062	
127-18-4	Tetrachloroethene	**18**	0.033	**2.6**	0.0049	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **2-SS-2-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-010

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01190

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/2/12
Volume(s) Analyzed: 0.50 Liter(s)

Initial Pressure (psig): -0.21 Final Pressure (psig): 3.55

Canister Dilution Factor: 1.26

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.063	ND	0.025	
75-35-4	1,1-Dichloroethene	ND	0.063	ND	0.016	
156-60-5	trans-1,2-Dichloroethene	ND	0.063	ND	0.016	
156-59-2	cis-1,2-Dichloroethene	ND	0.063	ND	0.016	
107-06-2	1,2-Dichloroethane	**0.30**	0.063	**0.075**	0.016	
71-55-6	1,1,1-Trichloroethane	**0.73**	0.063	**0.13**	0.012	
79-01-6	Trichloroethene	**1.8**	0.063	**0.33**	0.012	
127-18-4	Tetrachloroethene	**48**	0.063	**7.1**	0.0093	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **1-IA-3-BL** CAS Project ID: P1203080
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669** CAS Sample ID: P1203080-011

Test Code: EPA TO-15 SIM Date Collected: 7/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7 Date Received: 7/27/12
Analyst: #N/A Date Analyzed: 8/1/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00714
Initial Pressure (psig): 0.33 Final Pressure (psig): 3.72

Canister Dilution Factor: 1.23

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.031	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.031	ND	0.0078	
156-60-5	trans-1,2-Dichloroethene	**2.2**	0.031	**0.56**	0.0078	
156-59-2	cis-1,2-Dichloroethene	ND	0.031	ND	0.0078	
107-06-2	1,2-Dichloroethane	**0.051**	0.031	**0.013**	0.0076	
71-55-6	1,1,1-Trichloroethane	**0.041**	0.031	**0.0075**	0.0056	
79-01-6	Trichloroethene	**2.0**	0.031	**0.37**	0.0057	
127-18-4	Tetrachloroethene	**0.22**	0.031	**0.032**	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **1-IA-3-PP**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-012

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00229

Date Collected: 7/25/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): 0.31 Final Pressure (psig): 3.55

Canister Dilution Factor: 1.22

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.031	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.031	ND	0.0077	
156-60-5	trans-1,2-Dichloroethene	**1.5**	0.031	**0.39**	0.0077	
156-59-2	cis-1,2-Dichloroethene	ND	0.031	ND	0.0077	
107-06-2	1,2-Dichloroethane	**0.050**	0.031	**0.012**	0.0075	
71-55-6	1,1,1-Trichloroethane	**0.038**	0.031	**0.0069**	0.0056	
79-01-6	Trichloroethene	**1.2**	0.031	**0.22**	0.0057	
127-18-4	Tetrachloroethene	**0.17**	0.031	**0.025**	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **2-SS-3-CON-Resample**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-013

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01034

Date Collected: 7/26/12
Date Received: 7/27/12
Date Analyzed: 8/1 - 8/2/12
Volume(s) Analyzed: 1.00 Liter(s)
0.10 Liter(s)

Initial Pressure (psig): -0.90 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.32

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.033	ND	0.013	
75-35-4	1,1-Dichloroethene	ND	0.033	ND	0.0083	
156-60-5	trans-1,2-Dichloroethene	ND	0.033	ND	0.0083	
156-59-2	cis-1,2-Dichloroethene	ND	0.033	ND	0.0083	
107-06-2	1,2-Dichloroethane	**0.096**	0.033	**0.024**	0.0082	
71-55-6	1,1,1-Trichloroethane	**1.5**	0.033	**0.27**	0.0061	
79-01-6	Trichloroethene	**1.7**	0.033	**0.32**	0.0061	
127-18-4	Tetrachloroethene	**35**	0.33	**5.1**	0.049	**D**

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **2-IA-1-BL**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-014

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00748

Date Collected: 7/26/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): 0.33 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.21

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.030	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.030	ND	0.0076	
156-60-5	trans-1,2-Dichloroethene	ND	0.030	ND	0.0076	
156-59-2	cis-1,2-Dichloroethene	ND	0.030	ND	0.0076	
107-06-2	1,2-Dichloroethane	**0.036**	0.030	**0.0089**	0.0075	
71-55-6	1,1,1-Trichloroethane	ND	0.030	ND	0.0055	
79-01-6	Trichloroethene	**0.032**	0.030	**0.0060**	0.0056	
127-18-4	Tetrachloroethene	ND	0.030	ND	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **2-IA-1-NP**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-015

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01165

Date Collected: 7/26/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): 0.41 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.21

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.030	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.030	ND	0.0076	
156-60-5	trans-1,2-Dichloroethene	ND	0.030	ND	0.0076	
156-59-2	cis-1,2-Dichloroethene	ND	0.030	ND	0.0076	
107-06-2	1,2-Dichloroethane	**0.035**	0.030	**0.0088**	0.0075	
71-55-6	1,1,1-Trichloroethane	ND	0.030	ND	0.0055	
79-01-6	Trichloroethene	ND	0.030	ND	0.0056	
127-18-4	Tetrachloroethene	ND	0.030	ND	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **DUP-1**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-016

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00822

Date Collected: 7/26/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): 0.38 Final Pressure (psig): 3.75

Canister Dilution Factor: 1.22

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.031	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.031	ND	0.0077	
156-60-5	trans-1,2-Dichloroethene	ND	0.031	ND	0.0077	
156-59-2	cis-1,2-Dichloroethene	ND	0.031	ND	0.0077	
107-06-2	1,2-Dichloroethane	**0.035**	0.031	**0.0086**	0.0075	
71-55-6	1,1,1-Trichloroethane	ND	0.031	ND	0.0056	
79-01-6	Trichloroethene	ND	0.031	ND	0.0057	
127-18-4	Tetrachloroethene	ND	0.031	ND	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**1-IA-3-NP**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P1203080-017
Test Code:	EPA TO-15 SIM	Date Collected:	7/25/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	7/27/12
Analyst:	Wida Ang	Date Analyzed:	8/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AC01327		

Initial Pressure (psig): 0.37 Final Pressure (psig): 3.65

Canister Dilution Factor: 1.22

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.031	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.031	ND	0.0077	
156-60-5	trans-1,2-Dichloroethene	**1.0**	0.031	**0.25**	0.0077	
156-59-2	cis-1,2-Dichloroethene	ND	0.031	ND	0.0077	
107-06-2	1,2-Dichloroethane	**0.047**	0.031	**0.012**	0.0075	
71-55-6	1,1,1-Trichloroethane	**0.035**	0.031	**0.0065**	0.0056	
79-01-6	Trichloroethene	**2.0**	0.031	**0.38**	0.0057	
127-18-4	Tetrachloroethene	**0.16**	0.031	**0.023**	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Method Blank**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P120801-MB
Test Code:	EPA TO-15 SIM	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	NA
Analyst:	Wida Ang	Date Analyzed:	8/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.025	ND	0.0098	
75-35-4	1,1-Dichloroethene	ND	0.025	ND	0.0063	
156-60-5	trans-1,2-Dichloroethene	ND	0.025	ND	0.0063	
156-59-2	cis-1,2-Dichloroethene	ND	0.025	ND	0.0063	
107-06-2	1,2-Dichloroethane	ND	0.025	ND	0.0062	
71-55-6	1,1,1-Trichloroethane	ND	0.025	ND	0.0046	
79-01-6	Trichloroethene	ND	0.025	ND	0.0047	
127-18-4	Tetrachloroethene	ND	0.025	ND	0.0037	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P120802-MB

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 8/2/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.025	ND	0.0098	
75-35-4	1,1-Dichloroethene	ND	0.025	ND	0.0063	
156-60-5	trans-1,2-Dichloroethene	ND	0.025	ND	0.0063	
156-59-2	cis-1,2-Dichloroethene	ND	0.025	ND	0.0063	
107-06-2	1,2-Dichloroethane	ND	0.025	ND	0.0062	
71-55-6	1,1,1-Trichloroethane	ND	0.025	ND	0.0046	
79-01-6	Trichloroethene	ND	0.025	ND	0.0047	
127-18-4	Tetrachloroethene	ND	0.025	ND	0.0037	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**
CAS Project ID: P1203080

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 7/24 - 7/26/12
Date(s) Received: 7/27/12
Date(s) Analyzed: 8/1 - 8/2/12

Client Sample ID	CAS Sample ID	1,2-Dichloroethane-d4 % Recovered	Toluene-d8 % Recovered	Bromofluorobenzene % Recovered	Acceptance Limits	Data Qualifier
Method Blank	P120801-MB	**101**	**103**	**97**	70-130	
Method Blank	P120802-MB	**101**	**101**	**97**	70-130	
Lab Control Sample	P120801-LCS	**99**	**99**	**102**	70-130	
Lab Control Sample	P120802-LCS	**100**	**99**	**102**	70-130	
1-AA-1-CON	P1203080-001	**100**	**102**	**100**	70-130	
1-IA-1-CON	P1203080-002	**100**	**101**	**94**	70-130	
1-IA-2-CON	P1203080-003	**100**	**103**	**95**	70-130	
1-SS-1-CON	P1203080-004	**102**	**106**	**91**	70-130	
1-SS-2-CON	P1203080-005	**102**	**105**	**101**	70-130	
1-SS-3-CON	P1203080-006	**100**	**105**	**97**	70-130	
2-AA-1-CON	P1203080-007	**101**	**104**	**100**	70-130	
2-IA-1-CON	P1203080-008	**99**	**100**	**96**	70-130	
2-IA-1-CON	P1203080-008DUP	**100**	**99**	**99**	70-130	
2-SS-1-CON	P1203080-009	**99**	**104**	**90**	70-130	
2-SS-2-CON	P1203080-010	**101**	**103**	**97**	70-130	
2-SS-2-CON	P1203080-010DUP	**101**	**102**	**96**	70-130	
1-IA-3-BL	P1203080-011	**102**	**100**	**91**	70-130	
1-IA-3-PP	P1203080-012	**99**	**101**	**94**	70-130	
2-SS-3-CON-Resample	P1203080-013	**101**	**103**	**95**	70-130	
2-IA-1-BL	P1203080-014	**101**	**102**	**98**	70-130	
2-IA-1-NP	P1203080-015	**100**	**101**	**100**	70-130	
DUP-1	P1203080-016	**99**	**101**	**100**	70-130	
1-IA-3-NP	P1203080-017	**99**	**102**	**92**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

Page 1 of 1

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Lab Control Sample**	CAS Project ID:	P1203080
Client Project ID:	**ESTCP / JBLM Long Center / G-3585 / 3669**	CAS Sample ID:	P120801-LCS
Test Code:	EPA TO-15 SIM	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7	Date Received:	NA
Analyst:	Wida Ang	Date Analyzed:	8/01/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.125 Liter(s)
Test Notes:			

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
75-01-4	Vinyl Chloride	4.00	**3.18**	**80**	56-127	
75-35-4	1,1-Dichloroethene	4.36	**3.52**	**81**	59-131	
156-60-5	trans-1,2-Dichloroethene	4.04	**3.30**	**82**	60-128	
156-59-2	cis-1,2-Dichloroethene	4.28	**3.57**	**83**	62-130	
107-06-2	1,2-Dichloroethane	4.16	**3.41**	**82**	51-140	
71-55-6	1,1,1-Trichloroethane	4.08	**3.39**	**83**	57-132	
79-01-6	Trichloroethene	3.96	**3.33**	**84**	51-127	
127-18-4	Tetrachloroethene	3.80	**3.06**	**81**	58-134	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P120802-LCS

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 8/02/12
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
75-01-4	Vinyl Chloride	4.00	**3.26**	**82**	56-127	
75-35-4	1,1-Dichloroethene	4.36	**3.56**	**82**	59-131	
156-60-5	trans-1,2-Dichloroethene	4.04	**3.35**	**83**	60-128	
156-59-2	cis-1,2-Dichloroethene	4.28	**3.59**	**84**	62-130	
107-06-2	1,2-Dichloroethane	4.16	**3.44**	**83**	51-140	
71-55-6	1,1,1-Trichloroethane	4.08	**3.36**	**82**	57-132	
79-01-6	Trichloroethene	3.96	**3.28**	**83**	51-127	
127-18-4	Tetrachloroethene	3.80	**3.05**	**80**	58-134	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY DUPLICATE SUMMARY RESULTS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **2-IA-1-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-008DUP

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01900

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.57   Final Pressure (psig): 3.69

Canister Dilution Factor: 1.52

CAS #	**Compound**	Sample Result		**Duplicate Sample Result**		Average	**% RPD**	RPD Limit	**Data Qualifier**
		µg/m^3	ppbV	**µg/m^3**	ppbV	µg/m^3			
75-01-4	Vinyl Chloride	ND	ND	ND	ND	-	-	25	
75-35-4	1,1-Dichloroethene	ND	ND	ND	ND	-	-	25	
156-60-5	trans-1,2-Dichloroethene	ND	ND	ND	ND	-	-	25	
156-59-2	cis-1,2-Dichloroethene	ND	ND	ND	ND	-	-	25	
107-06-2	1,2-Dichloroethane	ND	ND	0.0391	0.00965	-	-	25	
71-55-6	1,1,1-Trichloroethane	ND	ND	ND	ND	-	-	25	
79-01-6	Trichloroethene	0.0715	0.0133	0.0714	0.0133	0.07145	**0.1**	25	
127-18-4	Tetrachloroethene	0.240	0.0355	0.264	0.0390	0.252	**10**	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

LABORATORY DUPLICATE SUMMARY RESULTS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **2-SS-2-CON**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**

CAS Project ID: P1203080
CAS Sample ID: P1203080-010DUP

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01190

Date Collected: 7/24/12
Date Received: 7/27/12
Date Analyzed: 8/2/12
Volume(s) Analyzed: 0.50 Liter(s)

Initial Pressure (psig): -0.21
Final Pressure (psig): 3.55

Canister Dilution Factor: 1.26

CAS #	**Compound**	Sample Result µg/m³	Sample Result ppbV	**Duplicate Sample Result µg/m³**	**Duplicate Sample Result** ppbV	Average µg/m³	**% RPD**	RPD Limit	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	ND	ND	ND	-	**-**	25	
75-35-4	1,1-Dichloroethene	ND	ND	ND	ND	-	**-**	25	
156-60-5	trans-1,2-Dichloroethene	ND	ND	ND	ND	-	**-**	25	
156-59-2	cis-1,2-Dichloroethene	ND	ND	ND	ND	-	**-**	25	
107-06-2	1,2-Dichloroethane	0.305	0.0753	0.300	0.0743	0.3025	**2**	25	
71-55-6	1,1,1-Trichloroethane	0.729	0.134	0.693	0.127	0.711	**5**	25	
79-01-6	Trichloroethene	1.79	0.333	1.76	0.327	1.775	**2**	25	
127-18-4	Tetrachloroethene	48.1	7.10	46.0	6.79	47.05	**4**	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669**
CAS Project ID: P1203080

Method Blank Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7
Lab File ID: 08011203.D
Analyst: Wida Ang
Date Analyzed: 8/01/12
Sampling Media: 6.0 L Summa Canister(s)
Time Analyzed: 08:17
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P120801-LCS	08011204.D	08:45
1-SS-1-CON	P1203080-004	08011208.D	11:47
1-SS-2-CON	P1203080-005	08011209.D	12:16
1-SS-3-CON	P1203080-006	08011210.D	12:43
1-AA-1-CON	P1203080-001	08011211.D	13:35
1-IA-1-CON	P1203080-002	08011212.D	14:07
1-IA-2-CON	P1203080-003	08011213.D	14:38
2-AA-1-CON	P1203080-007	08011214.D	15:29
2-IA-1-CON	P1203080-008	08011215.D	16:01
2-IA-1-CON (Lab Duplicate)	P1203080-008DUP	08011216.D	16:33
1-IA-3-BL	P1203080-011	08011218.D	17:32
1-IA-3-PP	P1203080-012	08011219.D	18:04
2-SS-3-CON-Resample	P1203080-013	08011220.D	18:36
2-IA-1-BL	P1203080-014	08011221.D	19:08
2-IA-1-NP	P1203080-015	08011222.D	19:40
DUP-1	P1203080-016	08011223.D	20:11
1-IA-3-NP	P1203080-017	08011224.D	20:44

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669** CAS Project ID: P1203080

Method Blank Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7 Lab File ID: 08021204.D
Analyst: Wida Ang Date Analyzed: 8/02/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 07:58
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P120802-LCS	08021205.D	08:26
2-SS-3-CON-Resample (Dilution)	P1203080-013	08021207.D	11:46
2-SS-1-CON	P1203080-009	08021208.D	12:18
2-SS-2-CON	P1203080-010	08021209.D	12:45
2-SS-2-CON (Lab Duplicate)	P1203080-010DUP	08021212.D	15:43

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669** CAS Project ID: P1203080

Internal Standard Area and RT Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7 Lab File ID: 08011202.D
Analyst: Wida Ang Date Analyzed: 8/1/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 07:28
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	29278		9.33		127514		10.66		28816		13.41	
	Upper Limit	40989		9.66		178520		10.99		40342		13.74	
	Lower Limit	17567		9.00		76508		10.33		17290		13.08	
	Client Sample ID												
01	Method Blank	30845		9.34		123583		10.66		29703		13.42	
02	Lab Control Sample	29936		9.33		130325		10.66		28507		13.41	
03	1-SS-1-CON	31782		9.33		143134		10.66		36766		13.41	
04	1-SS-2-CON	29743		9.32		129710		10.66		31527		13.41	
05	1-SS-3-CON	28554		9.33		126421		10.66		31108		13.41	
06	1-AA-1-CON	32709		9.33		147941		10.66		33323		13.41	
07	1-IA-1-CON	32046		9.33		142804		10.66		34896		13.41	
08	1-IA-2-CON	32257		9.33		144534		10.66		34788		13.41	
09	2-AA-1-CON	33601		9.33		151329		10.66		34469		13.41	
10	2-IA-1-CON	31687		9.33		144397		10.66		34845		13.41	
11	2-IA-1-CON (Lab Duplicate)	31234		9.33		144338		10.66		34069		13.41	
12	1-IA-3-BL	31724		9.33		143826		10.66		36880		13.41	
13	1-IA-3-PP	33066		9.33		149053		10.66		37242		13.41	
14	2-SS-3-CON-Resample	32821		9.33		147700		10.66		36898		13.41	
15	2-IA-1-BL	32378		9.33		146693		10.66		36271		13.41	
16	2-IA-1-NP	31576		9.33		142003		10.66		32886		13.41	
17	DUP-1	32252		9.33		143939		10.66		34688		13.41	
18	1-IA-3-NP	32639		9.33		147075		10.66		36089		13.41	
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits. See case narrative.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP / JBLM Long Center / G-3585 / 3669** CAS Project ID: P1203080

Internal Standard Area and RT Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5973N/HP6890A/MS7 Lab File ID: 08021203.D
Analyst: Wida Ang Date Analyzed: 8/2/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 07:27
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	31051		9.33		138795		10.66		31508		13.41	
	Upper Limit	43471		9.66		194313		10.99		44111		13.74	
	Lower Limit	18631		9.00		83277		10.33		18905		13.08	
	Client Sample ID												
01	Method Blank	30396		9.34		127198		10.66		29705		13.42	
02	Lab Control Sample	31152		9.32		138167		10.66		31140		13.41	
03	2-SS-3-CON-Resample (Dilution)	29546		9.33		125838		10.66		29193		13.41	
04	2-SS-1-CON	30276		9.33		130727		10.66		34933		13.41	
05	2-SS-2-CON	30419		9.32		137865		10.66		33676		13.41	
06	2-SS-2-CON (Lab Duplicate)	33994		9.33		154635		10.66		37520		13.41	
07													
08													
09													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits. See case narrative.

```
                          Response Factor Report  MS07

Method          : J:\Ms07\METHODS\X7071612.M (RTE Integrator)
Title           : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
Last Update     : Tue Jul 17 11:58:51 2012
Response via    : Initial Calibration

Calibration Files
10    =07161214.D  25    =07161205.D  75    =07161206.D   100   =07161207.D  500   =07161208.D
1000  =07161209.D  2500  =07161210.D  9999  =07161211.D   20K   =07161212.D        =

   Compound            10    25    75    100   500   1000  2500  9999  20K         Avg       %RSD
------------------------------------------------------------------------------------------------

 1) I  Bromochloromethan -------------------------ISTD-------------------------------
 2) T  Dichlorodifluorom 4.007 3.453 3.050 4.022 3.319 2.937 2.913 3.349 3.121       3.352      12.48
 3) T  Chloromethane           1.082 0.874 1.136 0.917 0.804 0.707 0.957 0.904       0.923      15.07
 4) T  Vinyl Chloride    3.280 2.535 2.261 3.021 2.481 2.232 2.217 2.589 2.491       2.567      14.17
 5) T  Bromomethane            1.740 1.298 1.745 1.352 1.206 1.148 1.394 1.361       1.406      15.90
 6) T  Chloroethane      1.650 1.297 1.159 1.535 1.248 1.088 1.102 1.273 1.247       1.289      14.69
 7) T  Acetone                             1.628 1.211 1.069 1.070 1.312 1.252       1.257      16.43
 8) T  Trichlorofluorome 3.170 2.700 2.447 3.223 2.677 2.381 2.373 2.761 2.643       2.708      11.49
 9) T  1,1-Dichloroethen 1.528 1.273 1.088 1.465 1.232 1.115 1.123 1.361 1.323       1.279      12.22
10) T  Methylene Chlorid             1.551 1.897 1.513 1.329 1.328 1.544 1.453       1.517      12.69
11) T  Trichlorotrifluor 1.376 1.196 1.021 1.366 1.114 0.992 0.967 1.119 1.058       1.134      13.36
12) T  trans-1,2-Dichlor 1.755 1.383 1.257 1.608 1.368 1.231 1.254 1.510 1.445       1.423      12.42
13) T  1,1-Dichloroethan 3.476 2.901 2.651 3.515 2.964 2.630 2.669 3.231 3.051       3.010      11.30
14) T  Methyl tert-Butyl 4.194 3.455 3.188 4.094 3.673 3.456 3.750 4.886 4.756       3.939      15.00
15) T  cis-1,2-Dichloroe 1.692 1.366 1.289 1.609 1.397 1.288 1.297 1.562 1.497       1.444      10.50
16) T  Chloroform                    2.997 3.582 2.559 2.276 2.272 2.611 2.494       2.684      17.33
17) S  1,2-Dichloroethan 1.905 1.870 1.861 1.883 1.849 1.830 1.843 1.826 1.825       1.855       1.49
18) T  1,2-Dichloroethan 2.749 2.177 2.021 2.642 2.209 1.981 2.001 2.322 2.216       2.258      12.15
19) T  1,1,1-Trichloroet 2.523 2.185 1.967 2.566 2.199 1.969 1.964 2.342 2.240       2.217      10.35
20) T  Benzene                       7.038 7.962 6.010 5.480 5.405 6.269 5.985       6.307      14.42
21) T  Carbon Tetrachlor 1.965 1.693 1.489 1.937 1.633 1.460 1.469 1.782 1.703       1.681      11.32

22) I  1,4-Difluorobenze -------------------------ISTD-------------------------------
23) T  1,2-Dichloropropa 0.477 0.414 0.368 0.486 0.385 0.340 0.332 0.389 0.370       0.396      13.85
24) T  Bromodichlorometh 0.546 0.494 0.433 0.578 0.461 0.405 0.415 0.464 0.451       0.472      12.30
25) T  Trichloroethene   0.397 0.343 0.306 0.402 0.322 0.285 0.284 0.323 0.309       0.330      13.16
26) T  1,4-Dioxane             0.292 0.245 0.281 0.234 0.216 0.225 0.281 0.270       0.255      11.36
27) T  cis-1,3-Dichlorop 0.615 0.500 0.448 0.587 0.507 0.468 0.488 0.593 0.582       0.532      11.68
28) T  trans-1,3-Dichlor 0.537 0.424 0.390 0.492 0.427 0.397 0.416 0.531 0.522       0.460      13.10

(#) = Out of Range  ### Number of calibration levels exceeded format  ###
      X7071612.M      Wed Aug 01 10:29:55 2012                                          Page 1
```

```
                                 Response Factor Report  MS07

   Method        : J:\Ms07\METHODS\X7071612.M (RTE Integrator)
   Title         : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
   Last Update   : Tue Jul 17 11:58:51 2012
   Response via  : Initial Calibration

   Calibration Files
   10   =07161214.D  25   =07161205.D  75   =07161206.D   100  =07161207.D  500  =07161208.D
   1000 =07161209.D  2500 =07161210.D  9999 =07161211.D   20K  =07161212.D       =

      Compound             10    25    75    100   500   1000  2500  9999  20K         Avg        %RSD
 ---------------------------------------------------------------------------------------------------------
 29) T  1,1,2-Trichloroet 0.364 0.324 0.287 0.370 0.291 0.257 0.253 0.292 0.280       0.302       13.99
 30) S  Toluene-d8 (SS2)  1.107 1.143 1.135 1.110 1.066 1.066 1.059 1.048 1.083       1.091        3.15
 31) T  Toluene                 1.599 1.319 1.639 1.310 1.193 1.205 1.417 1.374       1.382       11.95
 32) T  1,2-Dibromoethane 0.469 0.368 0.328 0.423 0.343 0.310 0.312 0.369 0.354       0.364       14.44
 33) T  Tetrachloroethene 0.416 0.371 0.319 0.428 0.333 0.298 0.288 0.333 0.319       0.345       14.37

 34) I  Chlorobenzene-d5  -------------------------ISTD-----------------------------
 35) T  Chlorobenzene     4.884 3.758 3.350 4.301 3.628 3.263 3.307 3.799 3.438       3.748       14.30
 36) T  Ethylbenzene      6.628 5.420 4.898 6.092 5.533 5.291 5.738 7.170 6.511       5.920       12.41
 37) T  m,p-Xylene        4.752 3.863 3.599 4.498 4.493 4.487 4.757 5.880 5.290       4.624       14.78
 38) T  o-Xylene          5.022 4.241 4.017 4.970 5.077 4.836 5.094 6.137 5.540       4.993       12.60
 39) T  1,1,2,2-Tetrachlo 2.897 2.661 2.409 3.057 2.697 2.441 2.457 2.949 2.690       2.695        8.71
 40) S  Bromofluorobenzen 1.682 1.762 1.818 1.826 1.923 1.948 1.863 1.838 1.760       1.825        4.54
 41) T  1,3-Dichlorobenze 3.633 2.580 2.518 3.055 2.837 2.615 2.665 3.203 2.861       2.885       12.50
 42) T  1,4-Dichlorobenze 3.859 2.481 2.438 2.997 2.777 2.573 2.655 3.220 2.882       2.876       15.54
 43) T  1,2-Dichlorobenze 3.609 2.480 2.387 2.900 2.721 2.511 2.560 3.101 2.753       2.780       13.78
 44) T  1,2,4-Trichlorobe       1.529 1.500 1.544 1.543 1.504 1.612 1.978 1.822       1.629       10.78
 45) T  Naphthalene             4.584 4.587 4.521 4.929 5.107 5.841 8.165 7.620       5.669       25.47
 46) T  Hexachlorobutadie 1.264 1.101 1.006 1.132 0.995 0.907 0.940 1.113 1.041       1.055       10.42


 (#) = Out of Range  ### Number of calibration levels exceeded format  ###
        X7071612.M      Wed Aug 01 10:29:56 2012                                                 Page 2
```

```
                 Evaluate Continuing Calibration Report

 Data Path : J:\Ms07\DATA\2012_08\01\
 Data File : 08011202.D
 Acq On    :  1 Aug 2012   7:28
 Operator  : WA
 Sample    : 500pg TO-15 SIM CCV STD (125mL)
 Misc      : S25-07131201/S25-07131206
 ALS Vial  : 16   Sample Multiplier: 1

 Quant Time: Aug 01 10:29:36 2012
 Quant Method : J:\Ms07\METHODS\X7071612.M
 Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
 QLast Update : Tue Jul 17 11:58:51 2012
 Response via : Initial Calibration


 Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
 Max. RRF Dev :  30%     Max. Rel. Area : 200%

       Compound                        AvgRF    CCRF      %Dev Area% Dev(min)
 ----------------------------------------------------------------------------
  1 I    Bromochloromethane (IS1)      1.000    1.000      0.0  118    0.00
  2 T    Dichlorodifluoromethane (CF   3.352    2.886     13.9  103    0.01
  3 T    Chloromethane                 0.923    0.807     12.6  104    0.01
  4 T    Vinyl Chloride                2.567    2.186     14.8  104    0.00
  5 T    Bromomethane                  1.406    1.223     13.0  107    0.00
  6 T    Chloroethane                  1.289    1.115     13.5  106    0.00
  7 T    Acetone                       1.257    1.178      6.3  115    0.00
  8 T    Trichlorofluoromethane        2.708    2.355     13.0  104    0.00
  9 T    1,1-Dichloroethene            1.279    1.119     12.5  107    0.00
 10 T    Methylene Chloride            1.517    1.322     12.9  103    0.00
 11 T    Trichlorotrifluoroethane      1.134    0.977     13.8  104    0.00
 12 T    trans-1,2-Dichloroethene      1.423    1.234     13.3  107    0.00
 13 T    1,1-Dichloroethane            3.010    2.563     14.9  102    0.00
 14 T    Methyl tert-Butyl Ether       3.939    3.489     11.4  112    0.00
 15 T    cis-1,2-Dichloroethene        1.444    1.264     12.5  107    0.00
 16 T    Chloroform                    2.684    2.315     13.7  107    0.00
 17 S    1,2-Dichloroethane-d4 (SS1)   1.855    1.835      1.1  117    0.00
 18 T    1,2-Dichloroethane            2.258    1.951     13.6  104    0.00
 19 T    1,1,1-Trichloroethane         2.217    1.932     12.9  104    0.00
 20 T    Benzene                       6.307    5.309     15.8  105    0.00
 21 T    Carbon Tetrachloride          1.681    1.441     14.3  104    0.00

 22 I    1,4-Difluorobenzene (IS2)     1.000    1.000      0.0  122    0.00
 23 T    1,2-Dichloropropane           0.396    0.331     16.4  105    0.00
 24 T    Bromodichloromethane          0.472    0.389     17.6  103    0.00
 25 T    Trichloroethene               0.330    0.281     14.8  107    0.00
 26 T    1,4-Dioxane                   0.255    0.226     11.4  118    0.00
 27 T    cis-1,3-Dichloropropene       0.532    0.455     14.5  110    0.00
 28 T    trans-1,3-Dichloropropene     0.460    0.383     16.7  110    0.00
 29 T    1,1,2-Trichloroethane         0.302    0.246     18.5  103    0.00
 30 S    Toluene-d8 (SS2)              1.091    1.089      0.2  125    0.00
 31 T    Toluene                       1.382    1.178     14.8  110    0.00
 32 T    1,2-Dibromoethane             0.364    0.297     18.4  106    0.00
 33 T    Tetrachloroethene             0.345    0.293     15.1  108    0.00

 34 I    Chlorobenzene-d5 (IS3)        1.000    1.000      0.0  122    0.00
 35 T    Chlorobenzene                 3.748    3.251     13.3  109    0.00
 36 T    Ethylbenzene                  5.920    5.324     10.1  117    0.00
 37 T    m,p-Xylene                    4.624    4.194      9.3  114    0.00
```

WA 8/1/12

Evaluate Continuing Calibration Report

```
Data Path : J:\Ms07\DATA\2012_08\01\
Data File : 08011202.D
Acq On    :  1 Aug 2012   7:28
Operator  : WA
Sample    : 500pg TO-15 SIM CCV STD (125mL)
Misc      : S25-07131201/S25-07131206
ALS Vial  : 16   Sample Multiplier: 1

Quant Time: Aug 01 10:29:36 2012
Quant Method : J:\Ms07\METHODS\X7071612.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Tue Jul 17 11:58:51 2012
Response via : Initial Calibration


Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%     Max. Rel. Area : 200%

        Compound                         AvgRF    CCRF      %Dev Area% Dev(min)
 ---------------------------------------------------------------------------
38 T    o-Xylene                         4.993    4.569      8.5  110   0.00
39 T    1,1,2,2-Tetrachloroethane        2.695    2.289     15.1  104   0.00
40 S    Bromofluorobenzene (SS3)         1.825    1.904     -4.3  121   0.00
41 T    1,3-Dichlorobenzene              2.885    2.502     13.3  108   0.00
42 T    1,4-Dichlorobenzene              2.876    2.462     14.4  108   0.00
43 T    1,2-Dichlorobenzene              2.780    2.405     13.5  108   0.00
44 T    1,2,4-Trichlorobenzene           1.629    1.455     10.7  115   0.00
45 T    Naphthalene                      5.669    5.612      1.0  139   0.00
46 T    Hexachlorobutadiene              1.055    0.897     15.0  110   0.00
----------------------------------------------------------------------------

   (#) = Out of Range                    SPCC's out = 0  CCC's out = 0
```

WA 8/1/12

```
                  Evaluate Continuing Calibration Report

Data Path : J:\Ms07\DATA\2012_08\02\
Data File : 08021203.D
Acq On    :  2 Aug 2012   7:27
Operator  : WA
Sample    : 500pg TO-15 SIM CCV STD (125mL)
Misc      : S25-07131201/S25-07131206
ALS Vial  : 16   Sample Multiplier: 1

Quant Time: Aug 02 11:07:37 2012
Quant Method : J:\Ms07\METHODS\X7071612.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Tue Jul 17 11:58:51 2012
Response via : Initial Calibration


Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%     Max. Rel. Area : 200%

       Compound                        AvgRF   CCRF      %Dev Area% Dev(min)
----------------------------------------------------------------------------
 1 I    Bromochloromethane (IS1)       1.000   1.000      0.0  125    0.00
 2 T    Dichlorodifluoromethane (CF    3.352   2.915     13.0  110    0.00
 3 T    Chloromethane                  0.923   0.803     13.0  110    0.00
 4 T    Vinyl Chloride                 2.567   2.191     14.6  111    0.00
 5 T    Bromomethane                   1.406   1.219     13.3  113    0.00
 6 T    Chloroethane                   1.289   1.113     13.7  112    0.00
 7 T    Acetone                        1.257   1.196      4.9  124    0.00
 8 T    Trichlorofluoromethane         2.708   2.360     12.9  111    0.00
 9 T    1,1-Dichloroethene             1.279   1.135     11.3  116    0.00
10 T    Methylene Chloride             1.517   1.319     13.1  109    0.00
11 T    Trichlorotrifluoroethane       1.134   0.978     13.8  110    0.00
12 T    trans-1,2-Dichloroethene       1.423   1.235     13.2  113    0.00
13 T    1,1-Dichloroethane             3.010   2.583     14.2  109    0.00
14 T    Methyl tert-Butyl Ether        3.939   3.618      8.1  124    0.00
15 T    cis-1,2-Dichloroethene         1.444   1.265     12.4  114    0.00
16 T    Chloroform                     2.684   2.310     13.9  113    0.00
17 S    1,2-Dichloroethane-d4 (SS1)    1.855   1.847      0.4  125    0.00
18 T    1,2-Dichloroethane             2.258   1.937     14.2  110    0.00
19 T    1,1,1-Trichloroethane          2.217   1.928     13.0  110    0.00
20 T    Benzene                        6.307   5.280     16.3  110    0.00
21 T    Carbon Tetrachloride           1.681   1.442     14.2  111    0.00

22 I    1,4-Difluorobenzene (IS2)      1.000   1.000      0.0  133    0.00
23 T    1,2-Dichloropropane            0.396   0.321     18.9  111    0.00
24 T    Bromodichloromethane           0.472   0.375     20.6  108    0.00
25 T    Trichloroethene                0.330   0.274     17.0  113    0.00
26 T    1,4-Dioxane                    0.255   0.223     12.5  127    0.00
27 T    cis-1,3-Dichloropropene        0.532   0.446     16.2  117    0.00
28 T    trans-1,3-Dichloropropene      0.460   0.382     17.0  119    0.00
29 T    1,1,2-Trichloroethane          0.302   0.241     20.2  110    0.00
30 S    Toluene-d8 (SS2)               1.091   1.099     -0.7  137    0.00
31 T    Toluene                        1.382   1.171     15.3  119    0.00
32 T    1,2-Dibromoethane              0.364   0.293     19.5  114    0.00
33 T    Tetrachloroethene              0.345   0.288     16.5  115    0.00

34 I    Chlorobenzene-d5 (IS3)         1.000   1.000      0.0  133    0.00
35 T    Chlorobenzene                  3.748   3.185     15.0  117    0.00
36 T    Ethylbenzene                   5.920   5.286     10.7  127    0.00
37 T    m,p-Xylene                     4.624   4.179      9.6  124    0.00
```

DA 8/2/12

Evaluate Continuing Calibration Report

```
Data Path : J:\Ms07\DATA\2012_08\02\
Data File : 08021203.D
Acq On    :  2 Aug 2012   7:27
Operator  : WA
Sample    : 500pg TO-15 SIM CCV STD (125mL)
Misc      : S25-07131201/S25-07131206
ALS Vial  : 16   Sample Multiplier: 1

Quant Time: Aug 02 11:07:37 2012
Quant Method : J:\Ms07\METHODS\X7071612.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Tue Jul 17 11:58:51 2012
Response via : Initial Calibration


Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%     Max. Rel. Area : 200%

       Compound                              AvgRF    CCRF       %Dev Area% Dev(min)
 -------------------------------------------------------------------------------
38 T    o-Xylene                             4.993    4.534        9.2  119    0.00
39 T    1,1,2,2-Tetrachloroethane            2.695    2.213       17.9  109    0.00
40 S    Bromofluorobenzene (SS3)             1.825    1.881       -3.1  130    0.00
41 T    1,3-Dichlorobenzene                  2.885    2.432       15.7  114    0.00
42 T    1,4-Dichlorobenzene                  2.876    2.419       15.9  116    0.00
43 T    1,2-Dichlorobenzene                  2.780    2.345       15.6  115    0.00
44 T    1,2,4-Trichlorobenzene               1.629    1.433       12.0  124    0.00
45 T    Naphthalene                          5.669    5.671       -0.0  153    0.00
46 T    Hexachlorobutadiene                  1.055    0.878       16.8  118    0.00
--------------------------------------------------------------------------------

   (#) = Out of Range                   SPCC's out = 0  CCC's out = 0
```

WA 8/2/12

Radon Analysis (EPA Method GS: Grab Sample/Scintillation Cell counting)

For GSI Environmental

Samples Collected by: T. McHugh/L. Beckley

Site: Tacoma, WA

Analysts: Doug Hammond

Phone: 310-490-7896

email: dhammond@usc.edu

Client Project Number: G-3669, 3585

Sample Dates: 07/25/2012, 7/26/12

Sample containers: Tedlar bags w/ nylon fittings

Assumed Site Pressure **1.00** atm

based on an elevation of 250 ft

Time Zone adjustment: add to decay time

0 hours

Collect (PDT)

Run (PDT)

	Summary	Collection		Analysis					Lab Duplicates		
		Date	time (PDT)	Date	time (PDT)	Vol run (cc)	Conc. pCi/L	±1 sig pCi/L	mean pCi/L	±1ssd pCi/L	Notes
Received 07/26/12, from ESTCP (Project G-3669)											
1	1-IA-3-BL	7/25/12	8:51	7/26/12	17:05	60	0.36	0.11			
2	1-IA-3-NP	7/25/12	11:06	7/26/12	17:02	120	0.20	0.06			
3	1-IA-3-PP	7/25/12	9:55	7/26/12	16:59	120	0.30	0.07			
4	1-AA-1	7/25/12	9:25	7/26/12	16:56	120	0.01	0.05			
Received 7/27/12, from JBLM (Project 3585)											
5	2-IA-1-NP	7/26/12	10:15	7/27/12	18:22	120	0.12	0.02			more precise
	lab dupe	7/26/12	10:15	7/30/12	10:37	120	0.23	0.11			less precise
6	Dup-1	7/26/12	10:15	7/27/12	18:30	60	0.10	0.04			
7	2-IA-1-BL	7/26/12	8:36	7/27/12	18:18	120	0.09	0.03			
8	2-AA-1	7/26/12	8:45	7/27/12	18:26	120	0.09	0.03			

Uncertainty given in pCi/liter is based on counting statistics for low activity samples. For high activity samples uncertainty is ±5%.

The Lower Limit of Detection for Rn (95% confidence level as recommended by EPA 402-R-95-012, Oct. 97) is 0.14 pCi/liter.

Results are reported based on standardization with NIST-traceable radon sources.

These results are for application of naturally-occurring radon as a tracer of soil vapor intrusion, but are not intended for evaluation of radon hazards.

Note Details:

Results corrected to in situ pressure as noted above

Raw Data, Calculation factors, and Analytical Details

	Sample ID	Collection Date	Time (PDT)	Analysis Date	Time (PDT)	Count in cell/ch	He eff	Air/He eff	Vol run (cc)	Press factor	obs dpm	sig dpm	Decay T (hours)	Decay factor	Concentration dpm/liter	pCi/liter	count stats pCi/liter ±1 sig	Notes
Received 07/26/12, from ESTCP (Project G-3669)																		
1	1-IA-3-BL	7/25/12	8:51	7/26/12	17:05	76/22	0.902	0.98	60	1.00	0.033	0.010	32.2	1.276	0.79	0.36	0.11	
2	1-IA-3-NP	7/25/12	11:06	7/26/12	17:02	84/11	0.785	0.95	120	1.00	0.032	0.010	29.9	1.254	0.45	0.20	0.06	
3	1-IA-3-PP	7/25/12	9:55	7/26/12	16:59	83/33	0.806	0.95	120	1.00	0.049	0.011	31.1	1.265	0.67	0.30	0.07	
4	1-AA-1	7/25/12	9:25	7/26/12	16:56	82/32	0.743	0.95	120	1.00	0.002	0.007	31.5	1.269	0.03	0.01	0.05	
Received 7/27/12, from JBLM (Project 3585)																		
5	2-IA-1-NP	7/26/12	10:15	7/27/12	18:22	81/31	0.818	0.95	120	1.00	0.019	0.004	32.1	1.275	0.26	0.12	0.02	
	lab dupe	7/26/12	10:15	7/30/12	10:37	82/32	0.743	0.95	120	1.00	0.021	0.010	96.4	2.071	0.51	0.23	0.11	
6	Dup-1	7/26/12	10:15	7/27/12	18:30	76/22	0.902	0.98	60	1.00	0.009	0.004	32.3	1.276	0.22	0.10	0.04	
7	2-IA-1-BL	7/26/12	8:36	7/27/12	18:18	82/32	0.743	0.95	120	1.00	0.013	0.004	33.7	1.290	0.20	0.09	0.03	
8	2-AA-1	7/26/12	8:45	7/27/12	18:26	83/33	0.806	0.95	120	1.00	0.014	0.004	33.7	1.290	0.20	0.09	0.03	

Decay correctiions based on Rn decay constant of 0.1813 per day

Conversion from dpm based on 0.4504 pCi/dpm

Radon Conc = {(0.4504)(1000)(obs dpm)(decay factor)(Press factor)}/{(cc used)(He eff)(Air/He)}
(in pCi/liter)

Blanks are negligible.

Definitions:

Cell/ch:	Counting cell and channel used	sig dpm	uncertainty (± 1 sig) in dpm based on counting statistics
He eff:	Cell and counter efficiency using helium matrix	Decay T:	time elapsed from sampling to analysis
Air/He:	Correction for matrix counting gas density	Decay factor:	Correction factor for decay from collection to analysis
Sample vol:	Volume analyzed (cc)	dpm/liter:	Radon concentration in disintigrations per minute per liter of sample
Press factor:	Correction to in situ pressure based on collection altitude	piC/liter:	Radon concentration in picoCuries per liter
obs dpm:	observed radon activity (disintigrations per minute) when analyzed	count stats:	uncertainty in observed radon based on counting statistics

Columbia Analytical Services
2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page ______ of ______

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

~~CAS Project No.~~ n/a

~~CAS Contact:~~ Doug Hammond

Company Name & Address (Reporting Information)
GSI Environmental
2211 Norfolk Ste 1000
Houston TX 77098

Project Name: ESTCP

Project Number: G-3669

Project Manager: T. McHugh / L. Beckley

P.O. # / Billing Information: G-3669

Phone: 713 367-4775

Fax:

Email Address for Result Reporting: temchugh@gsi-net.com/ lnbeckley@gsi-net.com

Sampler (Print & Sign): TEM/TTT

Analysis Method/Analytes: Radon

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Sample Type (Air/Tube/ Solid)	~~Canister ID (Bar code # - AC, SC, etc.)~~	container ~~Flow Controller (Bar code - FC #)~~	Sample Volume	Radon			Comments e.g. Actual Preservative or specific instruction
1-IA-3-BL		7/25/12	0851	Air		1-L Tedlar	500 mL	✓			
1-IA-3-NP		7/25/12	~~1000~~ 1106	Air			500 mL	✓			collected 1106
1-IA-3-PP		7/25/12	0955	Air			500 mL	✓			
1-AA-1		7/25/12	0925	Air			500 mL	✓			

Report Tier Levels - please select
Tier I - (Results/Default if not specified) ____
Tier II (Results + QC) ____
Tier III (Data Validation Package) 10% Surcharge ____
Tier V (client specified) ____

EDD required Yes / No
Type: ____
EDD Units: pCi/L

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	7/25/12	1700		7/26/12	1600
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature n/a

Columbia Analytical Services

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No.

CAS Contact:

Company Name & Address (Reporting Information)
GSI Environmental, Inc
2211 Norfolk, Suite 1000
Houston, TX 77098

Project Manager: Tom McHugh

Phone: 512-346-4464

Fax:

Email Address for Result Reporting: TEM@gsi-net.com

Project Name: JBLM IA Investigation

Project Number: 3585

P.O. # / Billing Information: 3585

Sampler (Print & Sign): Ty Tr

Analysis Method

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	~~Canister~~ End Pressure ~~"Hg/psig~~ Container Size (L)	Sample Volume (ml)	Radon		Comments e.g. Actual Preservative or specific instructions
2-IA-1-NP		7/26/12	1015				1	500	X	✓	
Dup-1							1	500	↓	✓	
2-IA-1-BL		7/26/12	0836				1	500		✓	
2-AA-1		7/26/12	0845				1	500		✓	

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required [✓ Yes] / No
Type: pCi/L

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date: 7/26/12	Time: 1200	Received by: (Signature)	Date: 7/27/12	Time: 1600
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____°C

Summary: Averages

	δ13C TCE (VPDB)	δ37Cl TCE (SMOC)
LC-18	-23.3	2.5
LC-48	-23.8	2.1
MT-1	-22.9	2.6
DUP-1	-23.6	2.4
1-IA-1-CSI	-25.9	2.0
1-SS-2-CSI	-18.5	5.8
3-SS-2-CSI	-18.8	5.5

Replicates and standards

Water samples

Run #	Sample ID	volume (ul)	δ13C TCE (VPDB)
6415	LC-18	4500	-23.3
6416	LC-48	2300	-23.9
6420	LC-48	2363	-23.7
6417	MT-1	2600	-22.7
6419	MT-1	5629	-23.2
6418	DUP-1	5000	-23.6

Run #	Standard ID	δ13C TCE (VPDB)
6414	Aqueous TCE	-30.65
6422	Aqueous TCE	-30.95
	stdev	0.2

Run #	Sample ID	volume (ul)	δ37Cl TCE (SMOC)
2910	LC-18	1270	2.5
2909	LC-48	547	2.0
2911	LC-48	500	2.1
2908	MT-1	1530	2.7
2912	MT-1	1525	2.6
2907	DUP-1	1250	2.4

Run #	Sample ID	δ37Cl TCE (SMOC)
2897	Aqueous TCE	3.5
2898	Aqueous TCE	3.6
2900	Aqueous TCE	3.3
2905	Aqueous TCE	3.5
2913	Aqueous TCE	2.6
	stdev	0.4

Vapor samples

Run #	Sample ID	Tube #	δ13C TCE (VPDB)	
8959	1-IA-1-CSI	C16_K08436	-25.9	see Note 1
8957	1-SS-2-CSI	C16_K08430	-18.2	
8960	1-SS-2-CSI	C16_J06979	-18.8	
8958	3-SS-2-CSI	C16_J03697	-18.8	

Run #	Standard ID	Tube #	δ13C TCE (VPDB)
8956	Vapor TCE	C16_K08457	-31.0
8961	Vapor TCE	C16_K08440	-30.6
8955	Vapor TCE	C16_J03150	-30.9
		stdev	0.2

Run #	Sample ID	Tube #	δ37Cl TCE (SMOC)
2926	1-IA-1-CSI	C16_K08451	2.0
2923	1-SS-2-CSI	C16_K08411	5.8
2924	3-SS-2-CSI	C16_J03143	5.5
2928	3-SS-2-CSI	C16_J06645	5.6

Run #	Standard ID	Tube #	δ37Cl TCE (SMOC)
2922	STD	C16_J06695	3.1
2925	STD	C16_J04853	3.3
2927	STD	C16_J03770	3.8
2929	STD	C16_J03146	3.2
2930	STD	C16_J07356	3.1
		stdev	0.3

Note 1: limited coelution, the reported value is biased by 1-2 permil (i.e., the reported number is more negative than a true number)

Received by GSI, 3 May 2013
Results of additional analyses of JBLM samples:

OU#613 TCE, C CSIA

Dup = split of the sample recollected on Cx1016
all tube numbers refer to the original samples collected in the field
analytical uncertainty defined by the standards: Aug-12 ± 0.4 (2 stdevs at n=4); Oct-12 ± 0.6 (2 stdevs at n=7); April-13 ± 0.4 (2 stdevs at n=10)

run #	date analyzed	sample ID	original airtube #	del TCE VPDB	remarks
8959	8/27/2012	1-IA-1-CSI	C16_K08436	-25.9	limited coelution, the reported number may be biased by 1-2 permil
9071	10/22/2012	1-IA-1-CSI	C16_J07242	peak coelutes	
9480	4/17/2013	1-IA-1-CSI	C16_J03141	-26.0	
9483	4/17/2013	Dup 1-IA-1-CSI	C16_J03141	-26.4	split of run #9480
8957	8/27/2012	1-SS-2-CSI	C16_K08430	-18.2	
8960	8/27/2012	1-SS-2-CSI	C16_J06979	-18.8	
9069	10/22/2012	1-SS-2-CSI	C16_J07342	no peak	
9482	4/17/2013	Dup 1-SS-2-CSI	C16_J07342	no peak	split of run #9069
8958	8/27/2012	3-SS-2-CSI	C16_J03697	-18.8	
9068	10/22/2012	3-SS-2-CSI	C16_J03553	-19.5	
9481	4/17/2013	Dup 3-SS-2-CSI	C16_J03553	-18.8	split of run #9068

Selfridge Air National Guard Base, Michigan

Columbia Analytical Services INC
Now part of the ALS Group
2655 Park Center Drive, Suite A, Simi Valley, CA 93065 | 805.526.7161 | www.caslab.com

LABORATORY REPORT

October 11, 2012

Tom McHugh
GSI Environmental Inc.
2211 Norfolk, Suite 1000
Houston, TX 77098

RE: ESTCP CSIA / 0SA Demonstration / 3585/3669

Dear Tom:

Your CAS report number P1203938 has been amended for the samples submitted to our laboratory on September 25, 2012. Sample Indoor-1-PP (P1203938-007) was re-run and a larger volume injected and the data has been added to the original report. The additional data pages have been indicated by the “Added Page” footer located at the bottom right of the page.

All analyses were performed according to our laboratory’s NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA200007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L11-203; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-12-3; Minnesota Department of Health, NELAP Certificate No. 362188; Washington State Department of Ecology, ELAP Lab ID: C946, State of Utah Department of Health, NELAP Certificate No. CA01527Z012-Z; Los Angeles Department of Building and Safety, Approval No: TA00001. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Sue Anderson
Digitally Signed By Sue Anderson at 1:26 pm, Oct 11, 2012

Sue Anderson
Project Manager

Client: GSI Environmental Inc. Service Request No: P1203938
Project: ESTCP CSIA / 0SA Demonstration / 3585/3669

CASE NARRATIVE

The samples were received intact under chain of custody on September 25, 2012 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Volatile Organic Compound Analysis

The samples were analyzed for volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of Columbia Analytical Services, Inc. dba ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to AALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

DETAIL SUMMARY REPORT

Client: GSI Environmental Inc. Service Request: P1203938
Project ID: ESTCP CSIA / 0SA Demonstration / 3585/3669

Date Received: 9/25/2012
Time Received: 09:35

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-15 - VOC Cans
Indoor-C1	P1203938-001	Air	9/18/2012	16:30	AS00243	-3.20	3.58	X
Outdoor-C1	P1203938-002	Air	9/18/2012	16:30	AC01931	-2.16	3.60	X
SS-1C	P1203938-003	Air	9/18/2012	13:20	AC00942	-0.73	3.53	X
SS-2C	P1203938-004	Air	9/18/2012	13:40	AC00977	-0.30	3.54	X
SS-3C	P1203938-005	Air	9/18/2012	13:55	AC01198	-1.53	3.50	X
Indoor-1-BL	P1203938-006	Air	9/19/2012	11:12	AS00228	0.02	3.61	X
Indoor-1-PP	P1203938-007	Air	9/19/2012	14:13	AC00376	-0.05	3.51	X
Indoor-1-NP	P1203938-008	Air	9/19/2012	16:40	AC01877	-0.02	4.36	X
Dup 1	P1203938-009	Air	9/19/2012	00:00	AC00745	-0.03	3.59	X

Columbia Analytical Services

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

SSC

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1203938

CAS Contact: Sue Anderson

Company Name & Address (Reporting Information)
GSI Environmental
2211 Norfolk Suite 1050
Houston TX ~~787~~ 77098

Project Name: ESTCP CSIA/OSA Demonstration

Project Number: 3585/3669

Project Manager: Tom McHugh/Lila Beckley

P.O. # / Billing Information:

Phone: 713 522 6300

Fax:

Email Address for Result Reporting: temchugh@gsi-net.com, lmbeckley@gsi-net.com

Sampler (Print & Sign): TEM/LMB

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method TO-15 Scan		Comments e.g. Actual Preservative or specific instructions
Indoor-C1	① -3.19	9/18/2012	0835-1630	AS00243	FCA00515	-29	-6.2	6L	✓		Hold cans
Outdoor-C1	② -2.16	9/18/2012	0835-1630	AC01931	FCA00392	-29	-4.5	6L			after TO-15 for
SS-1C	③ -0.71	9/18/2012	1320	AC00942	—	-28.8	-0.4	6L			possible add'l
SS-2C	④ -0.26	9/18/2012	1340	AC00977	—	-29.1	0	6L			analysis.
SS-3C	⑤ -1.50	9/18/2012	1355	AC01198	—	-29.2	-25	6L			
Indoor-1-BL	⑥ +0.02	9/19/2012	1112	AS00228	—	-29.2	0	6L			
Indoor-1-PP	⑦ -0.06	9/19/2012	1413	AC00376	—	-29.2	0	6L			
Indoor-1-NP	⑧ -0.06	9/19/2012	1640	AC01877	—	-29	0	6L			
Dup 1	⑨ -0.11 -14.53			AC00745	—	-29	0	6L			
1 returned can											

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ✓
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required [✓ Yes] / No
Type: µg/m3

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature) LM Beckley Date: 9/19/12 Time: 1800
Received by: (Signature) Date: 9/21/12 Time: 0935
Relinquished by: (Signature) Date: Time:
Received by: (Signature) Date: Time:

Cooler / Blank Temperature ____°C

COC AIR REV 3-11

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Sample Acceptance Check Form

Client: GSI Environmental Inc. Work order: P1203938
Project: ESTCP CSIA / 0SA Demonstration / 3585/3669
Sample(s) received on: 9/25/12 Date opened: 9/25/12 by: MZAMORA

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by CAS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☐	☒	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1203938-001.01	6.0 L Silonite Can					
P1203938-002.01	6.0 L Ambient Can					
P1203938-003.01	6.0 L Ambient Can					
P1203938-004.01	6.0 L Ambient Can					
P1203938-005.01	6.0 L Ambient Can					
P1203938-006.01	6.0 L Silonite Can					
P1203938-007.01	6.0 L Ambient Can					
P1203938-008.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

Sample -002 has an ID of (Outdoor-C1) on the COC, and (Ambient-C1) on the canister tag.

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

Sample Acceptance Check Form

Client: GSI Environmental Inc.
Work order: P1203938
Project: ESTCP CSIA / 0SA Demonstration / 3585/3669
Sample(s) received on: 9/25/12
Date opened: 9/25/12
by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1203938-009.01	6.0 L Ambient Can					
P1203938-010.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-C1**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-001

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AS00243

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.014 Liter(s)

Initial Pressure (psig): -3.20 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.59

CAS #	**Compound**	**Result** µg/m^3	MRL µg/m^3	**Result ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	ND	57	ND	33	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	57	ND	11	
74-87-3	Chloromethane	ND	23	ND	11	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	57	ND	8.1	
75-01-4	Vinyl Chloride	ND	11	ND	4.4	
106-99-0	1,3-Butadiene	ND	23	ND	10	
74-83-9	Bromomethane	ND	11	ND	2.9	
75-00-3	Chloroethane	ND	11	ND	4.3	
64-17-5	Ethanol	ND	570	ND	300	
75-05-8	Acetonitrile	ND	57	ND	34	
107-02-8	Acrolein	ND	230	ND	99	
67-64-1	Acetone	**54,000**	570	**23,000**	240	
75-69-4	Trichlorofluoromethane	ND	11	ND	2.0	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	570	ND	230	
107-13-1	Acrylonitrile	ND	57	ND	26	
75-35-4	1,1-Dichloroethene	ND	11	ND	2.9	
75-09-2	Methylene Chloride	ND	57	ND	16	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	11	ND	3.6	
76-13-1	Trichlorotrifluoroethane	ND	11	ND	1.5	
75-15-0	Carbon Disulfide	ND	570	ND	180	
156-60-5	trans-1,2-Dichloroethene	ND	11	ND	2.9	
75-34-3	1,1-Dichloroethane	ND	11	ND	2.8	
1634-04-4	Methyl tert-Butyl Ether	ND	11	ND	3.2	
108-05-4	Vinyl Acetate	ND	570	ND	160	
78-93-3	2-Butanone (MEK)	ND	570	ND	190	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 2 of 3

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Indoor-C1**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-001
Test Code:	EPA TO-15	Date Collected:	9/18/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.014 Liter(s)
Test Notes:			
Container ID:	AS00243		

Initial Pressure (psig): -3.20 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.59

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	11	ND	2.9	
141-78-6	Ethyl Acetate	ND	110	ND	32	
110-54-3	n-Hexane	**240**	57	**67**	16	
67-66-3	Chloroform	ND	11	ND	2.3	
109-99-9	Tetrahydrofuran (THF)	ND	57	ND	19	
107-06-2	1,2-Dichloroethane	ND	11	ND	2.8	
71-55-6	1,1,1-Trichloroethane	ND	11	ND	2.1	
71-43-2	Benzene	**14**	11	**4.4**	3.6	
56-23-5	Carbon Tetrachloride	ND	11	ND	1.8	
110-82-7	Cyclohexane	ND	110	ND	33	
78-87-5	1,2-Dichloropropane	ND	11	ND	2.5	
75-27-4	Bromodichloromethane	ND	11	ND	1.7	
79-01-6	Trichloroethene	**48**	11	**9.0**	2.1	
123-91-1	1,4-Dioxane	ND	57	ND	16	
80-62-6	Methyl Methacrylate	ND	110	ND	28	
142-82-5	n-Heptane	**5,700**	57	**1,400**	14	
10061-01-5	cis-1,3-Dichloropropene	ND	57	ND	13	
108-10-1	4-Methyl-2-pentanone	ND	57	ND	14	
10061-02-6	trans-1,3-Dichloropropene	ND	57	ND	13	
79-00-5	1,1,2-Trichloroethane	ND	11	ND	2.1	
108-88-3	Toluene	ND	57	ND	15	
591-78-6	2-Hexanone	ND	57	ND	14	
124-48-1	Dibromochloromethane	ND	11	ND	1.3	
106-93-4	1,2-Dibromoethane	ND	11	ND	1.5	
123-86-4	n-Butyl Acetate	ND	57	ND	12	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 3 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-C1**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-001

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AS00243

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.014 Liter(s)

Initial Pressure (psig): -3.20 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.59

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
111-65-9	n-Octane	ND	57	ND	12	
127-18-4	Tetrachloroethene	ND	11	ND	1.7	
108-90-7	Chlorobenzene	ND	11	ND	2.5	
100-41-4	Ethylbenzene	ND	57	ND	13	
179601-23-1	m,p-Xylenes	ND	57	ND	13	
75-25-2	Bromoform	ND	57	ND	5.5	
100-42-5	Styrene	ND	57	ND	13	
95-47-6	o-Xylene	ND	57	ND	13	
111-84-2	n-Nonane	ND	57	ND	11	
79-34-5	1,1,2,2-Tetrachloroethane	ND	11	ND	1.7	
98-82-8	Cumene	ND	57	ND	12	
80-56-8	alpha-Pinene	ND	57	ND	10	
103-65-1	n-Propylbenzene	ND	57	ND	12	
622-96-8	4-Ethyltoluene	ND	57	ND	12	
108-67-8	1,3,5-Trimethylbenzene	ND	57	ND	12	
95-63-6	1,2,4-Trimethylbenzene	ND	57	ND	12	
100-44-7	Benzyl Chloride	ND	57	ND	11	
541-73-1	1,3-Dichlorobenzene	ND	11	ND	1.9	
106-46-7	1,4-Dichlorobenzene	ND	11	ND	1.9	
95-50-1	1,2-Dichlorobenzene	ND	11	ND	1.9	
5989-27-5	d-Limonene	ND	57	ND	10	
96-12-8	1,2-Dibromo-3-chloropropane	ND	57	ND	5.9	
120-82-1	1,2,4-Trichlorobenzene	ND	57	ND	7.7	
91-20-3	Naphthalene	ND	57	ND	11	
87-68-3	Hexachlorobutadiene	ND	57	ND	5.3	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Outdoor-C1**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-002
Test Code:	EPA TO-15	Date Collected:	9/18/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AC01931		

Initial Pressure (psig): -2.16 Final Pressure (psig): 3.60

Canister Dilution Factor: 1.46

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	**4.8**	0.73	**2.8**	0.42	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.2**	0.73	**0.44**	0.15	
74-87-3	Chloromethane	**0.37**	0.29	**0.18**	0.14	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.73	ND	0.10	
75-01-4	Vinyl Chloride	ND	0.15	ND	0.057	
106-99-0	1,3-Butadiene	ND	0.29	ND	0.13	
74-83-9	Bromomethane	ND	0.15	ND	0.038	
75-00-3	Chloroethane	ND	0.15	ND	0.055	
64-17-5	Ethanol	ND	7.3	ND	3.9	
75-05-8	Acetonitrile	ND	0.73	ND	0.43	
107-02-8	Acrolein	ND	2.9	ND	1.3	
67-64-1	Acetone	**14**	7.3	**6.1**	3.1	
75-69-4	Trichlorofluoromethane	**1.2**	0.15	**0.21**	0.026	
67-63-0	2-Propanol (Isopropyl Alcohol)	**14**	7.3	**5.6**	3.0	
107-13-1	Acrylonitrile	ND	0.73	ND	0.34	
75-35-4	1,1-Dichloroethene	ND	0.15	ND	0.037	
75-09-2	Methylene Chloride	ND	0.73	ND	0.21	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.15	ND	0.047	
76-13-1	Trichlorotrifluoroethane	**0.48**	0.15	**0.063**	0.019	
75-15-0	Carbon Disulfide	ND	7.3	ND	2.3	
156-60-5	trans-1,2-Dichloroethene	ND	0.15	ND	0.037	
75-34-3	1,1-Dichloroethane	ND	0.15	ND	0.036	
1634-04-4	Methyl tert-Butyl Ether	ND	0.15	ND	0.041	
108-05-4	Vinyl Acetate	ND	7.3	ND	2.1	
78-93-3	2-Butanone (MEK)	ND	7.3	ND	2.5	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Outdoor-C1** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P1203938-002

Test Code: EPA TO-15 Date Collected: 9/18/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 9/25/12
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01931

Initial Pressure (psig): -2.16 Final Pressure (psig): 3.60

Canister Dilution Factor: 1.46

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	0.15	ND	0.037	
141-78-6	Ethyl Acetate	**3.1**	1.5	**0.86**	0.41	
110-54-3	n-Hexane	ND	0.73	ND	0.21	
67-66-3	Chloroform	ND	0.15	ND	0.030	
109-99-9	Tetrahydrofuran (THF)	ND	0.73	ND	0.25	
107-06-2	1,2-Dichloroethane	ND	0.15	ND	0.036	
71-55-6	1,1,1-Trichloroethane	ND	0.15	ND	0.027	
71-43-2	Benzene	**0.27**	0.15	**0.086**	0.046	
56-23-5	Carbon Tetrachloride	**0.48**	0.15	**0.077**	0.023	
110-82-7	Cyclohexane	ND	1.5	ND	0.42	
78-87-5	1,2-Dichloropropane	ND	0.15	ND	0.032	
75-27-4	Bromodichloromethane	ND	0.15	ND	0.022	
79-01-6	Trichloroethene	**0.30**	0.15	**0.055**	0.027	
123-91-1	1,4-Dioxane	ND	0.73	ND	0.20	
80-62-6	Methyl Methacrylate	ND	1.5	ND	0.36	
142-82-5	n-Heptane	**0.91**	0.73	**0.22**	0.18	
10061-01-5	cis-1,3-Dichloropropene	ND	0.73	ND	0.16	
108-10-1	4-Methyl-2-pentanone	ND	0.73	ND	0.18	
10061-02-6	trans-1,3-Dichloropropene	ND	0.73	ND	0.16	
79-00-5	1,1,2-Trichloroethane	ND	0.15	ND	0.027	
108-88-3	Toluene	**1.2**	0.73	**0.32**	0.19	
591-78-6	2-Hexanone	ND	0.73	ND	0.18	
124-48-1	Dibromochloromethane	ND	0.15	ND	0.017	
106-93-4	1,2-Dibromoethane	ND	0.15	ND	0.019	
123-86-4	n-Butyl Acetate	ND	0.73	ND	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Outdoor-C1**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-002

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01931

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.16 Final Pressure (psig): 3.60

Canister Dilution Factor: 1.46

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	ND	0.73	ND	0.16	
127-18-4	Tetrachloroethene	**0.52**	0.15	**0.077**	0.022	
108-90-7	Chlorobenzene	ND	0.15	ND	0.032	
100-41-4	Ethylbenzene	ND	0.73	ND	0.17	
179601-23-1	m,p-Xylenes	ND	0.73	ND	0.17	
75-25-2	Bromoform	ND	0.73	ND	0.071	
100-42-5	Styrene	ND	0.73	ND	0.17	
95-47-6	o-Xylene	ND	0.73	ND	0.17	
111-84-2	n-Nonane	ND	0.73	ND	0.14	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.15	ND	0.021	
98-82-8	Cumene	ND	0.73	ND	0.15	
80-56-8	alpha-Pinene	ND	0.73	ND	0.13	
103-65-1	n-Propylbenzene	ND	0.73	ND	0.15	
622-96-8	4-Ethyltoluene	ND	0.73	ND	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.73	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	ND	0.73	ND	0.15	
100-44-7	Benzyl Chloride	ND	0.73	ND	0.14	
541-73-1	1,3-Dichlorobenzene	ND	0.15	ND	0.024	
106-46-7	1,4-Dichlorobenzene	ND	0.15	ND	0.024	
95-50-1	1,2-Dichlorobenzene	ND	0.15	ND	0.024	
5989-27-5	d-Limonene	ND	0.73	ND	0.13	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.73	ND	0.076	
120-82-1	1,2,4-Trichlorobenzene	ND	0.73	ND	0.098	
91-20-3	Naphthalene	ND	0.73	ND	0.14	
87-68-3	Hexachlorobutadiene	ND	0.73	ND	0.068	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**SS-1C**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-003
Test Code:	EPA TO-15	Date Collected:	9/18/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.014 Liter(s)
Test Notes:			
Container ID:	AC00942		

Initial Pressure (psig): -0.73 Final Pressure (psig): 3.53

Canister Dilution Factor: 1.30

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
115-07-1	Propene	ND	46	ND	27	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	46	ND	9.4	
74-87-3	Chloromethane	ND	19	ND	9.0	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	46	ND	6.6	
75-01-4	Vinyl Chloride	ND	9.3	ND	3.6	
106-99-0	1,3-Butadiene	ND	19	ND	8.4	
74-83-9	Bromomethane	ND	9.3	ND	2.4	
75-00-3	Chloroethane	ND	9.3	ND	3.5	
64-17-5	Ethanol	ND	460	ND	250	
75-05-8	Acetonitrile	ND	46	ND	28	
107-02-8	Acrolein	ND	190	ND	81	
67-64-1	Acetone	**510**	460	**220**	200	
75-69-4	Trichlorofluoromethane	ND	9.3	ND	1.7	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	460	ND	190	
107-13-1	Acrylonitrile	ND	46	ND	21	
75-35-4	1,1-Dichloroethene	ND	9.3	ND	2.3	
75-09-2	Methylene Chloride	ND	46	ND	13	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	9.3	ND	3.0	
76-13-1	Trichlorotrifluoroethane	ND	9.3	ND	1.2	
75-15-0	Carbon Disulfide	ND	460	ND	150	
156-60-5	trans-1,2-Dichloroethene	ND	9.3	ND	2.3	
75-34-3	1,1-Dichloroethane	ND	9.3	ND	2.3	
1634-04-4	Methyl tert-Butyl Ether	ND	9.3	ND	2.6	
108-05-4	Vinyl Acetate	ND	460	ND	130	
78-93-3	2-Butanone (MEK)	ND	460	ND	160	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **SS-1C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-003

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00942

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.014 Liter(s)

Initial Pressure (psig): -0.73 Final Pressure (psig): 3.53

Canister Dilution Factor: 1.30

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	9.3	ND	2.3	
141-78-6	Ethyl Acetate	ND	93	ND	26	
110-54-3	n-Hexane	ND	46	ND	13	
67-66-3	Chloroform	ND	9.3	ND	1.9	
109-99-9	Tetrahydrofuran (THF)	ND	46	ND	16	
107-06-2	1,2-Dichloroethane	ND	9.3	ND	2.3	
71-55-6	1,1,1-Trichloroethane	ND	9.3	ND	1.7	
71-43-2	Benzene	ND	9.3	ND	2.9	
56-23-5	Carbon Tetrachloride	ND	9.3	ND	1.5	
110-82-7	Cyclohexane	ND	93	ND	27	
78-87-5	1,2-Dichloropropane	ND	9.3	ND	2.0	
75-27-4	Bromodichloromethane	ND	9.3	ND	1.4	
79-01-6	Trichloroethene	**9.4**	9.3	**1.7**	1.7	
123-91-1	1,4-Dioxane	ND	46	ND	13	
80-62-6	Methyl Methacrylate	ND	93	ND	23	
142-82-5	n-Heptane	ND	46	ND	11	
10061-01-5	cis-1,3-Dichloropropene	ND	46	ND	10	
108-10-1	4-Methyl-2-pentanone	ND	46	ND	11	
10061-02-6	trans-1,3-Dichloropropene	ND	46	ND	10	
79-00-5	1,1,2-Trichloroethane	ND	9.3	ND	1.7	
108-88-3	Toluene	ND	46	ND	12	
591-78-6	2-Hexanone	ND	46	ND	11	
124-48-1	Dibromochloromethane	ND	9.3	ND	1.1	
106-93-4	1,2-Dibromoethane	ND	9.3	ND	1.2	
123-86-4	n-Butyl Acetate	ND	46	ND	9.8	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Sample ID:	**SS-1C**	CAS Sample ID:	P1203938-003
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Test Code:	EPA TO-15	Date Collected:	9/18/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.014 Liter(s)
Test Notes:			
Container ID:	AC00942		

Initial Pressure (psig): -0.73 Final Pressure (psig): 3.53

Canister Dilution Factor: 1.30

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
111-65-9	n-Octane	ND	46	ND	9.9	
127-18-4	Tetrachloroethene	**8,000**	9.3	**1,200**	1.4	
108-90-7	Chlorobenzene	ND	9.3	ND	2.0	
100-41-4	Ethylbenzene	ND	46	ND	11	
179601-23-1	m,p-Xylenes	ND	46	ND	11	
75-25-2	Bromoform	ND	46	ND	4.5	
100-42-5	Styrene	ND	46	ND	11	
95-47-6	o-Xylene	ND	46	ND	11	
111-84-2	n-Nonane	ND	46	ND	8.9	
79-34-5	1,1,2,2-Tetrachloroethane	ND	9.3	ND	1.4	
98-82-8	Cumene	ND	46	ND	9.4	
80-56-8	alpha-Pinene	ND	46	ND	8.3	
103-65-1	n-Propylbenzene	ND	46	ND	9.4	
622-96-8	4-Ethyltoluene	ND	46	ND	9.4	
108-67-8	1,3,5-Trimethylbenzene	ND	46	ND	9.4	
95-63-6	1,2,4-Trimethylbenzene	ND	46	ND	9.4	
100-44-7	Benzyl Chloride	ND	46	ND	9.0	
541-73-1	1,3-Dichlorobenzene	ND	9.3	ND	1.5	
106-46-7	1,4-Dichlorobenzene	ND	9.3	ND	1.5	
95-50-1	1,2-Dichlorobenzene	ND	9.3	ND	1.5	
5989-27-5	d-Limonene	ND	46	ND	8.3	
96-12-8	1,2-Dibromo-3-chloropropane	ND	46	ND	4.8	
120-82-1	1,2,4-Trichlorobenzene	ND	46	ND	6.3	
91-20-3	Naphthalene	ND	46	ND	8.9	
87-68-3	Hexachlorobutadiene	ND	46	ND	4.4	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **SS-2C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-004

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00977

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.020 Liter(s)

Initial Pressure (psig): -0.30 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.27

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	ND	32	ND	18	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	32	ND	6.4	
74-87-3	Chloromethane	ND	13	ND	6.2	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	32	ND	4.5	
75-01-4	Vinyl Chloride	ND	6.4	ND	2.5	
106-99-0	1,3-Butadiene	ND	13	ND	5.7	
74-83-9	Bromomethane	ND	6.4	ND	1.6	
75-00-3	Chloroethane	ND	6.4	ND	2.4	
64-17-5	Ethanol	ND	320	ND	170	
75-05-8	Acetonitrile	ND	32	ND	19	
107-02-8	Acrolein	ND	130	ND	55	
67-64-1	Acetone	**3,300**	320	**1,400**	130	
75-69-4	Trichlorofluoromethane	ND	6.4	ND	1.1	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	320	ND	130	
107-13-1	Acrylonitrile	ND	32	ND	15	
75-35-4	1,1-Dichloroethene	ND	6.4	ND	1.6	
75-09-2	Methylene Chloride	ND	32	ND	9.1	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	6.4	ND	2.0	
76-13-1	Trichlorotrifluoroethane	ND	6.4	ND	0.83	
75-15-0	Carbon Disulfide	ND	320	ND	100	
156-60-5	trans-1,2-Dichloroethene	ND	6.4	ND	1.6	
75-34-3	1,1-Dichloroethane	ND	6.4	ND	1.6	
1634-04-4	Methyl tert-Butyl Ether	ND	6.4	ND	1.8	
108-05-4	Vinyl Acetate	ND	320	ND	90	
78-93-3	2-Butanone (MEK)	ND	320	ND	110	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**SS-2C**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-004
Test Code:	EPA TO-15	Date Collected:	9/18/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.020 Liter(s)
Test Notes:			
Container ID:	AC00977		

Initial Pressure (psig): -0.30 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.27

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	6.4	ND	1.6	
141-78-6	Ethyl Acetate	ND	64	ND	18	
110-54-3	n-Hexane	**1,200**	32	**350**	9.0	
67-66-3	Chloroform	ND	6.4	ND	1.3	
109-99-9	Tetrahydrofuran (THF)	ND	32	ND	11	
107-06-2	1,2-Dichloroethane	ND	6.4	ND	1.6	
71-55-6	1,1,1-Trichloroethane	ND	6.4	ND	1.2	
71-43-2	Benzene	**58**	6.4	**18**	2.0	
56-23-5	Carbon Tetrachloride	ND	6.4	ND	1.0	
110-82-7	Cyclohexane	**480**	64	**140**	18	
78-87-5	1,2-Dichloropropane	ND	6.4	ND	1.4	
75-27-4	Bromodichloromethane	ND	6.4	ND	0.95	
79-01-6	Trichloroethene	**26**	6.4	**4.8**	1.2	
123-91-1	1,4-Dioxane	ND	32	ND	8.8	
80-62-6	Methyl Methacrylate	ND	64	ND	16	
142-82-5	n-Heptane	**960**	32	**230**	7.8	
10061-01-5	cis-1,3-Dichloropropene	ND	32	ND	7.0	
108-10-1	4-Methyl-2-pentanone	ND	32	ND	7.8	
10061-02-6	trans-1,3-Dichloropropene	ND	32	ND	7.0	
79-00-5	1,1,2-Trichloroethane	ND	6.4	ND	1.2	
108-88-3	Toluene	**52**	32	**14**	8.4	
591-78-6	2-Hexanone	ND	32	ND	7.8	
124-48-1	Dibromochloromethane	ND	6.4	ND	0.75	
106-93-4	1,2-Dibromoethane	ND	6.4	ND	0.83	
123-86-4	n-Butyl Acetate	ND	32	ND	6.7	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **SS-2C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-004

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00977

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.020 Liter(s)

Initial Pressure (psig): -0.30 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.27

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	**210**	32	**45**	6.8	
127-18-4	Tetrachloroethene	**5,000**	6.4	**740**	0.94	
108-90-7	Chlorobenzene	ND	6.4	ND	1.4	
100-41-4	Ethylbenzene	**430**	32	**98**	7.3	
179601-23-1	m,p-Xylenes	**770**	32	**180**	7.3	
75-25-2	Bromoform	ND	32	ND	3.1	
100-42-5	Styrene	ND	32	ND	7.5	
95-47-6	o-Xylene	ND	32	ND	7.3	
111-84-2	n-Nonane	**51**	32	**9.8**	6.1	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.4	ND	0.93	
98-82-8	Cumene	**34**	32	**7.0**	6.5	
80-56-8	alpha-Pinene	ND	32	ND	5.7	
103-65-1	n-Propylbenzene	**130**	32	**27**	6.5	
622-96-8	4-Ethyltoluene	**260**	32	**52**	6.5	
108-67-8	1,3,5-Trimethylbenzene	**220**	32	**45**	6.5	
95-63-6	1,2,4-Trimethylbenzene	**860**	32	**170**	6.5	
100-44-7	Benzyl Chloride	ND	32	ND	6.1	
541-73-1	1,3-Dichlorobenzene	ND	6.4	ND	1.1	
106-46-7	1,4-Dichlorobenzene	ND	6.4	ND	1.1	
95-50-1	1,2-Dichlorobenzene	ND	6.4	ND	1.1	
5989-27-5	d-Limonene	ND	32	ND	5.7	
96-12-8	1,2-Dibromo-3-chloropropane	ND	32	ND	3.3	
120-82-1	1,2,4-Trichlorobenzene	ND	32	ND	4.3	
91-20-3	Naphthalene	ND	32	ND	6.1	
87-68-3	Hexachlorobutadiene	ND	32	ND	3.0	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **SS-3C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-005

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01198

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 1.00 Liter(s)
0.10 Liter(s)

Initial Pressure (psig): -1.53 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.38

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	**2.2**	0.69	**1.3**	0.40	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.2**	0.69	**0.45**	0.14	
74-87-3	Chloromethane	ND	0.28	ND	0.13	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.69	ND	0.099	
75-01-4	Vinyl Chloride	ND	0.14	ND	0.054	
106-99-0	1,3-Butadiene	ND	0.28	ND	0.12	
74-83-9	Bromomethane	ND	0.14	ND	0.036	
75-00-3	Chloroethane	ND	0.14	ND	0.052	
64-17-5	Ethanol	ND	6.9	ND	3.7	
75-05-8	Acetonitrile	ND	0.69	ND	0.41	
107-02-8	Acrolein	ND	2.8	ND	1.2	
67-64-1	Acetone	**250**	6.9	**110**	2.9	
75-69-4	Trichlorofluoromethane	**0.88**	0.14	**0.16**	0.025	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	6.9	ND	2.8	
107-13-1	Acrylonitrile	ND	0.69	ND	0.32	
75-35-4	1,1-Dichloroethene	ND	0.14	ND	0.035	
75-09-2	Methylene Chloride	ND	0.69	ND	0.20	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.14	ND	0.044	
76-13-1	Trichlorotrifluoroethane	**0.45**	0.14	**0.058**	0.018	
75-15-0	Carbon Disulfide	ND	6.9	ND	2.2	
156-60-5	trans-1,2-Dichloroethene	ND	0.14	ND	0.035	
75-34-3	1,1-Dichloroethane	ND	0.14	ND	0.034	
1634-04-4	Methyl tert-Butyl Ether	**0.45**	0.14	**0.13**	0.038	
108-05-4	Vinyl Acetate	ND	6.9	ND	2.0	
78-93-3	2-Butanone (MEK)	ND	6.9	ND	2.3	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **SS-3C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-005

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01198

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 1.00 Liter(s)
0.10 Liter(s)

Initial Pressure (psig): -1.53 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.38

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.14	ND	0.035	
141-78-6	Ethyl Acetate	ND	1.4	ND	0.38	
110-54-3	n-Hexane	**1.2**	0.69	**0.35**	0.20	
67-66-3	Chloroform	**0.20**	0.14	**0.041**	0.028	
109-99-9	Tetrahydrofuran (THF)	ND	0.69	ND	0.23	
107-06-2	1,2-Dichloroethane	ND	0.14	ND	0.034	
71-55-6	1,1,1-Trichloroethane	ND	0.14	ND	0.025	
71-43-2	Benzene	**0.32**	0.14	**0.10**	0.043	
56-23-5	Carbon Tetrachloride	ND	0.14	ND	0.022	
110-82-7	Cyclohexane	ND	1.4	ND	0.40	
78-87-5	1,2-Dichloropropane	ND	0.14	ND	0.030	
75-27-4	Bromodichloromethane	ND	0.14	ND	0.021	
79-01-6	Trichloroethene	**0.63**	0.14	**0.12**	0.026	
123-91-1	1,4-Dioxane	ND	0.69	ND	0.19	
80-62-6	Methyl Methacrylate	ND	1.4	ND	0.34	
142-82-5	n-Heptane	**11**	0.69	**2.6**	0.17	
10061-01-5	cis-1,3-Dichloropropene	ND	0.69	ND	0.15	
108-10-1	4-Methyl-2-pentanone	ND	0.69	ND	0.17	
10061-02-6	trans-1,3-Dichloropropene	ND	0.69	ND	0.15	
79-00-5	1,1,2-Trichloroethane	ND	0.14	ND	0.025	
108-88-3	Toluene	**1.5**	0.69	**0.40**	0.18	
591-78-6	2-Hexanone	ND	0.69	ND	0.17	
124-48-1	Dibromochloromethane	ND	0.14	ND	0.016	
106-93-4	1,2-Dibromoethane	ND	0.14	ND	0.018	
123-86-4	n-Butyl Acetate	ND	0.69	ND	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **SS-3C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-005

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01198

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 1.00 Liter(s)
0.10 Liter(s)

Initial Pressure (psig): -1.53 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.38

CAS #	Compound	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	**0.91**	0.69	**0.20**	0.15	
127-18-4	Tetrachloroethene	**610**	1.4	**89**	0.20	**D**
108-90-7	Chlorobenzene	ND	0.14	ND	0.030	
100-41-4	Ethylbenzene	**0.92**	0.69	**0.21**	0.16	
179601-23-1	m,p-Xylenes	**3.0**	0.69	**0.70**	0.16	
75-25-2	Bromoform	ND	0.69	ND	0.067	
100-42-5	Styrene	ND	0.69	ND	0.16	
95-47-6	o-Xylene	**2.2**	0.69	**0.51**	0.16	
111-84-2	n-Nonane	ND	0.69	ND	0.13	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.14	ND	0.020	
98-82-8	Cumene	ND	0.69	ND	0.14	
80-56-8	alpha-Pinene	**2.8**	0.69	**0.50**	0.12	
103-65-1	n-Propylbenzene	ND	0.69	ND	0.14	
622-96-8	4-Ethyltoluene	**1.2**	0.69	**0.24**	0.14	
108-67-8	1,3,5-Trimethylbenzene	**7.4**	0.69	**1.5**	0.14	
95-63-6	1,2,4-Trimethylbenzene	**25**	0.69	**5.0**	0.14	
100-44-7	Benzyl Chloride	ND	0.69	ND	0.13	
541-73-1	1,3-Dichlorobenzene	ND	0.14	ND	0.023	
106-46-7	1,4-Dichlorobenzene	**0.14**	0.14	**0.023**	0.023	
95-50-1	1,2-Dichlorobenzene	ND	0.14	ND	0.023	
5989-27-5	d-Limonene	ND	0.69	ND	0.12	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.69	ND	0.071	
120-82-1	1,2,4-Trichlorobenzene	ND	0.69	ND	0.093	
91-20-3	Naphthalene	**11**	0.69	**2.1**	0.13	
87-68-3	Hexachlorobutadiene	ND	0.69	ND	0.065	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Indoor-1-BL**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-006

Test Code:	EPA TO-15	Date Collected:	9/19/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.50 Liter(s)
Test Notes:			0.050 Liter(s)
Container ID:	AS00228		

Initial Pressure (psig): 0.02 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.24

CAS #	Compound	Result µg/m^3	MRL µg/m^3	Result ppbV	MRL ppbV	Data Qualifier
115-07-1	Propene	**86**	1.2	**50**	0.72	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.3**	1.2	**0.47**	0.25	
74-87-3	Chloromethane	**0.86**	0.50	**0.42**	0.24	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	1.2	ND	0.18	
75-01-4	Vinyl Chloride	ND	0.25	ND	0.097	
106-99-0	1,3-Butadiene	**33**	0.50	**15**	0.22	
74-83-9	Bromomethane	ND	0.25	ND	0.064	
75-00-3	Chloroethane	ND	0.25	ND	0.094	
64-17-5	Ethanol	**77**	12	**41**	6.6	
75-05-8	Acetonitrile	**2.4**	1.2	**1.4**	0.74	
107-02-8	Acrolein	ND	5.0	ND	2.2	
67-64-1	Acetone	**1,100**	12	**480**	5.2	
75-69-4	Trichlorofluoromethane	**1.2**	0.25	**0.22**	0.044	
67-63-0	2-Propanol (Isopropyl Alcohol)	**21**	12	**8.5**	5.0	
107-13-1	Acrylonitrile	ND	1.2	ND	0.57	
75-35-4	1,1-Dichloroethene	ND	0.25	ND	0.063	
75-09-2	Methylene Chloride	**23**	1.2	**6.7**	0.36	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.25	ND	0.079	
76-13-1	Trichlorotrifluoroethane	**0.49**	0.25	**0.064**	0.032	
75-15-0	Carbon Disulfide	ND	12	ND	4.0	
156-60-5	trans-1,2-Dichloroethene	ND	0.25	ND	0.063	
75-34-3	1,1-Dichloroethane	ND	0.25	ND	0.061	
1634-04-4	Methyl tert-Butyl Ether	ND	0.25	ND	0.069	
108-05-4	Vinyl Acetate	ND	12	ND	3.5	
78-93-3	2-Butanone (MEK)	ND	12	ND	4.2	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-BL**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-006

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AS00228

Date Collected: 9/19/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.50 Liter(s)
0.050 Liter(s)

Initial Pressure (psig): 0.02 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.24

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	0.25	ND	0.063	
141-78-6	Ethyl Acetate	ND	2.5	ND	0.69	
110-54-3	n-Hexane	**68**	1.2	**19**	0.35	
67-66-3	Chloroform	**0.27**	0.25	**0.055**	0.051	
109-99-9	Tetrahydrofuran (THF)	ND	1.2	ND	0.42	
107-06-2	1,2-Dichloroethane	ND	0.25	ND	0.061	
71-55-6	1,1,1-Trichloroethane	ND	0.25	ND	0.045	
71-43-2	Benzene	**130**	0.25	**41**	0.078	
56-23-5	Carbon Tetrachloride	**0.55**	0.25	**0.088**	0.039	
110-82-7	Cyclohexane	**12**	2.5	**3.6**	0.72	
78-87-5	1,2-Dichloropropane	ND	0.25	ND	0.054	
75-27-4	Bromodichloromethane	ND	0.25	ND	0.037	
79-01-6	Trichloroethene	**140**	0.25	**26**	0.046	
123-91-1	1,4-Dioxane	ND	1.2	ND	0.34	
80-62-6	Methyl Methacrylate	ND	2.5	ND	0.61	
142-82-5	n-Heptane	**130**	1.2	**32**	0.30	
10061-01-5	cis-1,3-Dichloropropene	ND	1.2	ND	0.27	
108-10-1	4-Methyl-2-pentanone	**20**	1.2	**4.9**	0.30	
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	ND	0.27	
79-00-5	1,1,2-Trichloroethane	ND	0.25	ND	0.045	
108-88-3	Toluene	**410**	12	**110**	3.3	**D**
591-78-6	2-Hexanone	ND	1.2	ND	0.30	
124-48-1	Dibromochloromethane	ND	0.25	ND	0.029	
106-93-4	1,2-Dibromoethane	ND	0.25	ND	0.032	
123-86-4	n-Butyl Acetate	**2.1**	1.2	**0.45**	0.26	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Sample ID:	**Indoor-1-BL**	CAS Sample ID:	P1203938-006
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Test Code:	EPA TO-15	Date Collected:	9/19/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.50 Liter(s)
Test Notes:			0.050 Liter(s)
Container ID:	AS00228		

Initial Pressure (psig): 0.02 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.24

CAS #	Compound	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	**25**	1.2	**5.4**	0.27	
127-18-4	Tetrachloroethene	**1.8**	0.25	**0.26**	0.037	
108-90-7	Chlorobenzene	ND	0.25	ND	0.054	
100-41-4	Ethylbenzene	**84**	1.2	**19**	0.29	
179601-23-1	m,p-Xylenes	**290**	1.2	**66**	0.29	
75-25-2	Bromoform	ND	1.2	ND	0.12	
100-42-5	Styrene	**31**	1.2	**7.2**	0.29	
95-47-6	o-Xylene	**100**	1.2	**24**	0.29	
111-84-2	n-Nonane	**46**	1.2	**8.7**	0.24	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.25	ND	0.036	
98-82-8	Cumene	**4.3**	1.2	**0.88**	0.25	
80-56-8	alpha-Pinene	ND	1.2	ND	0.22	
103-65-1	n-Propylbenzene	**16**	1.2	**3.2**	0.25	
622-96-8	4-Ethyltoluene	**36**	1.2	**7.4**	0.25	
108-67-8	1,3,5-Trimethylbenzene	**38**	1.2	**7.8**	0.25	
95-63-6	1,2,4-Trimethylbenzene	**120**	1.2	**25**	0.25	
100-44-7	Benzyl Chloride	ND	1.2	ND	0.24	
541-73-1	1,3-Dichlorobenzene	ND	0.25	ND	0.041	
106-46-7	1,4-Dichlorobenzene	ND	0.25	ND	0.041	
95-50-1	1,2-Dichlorobenzene	ND	0.25	ND	0.041	
5989-27-5	d-Limonene	**23**	1.2	**4.1**	0.22	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.2	ND	0.13	
120-82-1	1,2,4-Trichlorobenzene	ND	1.2	ND	0.17	
91-20-3	Naphthalene	**19**	1.2	**3.6**	0.24	
87-68-3	Hexachlorobutadiene	ND	1.2	ND	0.12	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-PP**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-007

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00376

Date Collected: 9/19/12
Date Received: 9/26/12
Date Analyzed: 9/28/12 & 10/1/12
Volume(s) Analyzed: 0.040 Liter(s)
0.020 Liter(s)

Initial Pressure (psig): -0.05 Final Pressure (psig): 3.51

Canister Dilution Factor: 1.24

CAS #	**Compound**	**Result** µg/m^3	MRL µg/m^3	**Result ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	ND	16	ND	9.0	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	16	ND	3.1	
74-87-3	Chloromethane	ND	6.2	ND	3.0	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	16	ND	2.2	
75-01-4	Vinyl Chloride	ND	3.1	ND	1.2	
106-99-0	1,3-Butadiene	ND	6.2	ND	2.8	
74-83-9	Bromomethane	ND	3.1	ND	0.80	
75-00-3	Chloroethane	ND	3.1	ND	1.2	
64-17-5	Ethanol	ND	160	ND	82	
75-05-8	Acetonitrile	ND	16	ND	9.2	
107-02-8	Acrolein	ND	62	ND	27	
67-64-1	Acetone	**23,000**	310	**9,500**	130	**D**
75-69-4	Trichlorofluoromethane	ND	3.1	ND	0.55	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	160	ND	63	
107-13-1	Acrylonitrile	ND	16	ND	7.1	
75-35-4	1,1-Dichloroethene	ND	3.1	ND	0.78	
75-09-2	Methylene Chloride	**16**	16	**4.6**	4.5	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	3.1	ND	0.99	
76-13-1	Trichlorotrifluoroethane	ND	3.1	ND	0.40	
75-15-0	Carbon Disulfide	ND	160	ND	50	
156-60-5	trans-1,2-Dichloroethene	ND	3.1	ND	0.78	
75-34-3	1,1-Dichloroethane	ND	3.1	ND	0.77	
1634-04-4	Methyl tert-Butyl Ether	ND	3.1	ND	0.86	
108-05-4	Vinyl Acetate	ND	160	ND	44	
78-93-3	2-Butanone (MEK)	ND	160	ND	53	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

Page 2 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-PP** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P1203938-007

Test Code: EPA TO-15 Date Collected: 9/19/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 9/26/12
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12 & 10/1/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.040 Liter(s)
Test Notes: 0.020 Liter(s)
Container ID: AC00376

Initial Pressure (psig): -0.05 Final Pressure (psig): 3.51

Canister Dilution Factor: 1.24

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	3.1	ND	0.78	
141-78-6	Ethyl Acetate	ND	31	ND	8.6	
110-54-3	n-Hexane	ND	16	ND	4.4	
67-66-3	Chloroform	ND	3.1	ND	0.64	
109-99-9	Tetrahydrofuran (THF)	ND	16	ND	5.3	
107-06-2	1,2-Dichloroethane	ND	3.1	ND	0.77	
71-55-6	1,1,1-Trichloroethane	ND	3.1	ND	0.57	
71-43-2	Benzene	**7.1**	3.1	**2.2**	0.97	
56-23-5	Carbon Tetrachloride	ND	3.1	ND	0.49	
110-82-7	Cyclohexane	**36**	31	**10**	9.0	
78-87-5	1,2-Dichloropropane	ND	3.1	ND	0.67	
75-27-4	Bromodichloromethane	ND	3.1	ND	0.46	
79-01-6	Trichloroethene	**70**	3.1	**13**	0.58	
123-91-1	1,4-Dioxane	ND	16	ND	4.3	
80-62-6	Methyl Methacrylate	ND	31	ND	7.6	
142-82-5	n-Heptane	**2,300**	16	**570**	3.8	
10061-01-5	cis-1,3-Dichloropropene	ND	16	ND	3.4	
108-10-1	4-Methyl-2-pentanone	ND	16	ND	3.8	
10061-02-6	trans-1,3-Dichloropropene	ND	16	ND	3.4	
79-00-5	1,1,2-Trichloroethane	ND	3.1	ND	0.57	
108-88-3	Toluene	**27**	16	**7.3**	4.1	
591-78-6	2-Hexanone	ND	16	ND	3.8	
124-48-1	Dibromochloromethane	ND	3.1	ND	0.36	
106-93-4	1,2-Dibromoethane	ND	3.1	ND	0.40	
123-86-4	n-Butyl Acetate	ND	16	ND	3.3	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-PP**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-007

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00376

Date Collected: 9/19/12
Date Received: 9/26/12
Date Analyzed: 9/28/12 & 10/1/12
Volume(s) Analyzed: 0.040 Liter(s)
0.020 Liter(s)

Initial Pressure (psig): -0.05 Final Pressure (psig): 3.51

Canister Dilution Factor: 1.24

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	ND	16	ND	3.3	
127-18-4	Tetrachloroethene	ND	3.1	ND	0.46	
108-90-7	Chlorobenzene	ND	3.1	ND	0.67	
100-41-4	Ethylbenzene	ND	16	ND	3.6	
179601-23-1	m,p-Xylenes	**31**	16	**7.1**	3.6	
75-25-2	Bromoform	ND	16	ND	1.5	
100-42-5	Styrene	ND	16	ND	3.6	
95-47-6	o-Xylene	ND	16	ND	3.6	
111-84-2	n-Nonane	ND	16	ND	3.0	
79-34-5	1,1,2,2-Tetrachloroethane	ND	3.1	ND	0.45	
98-82-8	Cumene	ND	16	ND	3.2	
80-56-8	alpha-Pinene	ND	16	ND	2.8	
103-65-1	n-Propylbenzene	ND	16	ND	3.2	
622-96-8	4-Ethyltoluene	ND	16	ND	3.2	
108-67-8	1,3,5-Trimethylbenzene	ND	16	ND	3.2	
95-63-6	1,2,4-Trimethylbenzene	**18**	16	**3.7**	3.2	
100-44-7	Benzyl Chloride	ND	16	ND	3.0	
541-73-1	1,3-Dichlorobenzene	ND	3.1	ND	0.52	
106-46-7	1,4-Dichlorobenzene	ND	3.1	ND	0.52	
95-50-1	1,2-Dichlorobenzene	ND	3.1	ND	0.52	
5989-27-5	d-Limonene	**26**	16	**4.7**	2.8	
96-12-8	1,2-Dibromo-3-chloropropane	ND	16	ND	1.6	
120-82-1	1,2,4-Trichlorobenzene	ND	16	ND	2.1	
91-20-3	Naphthalene	ND	16	ND	3.0	
87-68-3	Hexachlorobutadiene	ND	16	ND	1.5	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Indoor-1-NP**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-008

Test Code:	EPA TO-15	Date Collected:	9/19/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.10 Liter(s)
Test Notes:			0.020 Liter(s)
Container ID:	AC01877		

Initial Pressure (psig): -0.02 Final Pressure (psig): 4.36

Canister Dilution Factor: 1.30

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	**39**	6.5	**23**	3.8	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	6.5	ND	1.3	
74-87-3	Chloromethane	ND	2.6	ND	1.3	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	6.5	ND	0.93	
75-01-4	Vinyl Chloride	ND	1.3	ND	0.51	
106-99-0	1,3-Butadiene	**14**	2.6	**6.5**	1.2	
74-83-9	Bromomethane	ND	1.3	ND	0.33	
75-00-3	Chloroethane	ND	1.3	ND	0.49	
64-17-5	Ethanol	**80**	65	**42**	35	
75-05-8	Acetonitrile	ND	6.5	ND	3.9	
107-02-8	Acrolein	ND	26	ND	11	
67-64-1	Acetone	**9,400**	330	**4,000**	140	**D**
75-69-4	Trichlorofluoromethane	**1.8**	1.3	**0.32**	0.23	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	65	ND	26	
107-13-1	Acrylonitrile	ND	6.5	ND	3.0	
75-35-4	1,1-Dichloroethene	ND	1.3	ND	0.33	
75-09-2	Methylene Chloride	ND	6.5	ND	1.9	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	1.3	ND	0.42	
76-13-1	Trichlorotrifluoroethane	ND	1.3	ND	0.17	
75-15-0	Carbon Disulfide	ND	65	ND	21	
156-60-5	trans-1,2-Dichloroethene	ND	1.3	ND	0.33	
75-34-3	1,1-Dichloroethane	ND	1.3	ND	0.32	
1634-04-4	Methyl tert-Butyl Ether	ND	1.3	ND	0.36	
108-05-4	Vinyl Acetate	ND	65	ND	18	
78-93-3	2-Butanone (MEK)	ND	65	ND	22	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-NP**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-008

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC01877

Date Collected: 9/19/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.10 Liter(s)
0.020 Liter(s)

Initial Pressure (psig): -0.02 Final Pressure (psig): 4.36

Canister Dilution Factor: 1.30

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	1.3	ND	0.33	
141-78-6	Ethyl Acetate	**27**	13	**7.4**	3.6	
110-54-3	n-Hexane	**120**	6.5	**34**	1.8	
67-66-3	Chloroform	ND	1.3	ND	0.27	
109-99-9	Tetrahydrofuran (THF)	ND	6.5	ND	2.2	
107-06-2	1,2-Dichloroethane	ND	1.3	ND	0.32	
71-55-6	1,1,1-Trichloroethane	ND	1.3	ND	0.24	
71-43-2	Benzene	**69**	1.3	**22**	0.41	
56-23-5	Carbon Tetrachloride	ND	1.3	ND	0.21	
110-82-7	Cyclohexane	**33**	13	**9.7**	3.8	
78-87-5	1,2-Dichloropropane	ND	1.3	ND	0.28	
75-27-4	Bromodichloromethane	ND	1.3	ND	0.19	
79-01-6	Trichloroethene	**15**	1.3	**2.8**	0.24	
123-91-1	1,4-Dioxane	ND	6.5	ND	1.8	
80-62-6	Methyl Methacrylate	ND	13	ND	3.2	
142-82-5	n-Heptane	**1,100**	6.5	**260**	1.6	
10061-01-5	cis-1,3-Dichloropropene	ND	6.5	ND	1.4	
108-10-1	4-Methyl-2-pentanone	**9.5**	6.5	**2.3**	1.6	
10061-02-6	trans-1,3-Dichloropropene	ND	6.5	ND	1.4	
79-00-5	1,1,2-Trichloroethane	ND	1.3	ND	0.24	
108-88-3	Toluene	**170**	6.5	**44**	1.7	
591-78-6	2-Hexanone	ND	6.5	ND	1.6	
124-48-1	Dibromochloromethane	ND	1.3	ND	0.15	
106-93-4	1,2-Dibromoethane	ND	1.3	ND	0.17	
123-86-4	n-Butyl Acetate	ND	6.5	ND	1.4	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.** CAS Project ID: P1203938
Client Sample ID: **Indoor-1-NP** CAS Sample ID: P1203938-008
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

Test Code: EPA TO-15 Date Collected: 9/19/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 9/25/12
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.10 Liter(s)
Test Notes: 0.020 Liter(s)
Container ID: AC01877

Initial Pressure (psig): -0.02 Final Pressure (psig): 4.36

Canister Dilution Factor: 1.30

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
111-65-9	n-Octane	**15**	6.5	**3.2**	1.4	
127-18-4	Tetrachloroethene	**1.8**	1.3	**0.27**	0.19	
108-90-7	Chlorobenzene	ND	1.3	ND	0.28	
100-41-4	Ethylbenzene	**50**	6.5	**11**	1.5	
179601-23-1	m,p-Xylenes	**180**	6.5	**41**	1.5	
75-25-2	Bromoform	ND	6.5	ND	0.63	
100-42-5	Styrene	**21**	6.5	**4.9**	1.5	
95-47-6	o-Xylene	**70**	6.5	**16**	1.5	
111-84-2	n-Nonane	**14**	6.5	**2.7**	1.2	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.3	ND	0.19	
98-82-8	Cumene	ND	6.5	ND	1.3	
80-56-8	alpha-Pinene	ND	6.5	ND	1.2	
103-65-1	n-Propylbenzene	**12**	6.5	**2.4**	1.3	
622-96-8	4-Ethyltoluene	**29**	6.5	**5.8**	1.3	
108-67-8	1,3,5-Trimethylbenzene	**34**	6.5	**7.0**	1.3	
95-63-6	1,2,4-Trimethylbenzene	**110**	6.5	**23**	1.3	
100-44-7	Benzyl Chloride	ND	6.5	ND	1.3	
541-73-1	1,3-Dichlorobenzene	ND	1.3	ND	0.22	
106-46-7	1,4-Dichlorobenzene	ND	1.3	ND	0.22	
95-50-1	1,2-Dichlorobenzene	ND	1.3	ND	0.22	
5989-27-5	d-Limonene	**100**	6.5	**18**	1.2	
96-12-8	1,2-Dibromo-3-chloropropane	ND	6.5	ND	0.67	
120-82-1	1,2,4-Trichlorobenzene	ND	6.5	ND	0.88	
91-20-3	Naphthalene	**47**	6.5	**9.1**	1.2	
87-68-3	Hexachlorobutadiene	ND	6.5	ND	0.61	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Dup 1** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P1203938-009

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00745

Date Collected: 9/19/12
Date Received: 9/26/12
Date Analyzed: 9/28/12 & 10/1/12
Volume(s) Analyzed: 0.040 Liter(s)
0.020 Liter(s)

Initial Pressure (psig): -0.03 Final Pressure (psig): 3.59

Canister Dilution Factor: 1.25

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
115-07-1	Propene	ND	16	ND	9.1	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	16	ND	3.2	
74-87-3	Chloromethane	ND	6.3	ND	3.0	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	16	ND	2.2	
75-01-4	Vinyl Chloride	ND	3.1	ND	1.2	
106-99-0	1,3-Butadiene	ND	6.3	ND	2.8	
74-83-9	Bromomethane	ND	3.1	ND	0.81	
75-00-3	Chloroethane	ND	3.1	ND	1.2	
64-17-5	Ethanol	ND	160	ND	83	
75-05-8	Acetonitrile	ND	16	ND	9.3	
107-02-8	Acrolein	ND	63	ND	27	
67-64-1	Acetone	**23,000**	310	**9,800**	130	**D**
75-69-4	Trichlorofluoromethane	ND	3.1	ND	0.56	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	160	ND	64	
107-13-1	Acrylonitrile	ND	16	ND	7.2	
75-35-4	1,1-Dichloroethene	ND	3.1	ND	0.79	
75-09-2	Methylene Chloride	**16**	16	**4.7**	4.5	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	3.1	ND	1.0	
76-13-1	Trichlorotrifluoroethane	ND	3.1	ND	0.41	
75-15-0	Carbon Disulfide	ND	160	ND	50	
156-60-5	trans-1,2-Dichloroethene	ND	3.1	ND	0.79	
75-34-3	1,1-Dichloroethane	ND	3.1	ND	0.77	
1634-04-4	Methyl tert-Butyl Ether	ND	3.1	ND	0.87	
108-05-4	Vinyl Acetate	ND	160	ND	44	
78-93-3	2-Butanone (MEK)	ND	160	ND	53	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Dup 1**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-009

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00745

Date Collected: 9/19/12
Date Received: 9/26/12
Date Analyzed: 9/28/12 & 10/1/12
Volume(s) Analyzed: 0.040 Liter(s)
0.020 Liter(s)

Initial Pressure (psig): -0.03 Final Pressure (psig): 3.59

Canister Dilution Factor: 1.25

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	3.1	ND	0.79	
141-78-6	Ethyl Acetate	ND	31	ND	8.7	
110-54-3	n-Hexane	ND	16	ND	4.4	
67-66-3	Chloroform	ND	3.1	ND	0.64	
109-99-9	Tetrahydrofuran (THF)	ND	16	ND	5.3	
107-06-2	1,2-Dichloroethane	ND	3.1	ND	0.77	
71-55-6	1,1,1-Trichloroethane	ND	3.1	ND	0.57	
71-43-2	Benzene	**6.9**	3.1	**2.2**	0.98	
56-23-5	Carbon Tetrachloride	ND	3.1	ND	0.50	
110-82-7	Cyclohexane	**36**	31	**10**	9.1	
78-87-5	1,2-Dichloropropane	ND	3.1	ND	0.68	
75-27-4	Bromodichloromethane	ND	3.1	ND	0.47	
79-01-6	Trichloroethene	**73**	3.1	**14**	0.58	
123-91-1	1,4-Dioxane	ND	16	ND	4.3	
80-62-6	Methyl Methacrylate	ND	31	ND	7.6	
142-82-5	n-Heptane	**2,600**	16	**640**	3.8	
10061-01-5	cis-1,3-Dichloropropene	ND	16	ND	3.4	
108-10-1	4-Methyl-2-pentanone	ND	16	ND	3.8	
10061-02-6	trans-1,3-Dichloropropene	ND	16	ND	3.4	
79-00-5	1,1,2-Trichloroethane	ND	3.1	ND	0.57	
108-88-3	Toluene	**26**	16	**6.8**	4.1	
591-78-6	2-Hexanone	ND	16	ND	3.8	
124-48-1	Dibromochloromethane	ND	3.1	ND	0.37	
106-93-4	1,2-Dibromoethane	ND	3.1	ND	0.41	
123-86-4	n-Butyl Acetate	ND	16	ND	3.3	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Sample ID:	**Dup 1**	CAS Sample ID:	P1203938-009
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Test Code:	EPA TO-15	Date Collected:	9/19/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/26/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12 & 10/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.040 Liter(s)
Test Notes:			0.020 Liter(s)
Container ID:	AC00745		

Initial Pressure (psig): -0.03 Final Pressure (psig): 3.59

Canister Dilution Factor: 1.25

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
111-65-9	n-Octane	ND	16	ND	3.3	
127-18-4	Tetrachloroethene	ND	3.1	ND	0.46	
108-90-7	Chlorobenzene	ND	3.1	ND	0.68	
100-41-4	Ethylbenzene	ND	16	ND	3.6	
179601-23-1	m,p-Xylenes	**29**	16	**6.8**	3.6	
75-25-2	Bromoform	ND	16	ND	1.5	
100-42-5	Styrene	ND	16	ND	3.7	
95-47-6	o-Xylene	ND	16	ND	3.6	
111-84-2	n-Nonane	ND	16	ND	3.0	
79-34-5	1,1,2,2-Tetrachloroethane	ND	3.1	ND	0.46	
98-82-8	Cumene	ND	16	ND	3.2	
80-56-8	alpha-Pinene	ND	16	ND	2.8	
103-65-1	n-Propylbenzene	ND	16	ND	3.2	
622-96-8	4-Ethyltoluene	ND	16	ND	3.2	
108-67-8	1,3,5-Trimethylbenzene	ND	16	ND	3.2	
95-63-6	1,2,4-Trimethylbenzene	**18**	16	**3.6**	3.2	
100-44-7	Benzyl Chloride	ND	16	ND	3.0	
541-73-1	1,3-Dichlorobenzene	ND	3.1	ND	0.52	
106-46-7	1,4-Dichlorobenzene	ND	3.1	ND	0.52	
95-50-1	1,2-Dichlorobenzene	ND	3.1	ND	0.52	
5989-27-5	d-Limonene	**33**	16	**5.8**	2.8	
96-12-8	1,2-Dibromo-3-chloropropane	ND	16	ND	1.6	
120-82-1	1,2,4-Trichlorobenzene	ND	16	ND	2.1	
91-20-3	Naphthalene	ND	16	ND	3.0	
87-68-3	Hexachlorobutadiene	ND	16	ND	1.5	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P120928-MB

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 9/28/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
115-07-1	Propene	ND	0.50	ND	0.29	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	0.50	ND	0.10	
74-87-3	Chloromethane	ND	0.20	ND	0.097	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.50	ND	0.072	
75-01-4	Vinyl Chloride	ND	0.10	ND	0.039	
106-99-0	1,3-Butadiene	ND	0.20	ND	0.090	
74-83-9	Bromomethane	ND	0.10	ND	0.026	
75-00-3	Chloroethane	ND	0.10	ND	0.038	
64-17-5	Ethanol	ND	5.0	ND	2.7	
75-05-8	Acetonitrile	ND	0.50	ND	0.30	
107-02-8	Acrolein	ND	2.0	ND	0.87	
67-64-1	Acetone	ND	5.0	ND	2.1	
75-69-4	Trichlorofluoromethane	ND	0.10	ND	0.018	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	5.0	ND	2.0	
107-13-1	Acrylonitrile	ND	0.50	ND	0.23	
75-35-4	1,1-Dichloroethene	ND	0.10	ND	0.025	
75-09-2	Methylene Chloride	ND	0.50	ND	0.14	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.10	ND	0.032	
76-13-1	Trichlorotrifluoroethane	ND	0.10	ND	0.013	
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
156-60-5	trans-1,2-Dichloroethene	ND	0.10	ND	0.025	
75-34-3	1,1-Dichloroethane	ND	0.10	ND	0.025	
1634-04-4	Methyl tert-Butyl Ether	ND	0.10	ND	0.028	
108-05-4	Vinyl Acetate	ND	5.0	ND	1.4	
78-93-3	2-Butanone (MEK)	ND	5.0	ND	1.7	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P120928-MB

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	0.10	ND	0.025	
141-78-6	Ethyl Acetate	ND	1.0	ND	0.28	
110-54-3	n-Hexane	ND	0.50	ND	0.14	
67-66-3	Chloroform	ND	0.10	ND	0.020	
109-99-9	Tetrahydrofuran (THF)	ND	0.50	ND	0.17	
107-06-2	1,2-Dichloroethane	ND	0.10	ND	0.025	
71-55-6	1,1,1-Trichloroethane	ND	0.10	ND	0.018	
71-43-2	Benzene	ND	0.10	ND	0.031	
56-23-5	Carbon Tetrachloride	ND	0.10	ND	0.016	
110-82-7	Cyclohexane	ND	1.0	ND	0.29	
78-87-5	1,2-Dichloropropane	ND	0.10	ND	0.022	
75-27-4	Bromodichloromethane	ND	0.10	ND	0.015	
79-01-6	Trichloroethene	ND	0.10	ND	0.019	
123-91-1	1,4-Dioxane	ND	0.50	ND	0.14	
80-62-6	Methyl Methacrylate	ND	1.0	ND	0.24	
142-82-5	n-Heptane	ND	0.50	ND	0.12	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	ND	0.11	
108-10-1	4-Methyl-2-pentanone	ND	0.50	ND	0.12	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	ND	0.11	
79-00-5	1,1,2-Trichloroethane	ND	0.10	ND	0.018	
108-88-3	Toluene	ND	0.50	ND	0.13	
591-78-6	2-Hexanone	ND	0.50	ND	0.12	
124-48-1	Dibromochloromethane	ND	0.10	ND	0.012	
106-93-4	1,2-Dibromoethane	ND	0.10	ND	0.013	
123-86-4	n-Butyl Acetate	ND	0.50	ND	0.11	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Sample ID:	**Method Blank**	CAS Sample ID:	P120928-MB
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Test Code:	EPA TO-15	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	NA
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	ND	0.50	ND	0.11	
127-18-4	Tetrachloroethene	ND	0.10	ND	0.015	
108-90-7	Chlorobenzene	ND	0.10	ND	0.022	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	0.50	ND	0.12	
75-25-2	Bromoform	ND	0.50	ND	0.048	
100-42-5	Styrene	ND	0.50	ND	0.12	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
111-84-2	n-Nonane	ND	0.50	ND	0.095	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.10	ND	0.015	
98-82-8	Cumene	ND	0.50	ND	0.10	
80-56-8	alpha-Pinene	ND	0.50	ND	0.090	
103-65-1	n-Propylbenzene	ND	0.50	ND	0.10	
622-96-8	4-Ethyltoluene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	
100-44-7	Benzyl Chloride	ND	0.50	ND	0.097	
541-73-1	1,3-Dichlorobenzene	ND	0.10	ND	0.017	
106-46-7	1,4-Dichlorobenzene	ND	0.10	ND	0.017	
95-50-1	1,2-Dichlorobenzene	ND	0.10	ND	0.017	
5989-27-5	d-Limonene	ND	0.50	ND	0.090	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.50	ND	0.052	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	ND	0.067	
91-20-3	Naphthalene	ND	0.50	ND	0.095	
87-68-3	Hexachlorobutadiene	ND	0.50	ND	0.047	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P121001-MB

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
115-07-1	Propene	ND	0.50	ND	0.29	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	0.50	ND	0.10	
74-87-3	Chloromethane	ND	0.20	ND	0.097	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.50	ND	0.072	
75-01-4	Vinyl Chloride	ND	0.10	ND	0.039	
106-99-0	1,3-Butadiene	ND	0.20	ND	0.090	
74-83-9	Bromomethane	ND	0.10	ND	0.026	
75-00-3	Chloroethane	ND	0.10	ND	0.038	
64-17-5	Ethanol	ND	5.0	ND	2.7	
75-05-8	Acetonitrile	ND	0.50	ND	0.30	
107-02-8	Acrolein	ND	2.0	ND	0.87	
67-64-1	Acetone	ND	5.0	ND	2.1	
75-69-4	Trichlorofluoromethane	ND	0.10	ND	0.018	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	5.0	ND	2.0	
107-13-1	Acrylonitrile	ND	0.50	ND	0.23	
75-35-4	1,1-Dichloroethene	ND	0.10	ND	0.025	
75-09-2	Methylene Chloride	ND	0.50	ND	0.14	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.10	ND	0.032	
76-13-1	Trichlorotrifluoroethane	ND	0.10	ND	0.013	
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
156-60-5	trans-1,2-Dichloroethene	ND	0.10	ND	0.025	
75-34-3	1,1-Dichloroethane	ND	0.10	ND	0.025	
1634-04-4	Methyl tert-Butyl Ether	ND	0.10	ND	0.028	
108-05-4	Vinyl Acetate	ND	5.0	ND	1.4	
78-93-3	2-Butanone (MEK)	ND	5.0	ND	1.7	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 2 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P121001-MB

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/1/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	0.10	ND	0.025	
141-78-6	Ethyl Acetate	ND	1.0	ND	0.28	
110-54-3	n-Hexane	ND	0.50	ND	0.14	
67-66-3	Chloroform	ND	0.10	ND	0.020	
109-99-9	Tetrahydrofuran (THF)	ND	0.50	ND	0.17	
107-06-2	1,2-Dichloroethane	ND	0.10	ND	0.025	
71-55-6	1,1,1-Trichloroethane	ND	0.10	ND	0.018	
71-43-2	Benzene	ND	0.10	ND	0.031	
56-23-5	Carbon Tetrachloride	ND	0.10	ND	0.016	
110-82-7	Cyclohexane	ND	1.0	ND	0.29	
78-87-5	1,2-Dichloropropane	ND	0.10	ND	0.022	
75-27-4	Bromodichloromethane	ND	0.10	ND	0.015	
79-01-6	Trichloroethene	ND	0.10	ND	0.019	
123-91-1	1,4-Dioxane	ND	0.50	ND	0.14	
80-62-6	Methyl Methacrylate	ND	1.0	ND	0.24	
142-82-5	n-Heptane	ND	0.50	ND	0.12	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	ND	0.11	
108-10-1	4-Methyl-2-pentanone	ND	0.50	ND	0.12	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	ND	0.11	
79-00-5	1,1,2-Trichloroethane	ND	0.10	ND	0.018	
108-88-3	Toluene	ND	0.50	ND	0.13	
591-78-6	2-Hexanone	ND	0.50	ND	0.12	
124-48-1	Dibromochloromethane	ND	0.10	ND	0.012	
106-93-4	1,2-Dibromoethane	ND	0.10	ND	0.013	
123-86-4	n-Butyl Acetate	ND	0.50	ND	0.11	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Sample ID:	**Method Blank**	CAS Sample ID:	P121001-MB
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Test Code:	EPA TO-15	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	NA
Analyst:	Lusine Hakobyan	Date Analyzed:	10/1/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	ND	0.50	ND	0.11	
127-18-4	Tetrachloroethene	ND	0.10	ND	0.015	
108-90-7	Chlorobenzene	ND	0.10	ND	0.022	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	0.50	ND	0.12	
75-25-2	Bromoform	ND	0.50	ND	0.048	
100-42-5	Styrene	ND	0.50	ND	0.12	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
111-84-2	n-Nonane	ND	0.50	ND	0.095	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.10	ND	0.015	
98-82-8	Cumene	ND	0.50	ND	0.10	
80-56-8	alpha-Pinene	ND	0.50	ND	0.090	
103-65-1	n-Propylbenzene	ND	0.50	ND	0.10	
622-96-8	4-Ethyltoluene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	
100-44-7	Benzyl Chloride	ND	0.50	ND	0.097	
541-73-1	1,3-Dichlorobenzene	ND	0.10	ND	0.017	
106-46-7	1,4-Dichlorobenzene	ND	0.10	ND	0.017	
95-50-1	1,2-Dichlorobenzene	ND	0.10	ND	0.017	
5989-27-5	d-Limonene	ND	0.50	ND	0.090	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.50	ND	0.052	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	ND	0.067	
91-20-3	Naphthalene	ND	0.50	ND	0.095	
87-68-3	Hexachlorobutadiene	ND	0.50	ND	0.047	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**
CAS Project ID: P1203938

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 9/18 - 9/19/12
Date(s) Received: 9/25 - 9/26/12
Date(s) Analyzed: 9/28 - 10/1/12

Client Sample ID	**CAS Sample ID**	**1,2-Dichloroethane-d4** Percent Recovered	**Toluene-d8** Percent Recovered	**Bromofluorobenzene** Percent Recovered	Acceptance Limits	**Data Qualifier**
Method Blank	P120928-MB	**103**	**96**	**102**	70-130	
Method Blank	P121001-MB	**105**	**101**	**104**	70-130	
Lab Control Sample	P120928-LCS	**109**	**105**	**101**	70-130	
Lab Control Sample	P121001-LCS	**102**	**90**	**95**	70-130	
Indoor-C1	P1203938-001	**102**	**97**	**111**	70-130	
Outdoor-C1	P1203938-002	**107**	**95**	**106**	70-130	
SS-1C	P1203938-003	**97**	**95**	**104**	70-130	
SS-2C	P1203938-004	**98**	**96**	**103**	70-130	
SS-2C	P1203938-004DUP	**106**	**95**	**105**	70-130	
SS-3C	P1203938-005	**105**	**96**	**103**	70-130	
Indoor-1-BL	P1203938-006	**104**	**98**	**100**	70-130	
Indoor-1-PP	P1203938-007	**104**	**100**	**102**	70-130	
Indoor-1-NP	P1203938-008	**111**	**97**	**104**	70-130	
Dup 1	P1203938-009	**99**	**99**	**104**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P120928-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
115-07-1	Propene	204	**211**	**103**	59-137	
75-71-8	Dichlorodifluoromethane (CFC 12)	202	**197**	**98**	63-115	
74-87-3	Chloromethane	196	**191**	**97**	59-124	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	206	**211**	**102**	65-113	
75-01-4	Vinyl Chloride	200	**199**	**100**	59-121	
106-99-0	1,3-Butadiene	210	**224**	**107**	60-138	
74-83-9	Bromomethane	200	**199**	**100**	69-129	
75-00-3	Chloroethane	202	**193**	**96**	60-120	
64-17-5	Ethanol	958	**874**	**91**	58-121	
75-05-8	Acetonitrile	202	**215**	**106**	64-129	
107-02-8	Acrolein	204	**192**	**94**	54-127	
67-64-1	Acetone	1,040	**1020**	**98**	59-114	
75-69-4	Trichlorofluoromethane	210	**192**	**91**	66-108	
67-63-0	2-Propanol (Isopropyl Alcohol)	396	**354**	**89**	50-113	
107-13-1	Acrylonitrile	206	**254**	**123**	72-135	
75-35-4	1,1-Dichloroethene	218	**206**	**94**	70-117	
75-09-2	Methylene Chloride	212	**208**	**98**	61-108	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	214	**196**	**92**	70-131	
76-13-1	Trichlorotrifluoroethane	212	**199**	**94**	70-113	
75-15-0	Carbon Disulfide	208	**183**	**88**	65-112	
156-60-5	trans-1,2-Dichloroethene	202	**217**	**107**	71-119	
75-34-3	1,1-Dichloroethane	206	**198**	**96**	71-116	
1634-04-4	Methyl tert-Butyl Ether	204	**203**	**100**	67-116	
108-05-4	Vinyl Acetate	988	**1160**	**117**	59-142	
78-93-3	2-Butanone (MEK)	212	**229**	**108**	68-125	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 2 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P120928-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	214	**209**	**98**	69-119	
141-78-6	Ethyl Acetate	412	**422**	**102**	63-130	
110-54-3	n-Hexane	206	**182**	**88**	57-120	
67-66-3	Chloroform	222	**204**	**92**	69-111	
109-99-9	Tetrahydrofuran (THF)	208	**217**	**104**	57-123	
107-06-2	1,2-Dichloroethane	208	**212**	**102**	70-118	
71-55-6	1,1,1-Trichloroethane	204	**191**	**94**	73-119	
71-43-2	Benzene	208	**186**	**89**	66-121	
56-23-5	Carbon Tetrachloride	212	**217**	**102**	74-129	
110-82-7	Cyclohexane	402	**356**	**89**	70-113	
78-87-5	1,2-Dichloropropane	204	**179**	**88**	69-118	
75-27-4	Bromodichloromethane	204	**197**	**97**	75-124	
79-01-6	Trichloroethene	198	**194**	**98**	73-115	
123-91-1	1,4-Dioxane	206	**188**	**91**	71-123	
80-62-6	Methyl Methacrylate	414	**390**	**94**	72-127	
142-82-5	n-Heptane	202	**174**	**86**	68-120	
10061-01-5	cis-1,3-Dichloropropene	196	**193**	**98**	71-130	
108-10-1	4-Methyl-2-pentanone	210	**191**	**91**	69-130	
10061-02-6	trans-1,3-Dichloropropene	218	**228**	**105**	76-133	
79-00-5	1,1,2-Trichloroethane	202	**182**	**90**	73-120	
108-88-3	Toluene	208	**181**	**87**	67-111	
591-78-6	2-Hexanone	228	**206**	**90**	70-123	
124-48-1	Dibromochloromethane	216	**212**	**98**	75-129	
106-93-4	1,2-Dibromoethane	208	**194**	**93**	73-122	
123-86-4	n-Butyl Acetate	228	**229**	**100**	68-132	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 3 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P120928-LCS

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
111-65-9	n-Octane	206	**193**	**94**	68-116	
127-18-4	Tetrachloroethene	190	**185**	**97**	67-119	
108-90-7	Chlorobenzene	208	**188**	**90**	69-113	
100-41-4	Ethylbenzene	206	**178**	**86**	71-117	
179601-23-1	m,p-Xylenes	412	**381**	**92**	70-116	
75-25-2	Bromoform	216	**207**	**96**	69-127	
100-42-5	Styrene	208	**195**	**94**	71-125	
95-47-6	o-Xylene	200	**176**	**88**	70-116	
111-84-2	n-Nonane	202	**172**	**85**	68-116	
79-34-5	1,1,2,2-Tetrachloroethane	198	**174**	**88**	70-119	
98-82-8	Cumene	196	**185**	**94**	70-116	
80-56-8	alpha-Pinene	192	**182**	**95**	71-119	
103-65-1	n-Propylbenzene	198	**189**	**95**	71-119	
622-96-8	4-Ethyltoluene	204	**197**	**97**	71-119	
108-67-8	1,3,5-Trimethylbenzene	208	**192**	**92**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**185**	**93**	73-127	
100-44-7	Benzyl Chloride	206	**215**	**104**	65-137	
541-73-1	1,3-Dichlorobenzene	206	**208**	**101**	68-123	
106-46-7	1,4-Dichlorobenzene	212	**201**	**95**	65-120	
95-50-1	1,2-Dichlorobenzene	204	**186**	**91**	67-121	
5989-27-5	d-Limonene	206	**183**	**89**	67-130	
96-12-8	1,2-Dibromo-3-chloropropane	202	**206**	**102**	72-133	
120-82-1	1,2,4-Trichlorobenzene	200	**183**	**92**	62-133	
91-20-3	Naphthalene	178	**152**	**85**	56-138	
87-68-3	Hexachlorobutadiene	208	**182**	**88**	60-128	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 1 of 3

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Lab Control Sample**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P121001-LCS
Test Code:	EPA TO-15	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	NA
Analyst:	Lusine Hakobyan	Date Analyzed:	10/01/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.125 Liter(s)
Test Notes:			

CAS #	**Compound**	Spike Amount μg/m³	**Result μg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
115-07-1	Propene	204	**189**	**93**	59-137	
75-71-8	Dichlorodifluoromethane (CFC 12)	202	**180**	**89**	63-115	
74-87-3	Chloromethane	196	**178**	**91**	59-124	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	206	**196**	**95**	65-113	
75-01-4	Vinyl Chloride	200	**186**	**93**	59-121	
106-99-0	1,3-Butadiene	210	**211**	**100**	60-138	
74-83-9	Bromomethane	200	**180**	**90**	69-129	
75-00-3	Chloroethane	202	**181**	**90**	60-120	
64-17-5	Ethanol	958	**839**	**88**	58-121	
75-05-8	Acetonitrile	202	**199**	**99**	64-129	
107-02-8	Acrolein	204	**175**	**86**	54-127	
67-64-1	Acetone	1,040	**924**	**89**	59-114	
75-69-4	Trichlorofluoromethane	210	**184**	**88**	66-108	
67-63-0	2-Propanol (Isopropyl Alcohol)	396	**340**	**86**	50-113	
107-13-1	Acrylonitrile	206	**235**	**114**	72-135	
75-35-4	1,1-Dichloroethene	218	**199**	**91**	70-117	
75-09-2	Methylene Chloride	212	**191**	**90**	61-108	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	214	**185**	**86**	70-131	
76-13-1	Trichlorotrifluoroethane	212	**203**	**96**	70-113	
75-15-0	Carbon Disulfide	208	**178**	**86**	65-112	
156-60-5	trans-1,2-Dichloroethene	202	**206**	**102**	71-119	
75-34-3	1,1-Dichloroethane	206	**183**	**89**	71-116	
1634-04-4	Methyl tert-Butyl Ether	204	**187**	**92**	67-116	
108-05-4	Vinyl Acetate	988	**1080**	**109**	59-142	
78-93-3	2-Butanone (MEK)	212	**231**	**109**	68-125	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 2 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669** CAS Sample ID: P121001-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 10/01/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	214	**196**	**92**	69-119	
141-78-6	Ethyl Acetate	412	**427**	**104**	63-130	
110-54-3	n-Hexane	206	**183**	**89**	57-120	
67-66-3	Chloroform	222	**202**	**91**	69-111	
109-99-9	Tetrahydrofuran (THF)	208	**189**	**91**	57-123	
107-06-2	1,2-Dichloroethane	208	**199**	**96**	70-118	
71-55-6	1,1,1-Trichloroethane	204	**192**	**94**	73-119	
71-43-2	Benzene	208	**177**	**85**	66-121	
56-23-5	Carbon Tetrachloride	212	**208**	**98**	74-129	
110-82-7	Cyclohexane	402	**342**	**85**	70-113	
78-87-5	1,2-Dichloropropane	204	**186**	**91**	69-118	
75-27-4	Bromodichloromethane	204	**199**	**98**	75-124	
79-01-6	Trichloroethene	198	**195**	**98**	73-115	
123-91-1	1,4-Dioxane	206	**189**	**92**	71-123	
80-62-6	Methyl Methacrylate	414	**401**	**97**	72-127	
142-82-5	n-Heptane	202	**177**	**88**	68-120	
10061-01-5	cis-1,3-Dichloropropene	196	**200**	**102**	71-130	
108-10-1	4-Methyl-2-pentanone	210	**196**	**93**	69-130	
10061-02-6	trans-1,3-Dichloropropene	218	**228**	**105**	76-133	
79-00-5	1,1,2-Trichloroethane	202	**186**	**92**	73-120	
108-88-3	Toluene	208	**165**	**79**	67-111	
591-78-6	2-Hexanone	228	**196**	**86**	70-123	
124-48-1	Dibromochloromethane	216	**193**	**89**	75-129	
106-93-4	1,2-Dibromoethane	208	**175**	**84**	73-122	
123-86-4	n-Butyl Acetate	228	**198**	**87**	68-132	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 3 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P121001-LCS

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/01/12
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
111-65-9	n-Octane	206	**161**	**78**	68-116	
127-18-4	Tetrachloroethene	190	**157**	**83**	67-119	
108-90-7	Chlorobenzene	208	**183**	**88**	69-113	
100-41-4	Ethylbenzene	206	**179**	**87**	71-117	
179601-23-1	m,p-Xylenes	412	**351**	**85**	70-116	
75-25-2	Bromoform	216	**205**	**95**	69-127	
100-42-5	Styrene	208	**180**	**87**	71-125	
95-47-6	o-Xylene	200	**169**	**85**	70-116	
111-84-2	n-Nonane	202	**159**	**79**	68-116	
79-34-5	1,1,2,2-Tetrachloroethane	198	**168**	**85**	70-119	
98-82-8	Cumene	196	**153**	**78**	70-116	
80-56-8	alpha-Pinene	192	**150**	**78**	71-119	
103-65-1	n-Propylbenzene	198	**158**	**80**	71-119	
622-96-8	4-Ethyltoluene	204	**166**	**81**	71-119	
108-67-8	1,3,5-Trimethylbenzene	208	**176**	**85**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**163**	**82**	73-127	
100-44-7	Benzyl Chloride	206	**196**	**95**	65-137	
541-73-1	1,3-Dichlorobenzene	206	**184**	**89**	68-123	
106-46-7	1,4-Dichlorobenzene	212	**176**	**83**	65-120	
95-50-1	1,2-Dichlorobenzene	204	**168**	**82**	67-121	
5989-27-5	d-Limonene	206	**162**	**79**	67-130	
96-12-8	1,2-Dibromo-3-chloropropane	202	**178**	**88**	72-133	
120-82-1	1,2,4-Trichlorobenzene	200	**184**	**92**	62-133	
91-20-3	Naphthalene	178	**148**	**83**	56-138	
87-68-3	Hexachlorobutadiene	208	**177**	**85**	60-128	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY DUPLICATE SUMMARY RESULTS

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **SS-2C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-004DUP

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00977

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.020 Liter(s)

Initial Pressure (psig): -0.30 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.27

Compound	Sample Result		**Duplicate Sample Result**		Average	**% RPD**	RPD Limit	**Data Qualifier**
	µg/m³	ppbV	**µg/m³**	ppbV	µg/m³			
Propene	ND	ND	ND	ND	-	-	25	
Dichlorodifluoromethane (CFC 12)	ND	ND	ND	ND	-	-	25	
Chloromethane	ND	ND	ND	ND	-	-	25	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	ND	ND	ND	-	-	25	
Vinyl Chloride	ND	ND	ND	ND	-	-	25	
1,3-Butadiene	ND	ND	ND	ND	-	-	25	
Bromomethane	ND	ND	ND	ND	-	-	25	
Chloroethane	ND	ND	ND	ND	-	-	25	
Ethanol	ND	ND	ND	ND	-	-	25	
Acetonitrile	ND	ND	ND	ND	-	-	25	
Acrolein	ND	ND	ND	ND	-	-	25	
Acetone	3,330	1,400	3,570	1,510	3450	**7**	25	
Trichlorofluoromethane	ND	ND	ND	ND	-	-	25	
2-Propanol (Isopropyl Alcohol)	ND	ND	ND	ND	-	-	25	
Acrylonitrile	ND	ND	ND	ND	-	-	25	
1,1-Dichloroethene	ND	ND	ND	ND	-	-	25	
Methylene Chloride	ND	ND	ND	ND	-	-	25	
3-Chloro-1-propene (Allyl Chloride)	ND	ND	ND	ND	-	-	25	
Trichlorotrifluoroethane	ND	ND	ND	ND	-	-	25	
Carbon Disulfide	ND	ND	ND	ND	-	-	25	
trans-1,2-Dichloroethene	ND	ND	ND	ND	-	-	25	
1,1-Dichloroethane	ND	ND	ND	ND	-	-	25	
Methyl tert-Butyl Ether	ND	ND	ND	ND	-	-	25	
Vinyl Acetate	ND	ND	ND	ND	-	-	25	
2-Butanone (MEK)	ND	ND	ND	ND	-	-	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

LABORATORY DUPLICATE SUMMARY RESULTS

Page 2 of 3

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**SS-2C**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-004DUP
Test Code:	EPA TO-15	Date Collected:	9/18/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/25/12
Analyst:	Lusine Hakobyan	Date Analyzed:	9/28/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.020 Liter(s)
Test Notes:			
Container ID:	AC00977		

Initial Pressure (psig): -0.30 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.27

Compound	Sample Result µg/m³	Sample Result ppbV	**Duplicate Sample Result µg/m³**	**Duplicate Sample Result ppbV**	Average µg/m³	**% RPD**	RPD Limit	**Data Qualifier**
cis-1,2-Dichloroethene	ND	ND	ND	ND	-	-	25	
Ethyl Acetate	ND	ND	ND	ND	-	-	25	
n-Hexane	1,220	346	1,270	361	1245	**4**	25	
Chloroform	ND	ND	ND	ND	-	-	25	
Tetrahydrofuran (THF)	ND	ND	ND	ND	-	-	25	
1,2-Dichloroethane	ND	ND	ND	ND	-	-	25	
1,1,1-Trichloroethane	ND	ND	ND	ND	-	-	25	
Benzene	57.8	18.1	55.1	17.3	56.45	**5**	25	
Carbon Tetrachloride	ND	ND	ND	ND	-	-	25	
Cyclohexane	479	139	479	139	479	**0**	25	
1,2-Dichloropropane	ND	ND	ND	ND	-	-	25	
Bromodichloromethane	ND	ND	ND	ND	-	-	25	
Trichloroethene	26.0	4.85	27.0	5.02	26.5	**4**	25	
1,4-Dioxane	ND	ND	ND	ND	-	-	25	
Methyl Methacrylate	ND	ND	ND	ND	-	-	25	
n-Heptane	958	234	988	241	973	**3**	25	
cis-1,3-Dichloropropene	ND	ND	ND	ND	-	-	25	
4-Methyl-2-pentanone	ND	ND	ND	ND	-	-	25	
trans-1,3-Dichloropropene	ND	ND	ND	ND	-	-	25	
1,1,2-Trichloroethane	ND	ND	ND	ND	-	-	25	
Toluene	52.5	13.9	53.9	14.3	53.2	**3**	25	
2-Hexanone	ND	ND	ND	ND	-	-	25	
Dibromochloromethane	ND	ND	ND	ND	-	-	25	
1,2-Dibromoethane	ND	ND	ND	ND	-	-	25	
n-Butyl Acetate	ND	ND	ND	ND	-	-	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

LABORATORY DUPLICATE SUMMARY RESULTS

Page 3 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **SS-2C**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-004DUP

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00977

Date Collected: 9/18/12
Date Received: 9/25/12
Date Analyzed: 9/28/12
Volume(s) Analyzed: 0.020 Liter(s)

Initial Pressure (psig): -0.30
Final Pressure (psig): 3.54

Canister Dilution Factor: 1.27

Compound	Sample Result µg/m³	Sample Result ppbV	**Duplicate Sample Result µg/m³**	**Duplicate Sample Result ppbV**	Average µg/m³	**% RPD**	RPD Limit	**Data Qualifier**
n-Octane	210	44.9	207	44.3	208.5	**1**	25	
Tetrachloroethene	5,030	742	4,840	714	4935	**4**	25	
Chlorobenzene	ND	ND	ND	ND	-	-	25	
Ethylbenzene	427	98.3	457	105	442	**7**	25	
m,p-Xylenes	765	176	810	187	787.5	**6**	25	
Bromoform	ND	ND	ND	ND	-	-	25	
Styrene	ND	ND	ND	ND	-	-	25	
o-Xylene	ND	ND	ND	ND	-	-	25	
n-Nonane	51.5	9.82	51.9	9.91	51.7	**0.8**	25	
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	-	-	25	
Cumene	34.4	7.00	35.8	7.29	35.1	**4**	25	
alpha-Pinene	ND	ND	ND	ND	-	-	25	
n-Propylbenzene	133	27.0	142	28.9	137.5	**7**	25	
4-Ethyltoluene	257	52.2	273	55.5	265	**6**	25	
1,3,5-Trimethylbenzene	219	44.6	236	48.1	227.5	**7**	25	
1,2,4-Trimethylbenzene	857	174	911	185	884	**6**	25	
Benzyl Chloride	ND	ND	ND	ND	-	-	25	
1,3-Dichlorobenzene	ND	ND	ND	ND	-	-	25	
1,4-Dichlorobenzene	ND	ND	ND	ND	-	-	25	
1,2-Dichlorobenzene	ND	ND	ND	ND	-	-	25	
d-Limonene	ND	ND	ND	ND	-	-	25	
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	-	-	25	
1,2,4-Trichlorobenzene	ND	ND	ND	ND	-	-	25	
Naphthalene	ND	ND	ND	ND	-	-	25	
Hexachlorobutadiene	ND	ND	ND	ND	-	-	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

Method Blank Summary

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Lab File ID: 09281203.D
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 10:33
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P120928-LCS	09281204.D	11:08
Indoor-C1	P1203938-001	09281207.D	12:57
SS-2C	P1203938-004	09281209.D	14:06
Outdoor-C1	P1203938-002	09281210.D	14:55
SS-2C (Lab Duplicate)	P1203938-004DUP	09281212.D	16:02
SS-1C	P1203938-003	09281214.D	17:15
SS-3C	P1203938-005	09281215.D	17:48
SS-3C (Dilution)	P1203938-005	09281216.D	18:22
Indoor-1-BL	P1203938-006	09281217.D	18:55
Indoor-1-BL (Dilution)	P1203938-006	09281218.D	19:29
Indoor-1-PP	P1203938-007	09281219.D	20:03
Indoor-1-NP	P1203938-008	09281220.D	20:36
Indoor-1-NP (Dilution)	P1203938-008	09281221.D	21:10
Dup 1	P1203938-009	09281222.D	21:44

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

Method Blank Summary

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Lab File ID: 10011203.D
Analyst: Lusine Hakobyan Date Analyzed: 10/01/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 10:06
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P121001-LCS	10011204.D	10:48
Dup 1 (Dilution)	P1203938-009	10011207.D	12:33
Indoor-1-PP (Dilution)	P1203938-007	10011209.D	14:02

RESULTS OF ANALYSIS
Page 1 of 1

Client: **GSI Environmental Inc.** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

Internal Standard Area and RT Summary

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Lab File ID: 09281201.D
Analyst: Lusine Hakobyan Date Analyzed: 9/28/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 09:18
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	175739		11.30		771015		13.51		328997		17.46	
	Upper Limit	246035		11.63		1079421		13.84		460596		17.79	
	Lower Limit	105443		10.97		462609		13.18		197398		17.13	
	Client Sample ID												
01	Method Blank	174843		11.29		744034		13.51		316825		17.46	
02	Lab Control Sample	171874		11.31		735716		13.52		328833		17.46	
03	Indoor-C1	171333		11.31		683371		13.52		316587		17.46	
04	SS-2C	144647		11.30		564538		13.51		256648		17.46	
05	Outdoor-C1	183162		11.29		756778		13.51		358192		17.46	
06	SS-2C (Lab Duplicate)	139679		11.30		579632		13.51		261988		17.46	
07	SS-1C	172578		11.29		630876		13.51		309539		17.46	
08	SS-3C	166674		11.30		682369		13.51		320330		17.46	
09	SS-3C (Dilution)	132758		11.29		528587		13.51		242416		17.46	
10	Indoor-1-BL	166859		11.31		672825		13.52		309382		17.46	
11	Indoor-1-BL (Dilution)	133721		11.30		588837		13.51		260292		17.46	
12	Indoor-1-PP	144053		11.31		591128		13.52		263148		17.46	
13	Indoor-1-NP	124064		11.31		538874		13.52		235840		17.46	
14	Indoor-1-NP (Dilution)	139020		11.30		575890		13.51		257342		17.46	
15	Dup 1	141720		11.31		529231		13.52		269456		17.46	
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

Internal Standard Area and RT Summary

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Lab File ID: 10011201.D
Analyst: Lusine Hakobyan
Date Analyzed: 10/1/12
Sampling Media: 6.0 L Summa Canister(s)
Time Analyzed: 08:50
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	173895		11.30		701985		13.51		317585		17.46	
	Upper Limit	243453		11.63		982779		13.84		444619		17.79	
	Lower Limit	104337		10.97		421191		13.18		190551		17.13	
	Client Sample ID												
01	Method Blank	160822		11.29		716751		13.51		292160		17.46	
02	Lab Control Sample	171059		11.31		678667		13.52		340534		17.46	
03	Dup 1 (Dilution)	145877		11.30		593908		13.52		268172		17.46	
04	Indoor-1-PP (Dilution)	141213		11.30		580649		13.52		261033		17.46	
05													
06													
07													
08													
09													
10													
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15													
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits.

```
                        Response Factor Report GCMS-16

Method Path : J:\MS16\METHODS\
Method File : R16071312.M
Title       : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
Last Update  : Mon Jul 16 09:59:54 2012
Response Via : Initial Calibration

Calibration Files
0.1 =07131207.D  0.2 =07131208.D  0.5 =07131209.D  1.0 =07131210.D  5.0 =07131211.D  25   =07131212.D
50  =07131213.D  100 =07131214.D

      Compound            0.1   0.2   0.5   1.0   5.0   25    50    100   Avg      %RSD
-----------------------------------------------------------------------------------------

 1) IR  Bromochloromethane... ----------------ISTD--------------------
 2) T   Propene           1.696 1.340 1.661 1.508 1.517 1.872 1.492 1.343 1.554   11.67
 3) T   Dichlorodifluo... 3.068 2.698 2.539 2.079 2.094 2.482 1.979 1.839 2.347   17.84
 4) T   Chloromethane     2.235 1.947 1.800 1.418 1.428 1.736 1.401 1.201 1.646   20.88
 5) T   1,2-Dichloro-1... 1.641 1.480 1.428 1.148 1.163 1.337 1.089 1.026 1.289   16.78
 6) T   Vinyl Chloride    1.999 1.722 1.697 1.389 1.431 1.695 1.369 1.311 1.576   15.13
 7) T   1,3-Butadiene     1.417 1.109 1.173 0.947 0.988 1.232 0.995 0.948 1.101   15.10
 8) T   Bromomethane      1.419 1.204 1.210 0.934 0.939 1.122 0.923 0.879 1.079   17.70
 9) T   Chloroethane      1.042 0.807 0.858 0.700 0.692 0.816 0.666 0.632 0.776   17.26
10) T   Ethanol           1.321 1.022 0.921 0.722 0.644 0.841 0.695 0.658 0.853   27.16
11) T   Acetonitrile      2.423 1.952 1.889 1.550 1.455 1.841 1.529 1.461 1.763   18.94
12) T   Acrolein          0.728 0.684 0.612 0.474 0.527 0.620 0.506 0.481 0.579   16.60
13) T   Acetone                 0.971 0.863 0.675 0.635 0.746 0.602 0.566 0.722   20.44
14) T   Trichlorofluor... 2.806 2.335 2.378 1.866 1.902 2.237 1.816 1.702 2.130   17.52
15) T   2-Propanol (Is...             2.275 1.384 1.332 1.523 1.259 1.229 1.500   26.25
16) T   Acrylonitrile     0.814 0.941 1.159 1.009 1.077 1.346 1.107 1.055 1.063   14.72
17) T   1,1-Dichloroet... 1.230 1.158 1.118 0.911 0.923 1.097 0.902 0.860 1.025   13.77
18) T   2-Methyl-2-Pro...       3.047 3.011 2.321 2.359 1.407             2.429   27.48
19) T   Methylene Chlo...             1.302 1.038 0.951 1.118 0.907 0.864 1.030   15.68
20) T   3-Chloro-1-pro... 1.964 1.763 1.638 1.329 1.399 1.690 1.374 1.316 1.559   15.35
21) T   Trichlorotrifl... 1.457 1.270 1.210 0.988 0.978 1.149 0.930 0.876 1.107   17.97
22) T   Carbon Disulfide  5.408 4.597 4.360 3.491 3.567 4.206 3.455 3.268 4.044   18.16
23) T   trans-1,2-Dich... 1.733 1.501 1.606 1.343 1.392 1.683 1.380 1.314 1.494   10.85
24) T   1,1-Dichloroet... 2.716 2.180 2.126 1.718 1.746 2.071 1.685 1.592 1.979   18.83
25) T   Methyl tert-Bu... 4.329 3.512 3.603 2.819 2.879 3.490 2.836 2.365 3.229   19.19
26) T   Vinyl Acetate     0.180 0.193 0.207 0.186 0.200 0.255 0.207 0.176 0.200   12.52
27) T   2-Butanone (MEK)  0.665 0.627 0.689 0.572 0.593 0.691 0.492 0.387 0.589   17.91
28) T   cis-1,2-Dichlo... 1.856 1.550 1.599 1.264 1.302 1.592 1.291 1.217 1.459   15.38
29) T   Diisopropyl Ether 1.153 0.921 0.911 0.752 0.737 0.882 0.710 0.662 0.841   18.98
30) T   Ethyl Acetate     0.354 0.333 0.383 0.338 0.342 0.421 0.339 0.323 0.354    9.15
31) T   n-Hexane          2.503 2.061 2.003 1.616 1.603 1.880 1.509 1.399 1.822   19.95
```

```
Method Path : J:\MS16\METHODS\
Method File : R16071312.M
Title       : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
32) T   Chloroform        2.590 2.190 2.049 1.627 1.661 1.979 1.601 1.501 1.900   19.59
33) S   1,2-Dichloroet... 1.293 1.293 1.298 1.309 1.306 1.298 1.297 1.291 1.298    0.49
34) T   Tetrahydrofura...             0.832 0.621 0.598 0.681 0.556 0.524 0.635   17.40
35) T   Ethyl tert-But... 1.782 1.419 1.379 1.125 1.138 1.376 1.124 1.050 1.299   18.61
36) T   1,2-Dichloroet... 1.823 1.593 1.571 1.286 1.275 1.554 1.258 1.176 1.442   15.60

37) IR  1,4-Difluorobenzen... ----------------ISTD--------------------
38) T   1,1,1-Trichlor... 0.596 0.468 0.462 0.375 0.375 0.466 0.372 0.347 0.433   19.07
39) T   Isopropyl Acetate 0.196 0.179 0.167 0.138 0.141 0.176 0.141 0.134 0.159   14.73
40) T   1-Butanol         0.307 0.262 0.241 0.198 0.212 0.284 0.229 0.215 0.244   15.59
41) T   Benzene           1.666 1.323 1.162 0.902 0.871 1.063 0.851 0.807 1.081   27.36
42) T   Carbon Tetrach... 0.442 0.380 0.370 0.296 0.315 0.398 0.321 0.302 0.353   14.86
43) T   Cyclohexane       0.556 0.460 0.443 0.349 0.349 0.430 0.342 0.324 0.407   19.59
44) T   tert-Amyl Meth... 0.959 0.888 0.828 0.671 0.687 0.854 0.687 0.650 0.778   15.14
45) T   1,2-Dichloropr... 0.359 0.301 0.291 0.236 0.235 0.290 0.234 0.224 0.271   17.38
46) T   Bromodichlorom... 0.449 0.389 0.386 0.311 0.325 0.405 0.324 0.308 0.362   14.40
47) T   Trichloroethene   0.386 0.352 0.343 0.276 0.279 0.354 0.283 0.268 0.318   14.44
48) T   1,4-Dioxane       0.276 0.241 0.225 0.179 0.183 0.232 0.187 0.177 0.212   17.19
49) T   2,2,4-Trimethy... 1.498 1.307 1.250 0.969 0.978 1.205 0.966 0.913 1.136   18.53
50) T   Methyl Methacr... 0.145 0.122 0.121 0.096 0.102 0.128 0.103 0.098 0.114   15.20
51) T   n-Heptane         0.369 0.290 0.277 0.221 0.226 0.280 0.224 0.212 0.262   20.30
52) T   cis-1,3-Dichlo... 0.467 0.434 0.417 0.350 0.384 0.488 0.396 0.377 0.414   11.29
53) T   4-Methyl-2-pen... 0.294 0.264 0.247 0.205 0.214 0.269 0.218 0.207 0.240   13.97
54) T   trans-1,3-Dich... 0.373 0.352 0.361 0.311 0.350 0.455 0.369 0.353 0.365   11.19
55) T   1,1,2-Trichlor... 0.350 0.306 0.296 0.232 0.240 0.297 0.240 0.228 0.274   16.39

56) IR  Chlorobenzene-d5 (... ----------------ISTD--------------------
57) S   Toluene-d8 (SS2)  2.300 2.325 2.319 2.315 2.322 2.293 2.307 2.295 2.309    0.54
58) T   Toluene           3.746 3.082 2.819 2.216 2.227 2.690 2.171 2.017 2.621   22.38
59) T   2-Hexanone        1.609 1.363 1.391 1.023 1.119 1.379 1.113 1.040 1.255   16.77
60) T   Dibromochlorom... 0.831 0.767 0.746 0.625 0.662 0.826 0.671 0.629 0.720   11.69
61) T   1,2-Dibromoethane 0.908 0.762 0.744 0.610 0.643 0.794 0.639 0.601 0.713   15.12
62) T   n-Butyl Acetate   1.763 1.549 1.525 1.230 1.330 1.678 1.394 1.344 1.477   12.45
63) T   n-Octane          0.700 0.617 0.590 0.468 0.477 0.567 0.455 0.426 0.538   17.82
64) T   Tetrachloroethene 1.244 1.079 0.970 0.791 0.800 0.972 0.782 0.729 0.921   19.34
65) T   Chlorobenzene     2.378 1.941 1.911 1.514 1.524 1.845 1.486 1.391 1.749   18.98
66) T   Ethylbenzene      4.163 3.380 3.161 2.556 2.571 3.086 2.489 2.303 2.964   20.75
67) T   m- & p-Xylenes    3.266 2.687 2.524 1.999 2.020 2.438 1.965 1.822 2.340   20.74
68) T   Bromoform         0.794 0.716 0.712 0.596 0.655 0.842 0.684 0.650 0.706   11.33
69) T   Styrene           2.309 1.852 1.860 1.497 1.586 1.941 1.572 1.474 1.761   16.20
70) T   o-Xylene          3.478 2.791 2.674 2.087 2.130 2.558 2.051 1.913 2.460   21.26
```

```
Method Path : J:\MS16\METHODS\
Method File : R16071312.M
Title       : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
 71) T   n-Nonane           1.829 1.467 1.422 1.122 1.158 1.374 1.103 1.028 1.313   20.20
 72) T   1,1,2,2-Tetrac...  1.471 1.264 1.247 0.975 1.024 1.248 1.005 0.943 1.147   16.33
 73) S   Bromofluoroben...  1.181 1.192 1.193 1.209 1.192 1.176 1.198 1.187 1.191    0.85
 74) T   Cumene             4.597 4.210 3.523 2.746 2.799 3.341 2.692 2.478 3.298   23.38
 75) T   alpha-Pinene       2.024 1.722 1.661 1.325 1.370 1.643 1.331 1.247 1.541   17.30
 76) T   n-Propylbenzene    5.361 4.357 4.010 3.255 3.301 3.992 3.205 2.941 3.803   21.01
 77) T   3-Ethyltoluene     3.796 3.263 3.263 2.631 2.696 3.211 2.718 2.387 2.995   15.46
 78) T   4-Ethyltoluene     3.849 3.230 3.064 2.471 2.442 3.080 2.344 2.295 2.847   19.30
 79) T   1,3,5-Trimethy...  3.737 2.685 2.721 2.064 2.135 2.586 2.087 1.932 2.493   23.66
 80) T   alpha-Methylst...  1.616 1.424 1.377 1.100 1.187 1.475 1.194 1.115 1.311   14.38
 81) T   2-Ethyltoluene     4.529 3.683 3.401 2.634 2.696 3.250 2.616 2.425 3.154   22.55
 82) T   1,2,4-Trimethy...  3.895 3.059 2.678 2.129 2.197 2.670 2.149 1.979 2.595   24.69
 83) T   n-Decane           1.747 1.516 1.430 1.132 1.184 1.429 1.151 1.079 1.334   17.54
 84) T   Benzyl Chloride    1.911 1.943 1.903 1.579 1.822 2.433 1.998 1.880 1.934   12.30
 85) T   1,3-Dichlorobe...  2.106 1.761 1.641 1.310 1.360 1.674 1.347 1.258 1.557   18.76
 86) T   1,4-Dichlorobe...  2.346 1.807 1.698 1.317 1.377 1.705 1.374 1.279 1.613   22.26
 87) T   sec-Butylbenzene   4.502 3.780 3.550 2.891 2.946 3.562 2.857 2.621 3.339   18.75
 88) T   4-Isopropyltol...  4.363 3.725 3.526 2.810 2.946 3.576 2.857 2.596 3.300   18.09
 89) T   1,2,3-Trimethy...  3.424 2.813 2.714 2.140 2.241 2.735 2.207 2.040 2.539   18.44
 90) T   1,2-Dichlorobe...  1.947 1.690 1.619 1.270 1.327 1.631 1.319 1.225 1.503   17.02
 91) T   d-Limonene         1.185 0.939 0.960 0.794 0.824 1.018 0.827 0.771 0.915   15.32
 92) T   1,2-Dibromo-3-...  0.657 0.582 0.567 0.446 0.512 0.663 0.538 0.505 0.559   13.45
 93) T   n-Undecane         1.801 1.459 1.390 1.101 1.227 1.484 1.194 1.103 1.345   17.71
 94) T   1,2,4-Trichlor...  1.658 1.351 1.210 0.958 1.130 1.395 1.128 1.051 1.235   18.15
 95) T   Naphthalene        5.981 4.526 3.881 2.914 3.404 4.290 3.507 3.229 3.967   24.59
 96) T   n-Dodecane         1.537 1.273 1.216 0.987 1.272 1.519 1.238 1.152 1.274   14.27
 97) T   Hexachlorobuta...  1.161 0.949 0.852 0.703 0.742 0.894 0.722 0.673 0.837   19.57
 98) T   Cyclohexanone      1.306 1.032 0.948 0.742 0.792 0.985 0.795 0.750 0.919   20.94
 99) T   tert-Butylbenzene  3.555 2.905 2.747 2.182 2.246 2.688 2.143 1.961 2.554   20.59
100) T   n-Butylbenzene     3.342 2.755 2.672 2.133 2.291 2.767 2.233 2.058 2.531   17.10
 -------------------------------------------------------------------------------
 (#) = Out of Range
```

```
                    Evaluate Continuing Calibration Report

 Data Path : J:\MS16\DATA\2012_09\28\
 Data File : 09281201.D
 Acq On    : 28 Sep 2012   9:18
 Operator  : LH
 Sample    : 25ng TO-15 CCV STD
 Misc      : S25-09261201/S25-08301203
 ALS Vial  : 2   Sample Multiplier: 1

 Quant Time: Sep 28 11:34:10 2012
 Quant Method : J:\MS16\METHODS\R16071312.M
 Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
 QLast Update : Mon Jul 16 09:59:54 2012
 Response via : Initial Calibration


 Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
 Max. RRF Dev :  30%     Max. Rel. Area : 200%

        Compound                           AvgRF   CCRF      %Dev Area% Dev(min)
 -------------------------------------------------------------------------------
  1 IR  Bromochloromethane (IS1)          1.000   1.000      0.0  118  -0.02
  2 T   Propene                           1.554   1.456      6.3   92   0.00
  3 T   Dichlorodifluoromethane (CF       2.347   2.208      5.9  105   0.00
  4 T   Chloromethane                     1.646   1.492      9.4  101  -0.01
  5 T   1,2-Dichloro-1,1,2,2-tetraf       1.289   1.199      7.0  106  -0.01
  6 T   Vinyl Chloride                    1.576   1.485      5.8  103  -0.01
  7 T   1,3-Butadiene                     1.101   1.103     -0.2  106  -0.01
  8 T   Bromomethane                      1.079   1.033      4.3  109  -0.02
  9 T   Chloroethane                      0.776   0.726      6.4  105  -0.01
 10 T   Ethanol                           0.853   0.780      8.6  109  -0.07
 11 T   Acetonitrile                      1.763   1.665      5.6  107  -0.05
 12 T   Acrolein                          0.579   0.538      7.1  102  -0.02
 13 T   Acetone                           0.722   0.665      7.9  105  -0.05
 14 T   Trichlorofluoromethane            2.130   2.054      3.6  108  -0.01
 15 T   2-Propanol (Isopropanol)          1.500   1.615     -7.7  125  -0.05
 16 T   Acrylonitrile                     1.063   1.187    -11.7  104  -0.03
 17 T   1,1-Dichloroethene                1.025   0.971      5.3  104  -0.02
 18 T   2-Methyl-2-Propanol (tert-B       2.429   2.625     -8.1  220# -0.04
 19 T   Methylene Chloride                1.030   1.047     -1.7  110  -0.02
 20 T   3-Chloro-1-propene (Allyl C       1.559   1.516      2.8  106  -0.02
 21 T   Trichlorotrifluoroethane          1.107   1.080      2.4  111  -0.02
 22 T   Carbon Disulfide                  4.044   3.921      3.0  110  -0.02
 23 T   trans-1,2-Dichloroethene          1.494   1.490      0.3  104  -0.02
 24 T   1,1-Dichloroethane                1.979   1.820      8.0  104  -0.02
 25 T   Methyl tert-Butyl Ether           3.229   3.075      4.8  104  -0.02
 26 T   Vinyl Acetate                     0.200   0.230    -15.0  106  -0.03
 27 T   2-Butanone (MEK)                  0.589   0.620     -5.3  106  -0.02
 28 T   cis-1,2-Dichloroethene            1.459   1.426      2.3  106  -0.02
 29 T   Diisopropyl Ether                 0.841   0.771      8.3  103  -0.02
 30 T   Ethyl Acetate                     0.354   0.361     -2.0  101  -0.03
 31 T   n-Hexane                          1.822   1.623     10.9  102  -0.01
 32 T   Chloroform                        1.900   1.815      4.5  108  -0.03
 33 S   1,2-Dichloroethane-d4(SS1)        1.298   1.407     -8.4  128  -0.02
 34 T   Tetrahydrofuran (THF)             0.635   0.600      5.5  104  -0.02
 35 T   Ethyl tert-Butyl Ether            1.299   1.216      6.4  104  -0.02
 36 T   1,2-Dichloroethane                1.442   1.433      0.6  109  -0.02

 37 IR  1,4-Difluorobenzene (IS2)         1.000   1.000      0.0  129  -0.02
 38 T   1,1,1-Trichloroethane             0.433   0.385     11.1  107  -0.01

R16071312.M Fri Sep 28 11:34:29 2012                                  Page: 1
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LH 9/28/12

```
                 Evaluate Continuing Calibration Report

  Data Path : J:\MS16\DATA\2012_09\28\
  Data File : 09281201.D
  Acq On    : 28 Sep 2012   9:18
  Operator  : LH
  Sample    : 25ng TO-15 CCV STD
  Misc      : S25-09261201/S25-08301203
  ALS Vial  : 2   Sample Multiplier: 1

  Quant Time: Sep 28 11:34:10 2012
  Quant Method : J:\MS16\METHODS\R16071312.M
  Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
  QLast Update : Mon Jul 16 09:59:54 2012
  Response via : Initial Calibration


  Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
  Max. RRF Dev :  30%     Max. Rel. Area : 200%

         Compound                          AvgRF   CCRF      %Dev Area% Dev(min)
  ----------------------------------------------------------------------------
 39 T    Isopropyl Acetate                 0.159   0.148      6.9  109  -0.02
 40 T    1-Butanol                         0.244   0.241      1.2  109  -0.05
 41 T    Benzene                           1.081   0.900     16.7  109  -0.01
 42 T    Carbon Tetrachloride              0.353   0.357     -1.1  116  -0.02
 43 T    Cyclohexane                       0.407   0.360     11.5  108  -0.02
 44 T    tert-Amyl Methyl Ether            0.778   0.727      6.6  110  -0.01
 45 T    1,2-Dichloropropane               0.271   0.241     11.1  107  -0.01
 46 T    Bromodichloromethane              0.362   0.350      3.3  112  -0.01
 47 T    Trichloroethene                   0.318   0.301      5.3  110  -0.02
 48 T    1,4-Dioxane                       0.212   0.195      8.0  108  -0.02
 49 T    2,2,4-Trimethylpentane (Iso       1.136   0.990     12.9  106  -0.01
 50 T    Methyl Methacrylate               0.114   0.108      5.3  109  -0.02
 51 T    n-Heptane                         0.262   0.231     11.8  107  -0.01
 52 T    cis-1,3-Dichloropropene           0.414   0.414      0.0  110  -0.01
 53 T    4-Methyl-2-pentanone              0.240   0.221      7.9  106  -0.01
 54 T    trans-1,3-Dichloropropene         0.365   0.385     -5.5  110  -0.01
 55 T    1,1,2-Trichloroethane             0.274   0.248      9.5  108  -0.01

 56 IR   Chlorobenzene-d5 (IS3)            1.000   1.000      0.0  123   0.00
 57 S    Toluene-d8 (SS2)                  2.309   2.289      0.9  123  -0.01
 58 T    Toluene                           2.621   2.259     13.8  103  -0.01
 59 T    2-Hexanone                        1.255   1.133      9.7  101  -0.02
 60 T    Dibromochloromethane              0.720   0.706      1.9  105  -0.01
 61 T    1,2-Dibromoethane                 0.713   0.663      7.0  103  -0.01
 62 T    n-Butyl Acetate                   1.477   1.357      8.1   99  -0.01
 63 T    n-Octane                          0.538   0.460     14.5  100  -0.01
 64 T    Tetrachloroethene                 0.921   0.815     11.5  103   0.00
 65 T    Chlorobenzene                     1.749   1.531     12.5  102  -0.01
 66 T    Ethylbenzene                      2.964   2.577     13.1  103   0.00
 67 T    m- & p-Xylenes                    2.340   2.066     11.7  104  -0.01
 68 T    Bromoform                         0.706   0.729     -3.3  106  -0.01
 69 T    Styrene                           1.761   1.539     12.6   97  -0.01
 70 T    o-Xylene                          2.460   2.160     12.2  104   0.00
 71 T    n-Nonane                          1.313   1.113     15.2  100  -0.01
 72 T    1,1,2,2-Tetrachloroethane         1.147   1.047      8.7  103   0.00
 73 S    Bromofluorobenzene (SS3)          1.191   1.286     -8.0  134   0.00
 74 T    Cumene                            3.298   2.871     12.9  106   0.00
 75 T    alpha-Pinene                      1.541   1.275     17.3   95   0.00
 76 T    n-Propylbenzene                   3.803   3.308     13.0  102   0.00
```

LH 9/28/12

```
                    Evaluate Continuing Calibration Report

  Data Path : J:\MS16\DATA\2012_09\28\
  Data File : 09281201.D
  Acq On    : 28 Sep 2012   9:18
  Operator  : LH
  Sample    : 25ng TO-15 CCV STD
  Misc      : S25-09261201/S25-08301203
  ALS Vial  : 2   Sample Multiplier: 1

  Quant Time: Sep 28 11:34:10 2012
  Quant Method : J:\MS16\METHODS\R16071312.M
  Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
  QLast Update : Mon Jul 16 09:59:54 2012
  Response via : Initial Calibration


  Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
  Max. RRF Dev :  30%     Max. Rel. Area : 200%

         Compound                           AvgRF   CCRF       %Dev Area% Dev(min)
  ------------------------------------------------------------------------------
 77 T    3-Ethyltoluene                     2.995   2.687       10.3  103   0.00
 78 T    4-Ethyltoluene                     2.847   2.545       10.6  102   0.00
 79 T    1,3,5-Trimethylbenzene             2.493   2.157       13.5  103  -0.01
 80 T    alpha-Methylstyrene                1.311   0.993       24.3   83  -0.01
 81 T    2-Ethyltoluene                     3.154   2.704       14.3  102  -0.01
 82 T    1,2,4-Trimethylbenzene             2.595   2.272       12.4  105   0.00
 83 T    n-Decane                           1.334   1.168       12.4  101  -0.01
 84 T    Benzyl Chloride                    1.934   1.992       -3.0  101  -0.01
 85 T    1,3-Dichlorobenzene                1.557   1.395       10.4  102  -0.01
 86 T    1,4-Dichlorobenzene                1.613   1.483        8.1  107  -0.01
 87 T    sec-Butylbenzene                   3.339   2.989       10.5  103   0.00
 88 T    4-Isopropyltoluene (p-Cymen        3.300   3.004        9.0  103   0.00
 89 T    1,2,3-Trimethylbenzene             2.539   2.314        8.9  104   0.00
 90 T    1,2-Dichlorobenzene                1.503   1.382        8.1  104  -0.01
 91 T    d-Limonene                         0.915   0.691       24.5   83   0.00
 92 T    1,2-Dibromo-3-Chloropropane        0.559   0.564       -0.9  104   0.00
 93 T    n-Undecane                         1.345   1.286        4.4  107   0.00
 94 T    1,2,4-Trichlorobenzene             1.235   1.177        4.7  104   0.00
 95 T    Naphthalene                        3.967   3.603        9.2  103   0.00
 96 T    n-Dodecane                         1.274   1.233        3.2  100   0.00
 97 T    Hexachlorobutadiene                0.837   0.754        9.9  104   0.00
 98 T    Cyclohexanone                      0.919   0.801       12.8  100  -0.01
 99 T    tert-Butylbenzene                  2.554   2.277       10.8  104   0.00
100 T    n-Butylbenzene                     2.531   2.300        9.1  102   0.00
 -------------------------------------------------------------------------------

    (#) = Out of Range                 SPCC's out = 0   CCC's out = 0
```

LH 9/28/12

```
                    Evaluate Continuing Calibration Report

 Data Path : J:\MS16\DATA\2012_10\01\
 Data File : 10011201.D
 Acq On    :  1 Oct 2012   8:50
 Operator  : LH
 Sample    : 25ng TO-15 CCV STD
 Misc      : S25-09261201/S25-09211205
 ALS Vial  : 2   Sample Multiplier: 1

 Quant Time: Oct 01 10:15:40 2012
 Quant Method : J:\MS16\METHODS\R16071312.M
 Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
 QLast Update : Mon Jul 16 09:59:54 2012
 Response via : Initial Calibration


 Min. RRF      :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
 Max. RRF Dev :  30%     Max. Rel. Area : 200%

       Compound                             AvgRF   CCRF      %Dev Area% Dev(min)
 ----------------------------------------------------------------------------
 1 IR   Bromochloromethane (IS1)            1.000   1.000      0.0  117  -0.02
 2 T    Propene                             1.554   1.304     16.1   81   0.00
 3 T    Dichlorodifluoromethane (CF         2.347   2.128      9.3  100   0.00
 4 T    Chloromethane                       1.646   1.469     10.8   99  -0.01
 5 T    1,2-Dichloro-1,1,2,2-tetraf         1.289   1.170      9.2  102  -0.01
 6 T    Vinyl Chloride                      1.576   1.433      9.1   99  -0.02
 7 T    1,3-Butadiene                       1.101   1.062      3.5  101  -0.02
 8 T    Bromomethane                        1.079   0.984      8.8  102  -0.02
 9 T    Chloroethane                        0.776   0.683     12.0   98  -0.02
10 T    Ethanol                             0.853   0.689     19.2   96  -0.08
11 T    Acetonitrile                        1.763   1.447     17.9   92  -0.05
12 T    Acrolein                            0.579   0.502     13.3   94  -0.03
13 T    Acetone                             0.722   0.615     14.8   96  -0.05
14 T    Trichlorofluoromethane              2.130   1.979      7.1  103  -0.01
15 T    2-Propanol (Isopropanol)            1.500   1.642     -9.5  126  -0.05
16 T    Acrylonitrile                       1.063   1.079     -1.5   93  -0.03
17 T    1,1-Dichloroethene                  1.025   0.936      8.7  100  -0.02
18 T    2-Methyl-2-Propanol (tert-B         2.429   2.422      0.3  201# -0.04
19 T    Methylene Chloride                  1.030   0.931      9.6   97  -0.02
20 T    3-Chloro-1-propene (Allyl C         1.559   1.337     14.2   92  -0.02
21 T    Trichlorotrifluoroethane            1.107   0.983     11.2  100  -0.02
22 T    Carbon Disulfide                    4.044   3.597     11.1  100  -0.02
23 T    trans-1,2-Dichloroethene            1.494   1.433      4.1   99  -0.02
24 T    1,1-Dichloroethane                  1.979   1.739     12.1   98  -0.02
25 T    Methyl tert-Butyl Ether             3.229   3.017      6.6  101  -0.02
26 T    Vinyl Acetate                       0.200   0.224    -12.0  102  -0.03
27 T    2-Butanone (MEK)                    0.589   0.602     -2.2  102  -0.03
28 T    cis-1,2-Dichloroethene              1.459   1.350      7.5   99  -0.02
29 T    Diisopropyl Ether                   0.841   0.755     10.2  100  -0.02
30 T    Ethyl Acetate                       0.354   0.352      0.6   98  -0.03
31 T    n-Hexane                            1.822   1.564     14.2   97  -0.02
32 T    Chloroform                          1.900   1.705     10.3  100  -0.03
33 S    1,2-Dichloroethane-d4(SS1)          1.298   1.347     -3.8  121  -0.02
34 T    Tetrahydrofuran (THF)               0.635   0.576      9.3   99  -0.02
35 T    Ethyl tert-Butyl Ether              1.299   1.166     10.2   99  -0.02
36 T    1,2-Dichloroethane                  1.442   1.369      5.1  103  -0.02

37 IR   1,4-Difluorobenzene (IS2)           1.000   1.000      0.0  118  -0.02
38 T    1,1,1-Trichloroethane               0.433   0.399      7.9  101  -0.01

R16071312.M Mon Oct 01 10:16:14 2012                                 Page: 1
```

LH 10/1/12

```
              Evaluate Continuing Calibration Report

Data Path : J:\MS16\DATA\2012_10\01\
Data File : 10011201.D
Acq On    :  1 Oct 2012   8:50
Operator  : LH
Sample    : 25ng TO-15 CCV STD
Misc      : S25-09261201/S25-09211205
ALS Vial  : 2   Sample Multiplier: 1

Quant Time: Oct 01 10:15:40 2012
Quant Method : J:\MS16\METHODS\R16071312.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Mon Jul 16 09:59:54 2012
Response via : Initial Calibration


Min. RRF      :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%     Max. Rel. Area : 200%

       Compound                          AvgRF   CCRF      %Dev Area% Dev(min)
 -----------------------------------------------------------------------------
39 T    Isopropyl Acetate                0.159   0.143      10.1   96  -0.02
40 T    1-Butanol                        0.244   0.236       3.3   98  -0.05
41 T    Benzene                          1.081   0.884      18.2   98  -0.01
42 T    Carbon Tetrachloride             0.353   0.352       0.3  104  -0.02
43 T    Cyclohexane                      0.407   0.360      11.5   99  -0.02
44 T    tert-Amyl Methyl Ether           0.778   0.722       7.2  100  -0.01
45 T    1,2-Dichloropropane              0.271   0.236      12.9   96  -0.02
46 T    Bromodichloromethane             0.362   0.347       4.1  101  -0.02
47 T    Trichloroethene                  0.318   0.293       7.9   97  -0.02
48 T    1,4-Dioxane                      0.212   0.193       9.0   98  -0.02
49 T    2,2,4-Trimethylpentane (Iso      1.136   0.975      14.2   95  -0.01
50 T    Methyl Methacrylate              0.114   0.107       6.1   98  -0.02
51 T    n-Heptane                        0.262   0.237       9.5  100  -0.02
52 T    cis-1,3-Dichloropropene          0.414   0.428      -3.4  103  -0.01
53 T    4-Methyl-2-pentanone             0.240   0.227       5.4   99  -0.01
54 T    trans-1,3-Dichloropropene        0.365   0.375      -2.7   97  -0.01
55 T    1,1,2-Trichloroethane            0.274   0.246      10.2   98  -0.01

56 IR   Chlorobenzene-d5 (IS3)           1.000   1.000       0.0  119   0.00
57 S    Toluene-d8 (SS2)                 2.309   2.277       1.4  118  -0.01
58 T    Toluene                          2.621   2.207      15.8   97  -0.01
59 T    2-Hexanone                       1.255   1.107      11.8   95  -0.02
60 T    Dibromochloromethane             0.720   0.698       3.1  100  -0.01
61 T    1,2-Dibromoethane                0.713   0.652       8.6   97  -0.01
62 T    n-Butyl Acetate                  1.477   1.368       7.4   97  -0.01
63 T    n-Octane                         0.538   0.450      16.4   94  -0.01
64 T    Tetrachloroethene                0.921   0.808      12.3   99   0.00
65 T    Chlorobenzene                    1.749   1.546      11.6   99  -0.01
66 T    Ethylbenzene                     2.964   2.576      13.1   99   0.00
67 T    m- & p-Xylenes                   2.340   2.032      13.2   99  -0.01
68 T    Bromoform                        0.706   0.716      -1.4  101  -0.01
69 T    Styrene                          1.761   1.584      10.1   97  -0.01
70 T    o-Xylene                         2.460   2.121      13.8   98  -0.01
71 T    n-Nonane                         1.313   1.092      16.8   94  -0.01
72 T    1,1,2,2-Tetrachloroethane        1.147   1.028      10.4   98  -0.01
73 S    Bromofluorobenzene (SS3)         1.191   1.262      -6.0  127   0.00
74 T    Cumene                           3.298   2.767      16.1   98   0.00
75 T    alpha-Pinene                     1.541   1.338      13.2   97   0.00
76 T    n-Propylbenzene                  3.803   3.326      12.5   99   0.00
```

LH 10/1/12

```
                    Evaluate Continuing Calibration Report

  Data Path : J:\MS16\DATA\2012_10\01\
  Data File : 10011201.D
  Acq On    :  1 Oct 2012   8:50
  Operator  : LH
  Sample    : 25ng TO-15 CCV STD
  Misc      : S25-09261201/S25-09211205
  ALS Vial  : 2   Sample Multiplier: 1

  Quant Time: Oct 01 10:15:40 2012
  Quant Method : J:\MS16\METHODS\R16071312.M
  Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
  QLast Update : Mon Jul 16 09:59:54 2012
  Response via : Initial Calibration


  Min. RRF     :    0.000  Min. Rel. Area :   50%  Max. R.T. Dev  0.33min
  Max. RRF Dev :  30%      Max. Rel. Area : 200%

         Compound                           AvgRF   CCRF       %Dev Area% Dev(min)
  ---------------------------------------------------------------------------------
 77 T    3-Ethyltoluene                     2.995   2.709       9.5  100   0.00
 78 T    4-Ethyltoluene                     2.847   2.478      13.0   95   0.00
 79 T    1,3,5-Trimethylbenzene             2.493   2.130      14.6   98  -0.01
 80 T    alpha-Methylstyrene                1.311   1.192       9.1   96  -0.01
 81 T    2-Ethyltoluene                     3.154   2.694      14.6   98   0.00
 82 T    1,2,4-Trimethylbenzene             2.595   2.257      13.0  100  -0.01
 83 T    n-Decane                           1.334   1.153      13.6   96  -0.01
 84 T    Benzyl Chloride                    1.934   1.991      -2.9   97  -0.01
 85 T    1,3-Dichlorobenzene                1.557   1.403       9.9   99  -0.01
 86 T    1,4-Dichlorobenzene                1.613   1.417      12.2   99  -0.01
 87 T    sec-Butylbenzene                   3.339   2.995      10.3  100   0.00
 88 T    4-Isopropyltoluene (p-Cymen        3.300   3.006       8.9  100   0.00
 89 T    1,2,3-Trimethylbenzene             2.539   2.303       9.3  100   0.00
 90 T    1,2-Dichlorobenzene                1.503   1.359       9.6   99  -0.01
 91 T    d-Limonene                         0.915   0.828       9.5   97  -0.01
 92 T    1,2-Dibromo-3-Chloropropane        0.559   0.549       1.8   98   0.00
 93 T    n-Undecane                         1.345   1.182      12.1   95   0.00
 94 T    1,2,4-Trichlorobenzene             1.235   1.150       6.9   98   0.00
 95 T    Naphthalene                        3.967   3.554      10.4   98   0.00
 96 T    n-Dodecane                         1.274   1.215       4.6   95   0.00
 97 T    Hexachlorobutadiene                0.837   0.758       9.4  101   0.00
 98 T    Cyclohexanone                      0.919   0.807      12.2   97  -0.01
 99 T    tert-Butylbenzene                  2.554   2.266      11.3  100   0.00
100 T    n-Butylbenzene                     2.531   2.304       9.0   99   0.00
 ---------------------------------------------------------------------------------

    (#) = Out of Range                   SPCC's out = 0   CCC's out = 0
```

LH 10/1/12

RESULTS OF ANALYSIS

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-PP**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-007

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00376

Date Collected: 9/19/12
Date Received: 9/26/12
Date Analyzed: 10/9/12
Volume(s) Analyzed: 0.25 Liter(s)

Initial Pressure (psig): -0.05 Final Pressure (psig): 3.51

Canister Dilution Factor: 1.24

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
115-07-1	Propene	**3.4**	2.5	**2.0**	1.4	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	2.5	ND	0.50	
74-87-3	Chloromethane	ND	0.99	ND	0.48	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	2.5	ND	0.35	
75-01-4	Vinyl Chloride	ND	0.50	ND	0.19	
106-99-0	1,3-Butadiene	ND	0.99	ND	0.45	
74-83-9	Bromomethane	ND	0.50	ND	0.13	
75-00-3	Chloroethane	ND	0.50	ND	0.19	
64-17-5	Ethanol	**25**	25	**13**	13	
75-05-8	Acetonitrile	ND	2.5	ND	1.5	
107-02-8	Acrolein	ND	9.9	ND	4.3	
67-64-1	Acetone	**18,000**	25	**7,600**	10	E
75-69-4	Trichlorofluoromethane	**1.2**	0.50	**0.22**	0.088	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	25	ND	10	
107-13-1	Acrylonitrile	ND	2.5	ND	1.1	
75-35-4	1,1-Dichloroethene	ND	0.50	ND	0.13	
75-09-2	Methylene Chloride	**9.7**	2.5	**2.8**	0.71	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.50	ND	0.16	
76-13-1	Trichlorotrifluoroethane	ND	0.50	ND	0.065	
75-15-0	Carbon Disulfide	ND	25	ND	8.0	
156-60-5	trans-1,2-Dichloroethene	ND	0.50	ND	0.13	
75-34-3	1,1-Dichloroethane	ND	0.50	ND	0.12	
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
108-05-4	Vinyl Acetate	ND	25	ND	7.0	
78-93-3	2-Butanone (MEK)	ND	25	ND	8.4	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
E = Estimated; concentration exceeded calibration range.

Added Page

RESULTS OF ANALYSIS

Page 2 of 3

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Indoor-1-PP**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P1203938-007
Test Code:	EPA TO-15	Date Collected:	9/19/12
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	9/26/12
Analyst:	Lusine Hakobyan	Date Analyzed:	10/9/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.25 Liter(s)
Test Notes:			
Container ID:	AC00376		

Initial Pressure (psig): -0.05 Final Pressure (psig): 3.51

Canister Dilution Factor: 1.24

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	0.50	ND	0.13	
141-78-6	Ethyl Acetate	ND	5.0	ND	1.4	
110-54-3	n-Hexane	**10**	2.5	**2.9**	0.70	
67-66-3	Chloroform	ND	0.50	ND	0.10	
109-99-9	Tetrahydrofuran (THF)	ND	2.5	ND	0.84	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-55-6	1,1,1-Trichloroethane	ND	0.50	ND	0.091	
71-43-2	Benzene	**5.3**	0.50	**1.7**	0.16	
56-23-5	Carbon Tetrachloride	ND	0.50	ND	0.079	
110-82-7	Cyclohexane	**27**	5.0	**7.8**	1.4	
78-87-5	1,2-Dichloropropane	ND	0.50	ND	0.11	
75-27-4	Bromodichloromethane	ND	0.50	ND	0.074	
79-01-6	Trichloroethene	**54**	0.50	**10**	0.092	
123-91-1	1,4-Dioxane	ND	2.5	ND	0.69	
80-62-6	Methyl Methacrylate	ND	5.0	ND	1.2	
142-82-5	n-Heptane	**1,800**	2.5	**440**	0.61	**E**
10061-01-5	cis-1,3-Dichloropropene	ND	2.5	ND	0.55	
108-10-1	4-Methyl-2-pentanone	**6.0**	2.5	**1.5**	0.61	
10061-02-6	trans-1,3-Dichloropropene	ND	2.5	ND	0.55	
79-00-5	1,1,2-Trichloroethane	ND	0.50	ND	0.091	
108-88-3	Toluene	**18**	2.5	**4.8**	0.66	
591-78-6	2-Hexanone	ND	2.5	ND	0.61	
124-48-1	Dibromochloromethane	ND	0.50	ND	0.058	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
123-86-4	n-Butyl Acetate	ND	2.5	ND	0.52	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
E = Estimated; concentration exceeded calibration range.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Indoor-1-PP**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P1203938-007

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: AC00376

Date Collected: 9/19/12
Date Received: 9/26/12
Date Analyzed: 10/9/12
Volume(s) Analyzed: 0.25 Liter(s)

Initial Pressure (psig): -0.05 Final Pressure (psig): 3.51

Canister Dilution Factor: 1.24

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
111-65-9	n-Octane	ND	2.5	ND	0.53	
127-18-4	Tetrachloroethene	**0.57**	0.50	**0.084**	0.073	
108-90-7	Chlorobenzene	ND	0.50	ND	0.11	
100-41-4	Ethylbenzene	**6.0**	2.5	**1.4**	0.57	
179601-23-1	m,p-Xylenes	**21**	2.5	**4.9**	0.57	
75-25-2	Bromoform	ND	2.5	ND	0.24	
100-42-5	Styrene	ND	2.5	ND	0.58	
95-47-6	o-Xylene	**8.2**	2.5	**1.9**	0.57	
111-84-2	n-Nonane	**3.7**	2.5	**0.71**	0.47	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	ND	0.072	
98-82-8	Cumene	ND	2.5	ND	0.50	
80-56-8	alpha-Pinene	ND	2.5	ND	0.45	
103-65-1	n-Propylbenzene	ND	2.5	ND	0.50	
622-96-8	4-Ethyltoluene	**3.3**	2.5	**0.67**	0.50	
108-67-8	1,3,5-Trimethylbenzene	**3.8**	2.5	**0.77**	0.50	
95-63-6	1,2,4-Trimethylbenzene	**13**	2.5	**2.7**	0.50	
100-44-7	Benzyl Chloride	ND	2.5	ND	0.48	
541-73-1	1,3-Dichlorobenzene	ND	0.50	ND	0.083	
106-46-7	1,4-Dichlorobenzene	ND	0.50	ND	0.083	
95-50-1	1,2-Dichlorobenzene	ND	0.50	ND	0.083	
5989-27-5	d-Limonene	**19**	2.5	**3.5**	0.45	
96-12-8	1,2-Dibromo-3-chloropropane	ND	2.5	ND	0.26	
120-82-1	1,2,4-Trichlorobenzene	ND	2.5	ND	0.33	
91-20-3	Naphthalene	**2.7**	2.5	**0.51**	0.47	
87-68-3	Hexachlorobutadiene	ND	2.5	ND	0.23	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P121009-MB

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** µg/m^3	MRL µg/m^3	**Result ppbV**	MRL ppbV	**Data Qualifier**
115-07-1	Propene	ND	0.50	ND	0.29	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	0.50	ND	0.10	
74-87-3	Chloromethane	ND	0.20	ND	0.097	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.50	ND	0.072	
75-01-4	Vinyl Chloride	ND	0.10	ND	0.039	
106-99-0	1,3-Butadiene	ND	0.20	ND	0.090	
74-83-9	Bromomethane	ND	0.10	ND	0.026	
75-00-3	Chloroethane	ND	0.10	ND	0.038	
64-17-5	Ethanol	ND	5.0	ND	2.7	
75-05-8	Acetonitrile	ND	0.50	ND	0.30	
107-02-8	Acrolein	ND	2.0	ND	0.87	
67-64-1	Acetone	ND	5.0	ND	2.1	
75-69-4	Trichlorofluoromethane	ND	0.10	ND	0.018	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	5.0	ND	2.0	
107-13-1	Acrylonitrile	ND	0.50	ND	0.23	
75-35-4	1,1-Dichloroethene	ND	0.10	ND	0.025	
75-09-2	Methylene Chloride	ND	0.50	ND	0.14	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.10	ND	0.032	
76-13-1	Trichlorotrifluoroethane	ND	0.10	ND	0.013	
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
156-60-5	trans-1,2-Dichloroethene	ND	0.10	ND	0.025	
75-34-3	1,1-Dichloroethane	ND	0.10	ND	0.025	
1634-04-4	Methyl tert-Butyl Ether	ND	0.10	ND	0.028	
108-05-4	Vinyl Acetate	ND	5.0	ND	1.4	
78-93-3	2-Butanone (MEK)	ND	5.0	ND	1.7	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Added Page

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P121009-MB

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	ND	0.10	ND	0.025	
141-78-6	Ethyl Acetate	ND	1.0	ND	0.28	
110-54-3	n-Hexane	ND	0.50	ND	0.14	
67-66-3	Chloroform	ND	0.10	ND	0.020	
109-99-9	Tetrahydrofuran (THF)	ND	0.50	ND	0.17	
107-06-2	1,2-Dichloroethane	ND	0.10	ND	0.025	
71-55-6	1,1,1-Trichloroethane	ND	0.10	ND	0.018	
71-43-2	Benzene	ND	0.10	ND	0.031	
56-23-5	Carbon Tetrachloride	ND	0.10	ND	0.016	
110-82-7	Cyclohexane	ND	1.0	ND	0.29	
78-87-5	1,2-Dichloropropane	ND	0.10	ND	0.022	
75-27-4	Bromodichloromethane	ND	0.10	ND	0.015	
79-01-6	Trichloroethene	ND	0.10	ND	0.019	
123-91-1	1,4-Dioxane	ND	0.50	ND	0.14	
80-62-6	Methyl Methacrylate	ND	1.0	ND	0.24	
142-82-5	n-Heptane	ND	0.50	ND	0.12	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	ND	0.11	
108-10-1	4-Methyl-2-pentanone	ND	0.50	ND	0.12	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	ND	0.11	
79-00-5	1,1,2-Trichloroethane	ND	0.10	ND	0.018	
108-88-3	Toluene	ND	0.50	ND	0.13	
591-78-6	2-Hexanone	ND	0.50	ND	0.12	
124-48-1	Dibromochloromethane	ND	0.10	ND	0.012	
106-93-4	1,2-Dibromoethane	ND	0.10	ND	0.013	
123-86-4	n-Butyl Acetate	ND	0.50	ND	0.11	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Added Page

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Sample ID:	**Method Blank**	CAS Sample ID:	P121009-MB
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Test Code:	EPA TO-15	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	NA
Analyst:	Lusine Hakobyan	Date Analyzed:	10/9/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			

Canister Dilution Factor: 1.00

CAS #	Compound	**Result** μg/m³	MRL μg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
111-65-9	n-Octane	ND	0.50	ND	0.11	
127-18-4	Tetrachloroethene	ND	0.10	ND	0.015	
108-90-7	Chlorobenzene	ND	0.10	ND	0.022	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	0.50	ND	0.12	
75-25-2	Bromoform	ND	0.50	ND	0.048	
100-42-5	Styrene	ND	0.50	ND	0.12	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
111-84-2	n-Nonane	ND	0.50	ND	0.095	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.10	ND	0.015	
98-82-8	Cumene	ND	0.50	ND	0.10	
80-56-8	alpha-Pinene	ND	0.50	ND	0.090	
103-65-1	n-Propylbenzene	ND	0.50	ND	0.10	
622-96-8	4-Ethyltoluene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	
100-44-7	Benzyl Chloride	ND	0.50	ND	0.097	
541-73-1	1,3-Dichlorobenzene	ND	0.10	ND	0.017	
106-46-7	1,4-Dichlorobenzene	ND	0.10	ND	0.017	
95-50-1	1,2-Dichlorobenzene	ND	0.10	ND	0.017	
5989-27-5	d-Limonene	ND	0.50	ND	0.090	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.50	ND	0.052	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	ND	0.067	
91-20-3	Naphthalene	ND	0.50	ND	0.095	
87-68-3	Hexachlorobutadiene	ND	0.50	ND	0.047	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Added Page

SURROGATE SPIKE RECOVERY RESULTS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**
CAS Project ID: P1203938

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 9/18 - 9/19/12
Date(s) Received: 9/25 - 9/26/12
Date(s) Analyzed: 9/28 - 10/9/12

Client Sample ID	CAS Sample ID	1,2-Dichloroethane-d4 Percent Recovered	Toluene-d8 Percent Recovered	Bromofluorobenzene Percent Recovered	Acceptance Limits	Data Qualifier
Method Blank	P120928-MB	**103**	**96**	**102**	70-130	
Method Blank	P121001-MB	**105**	**101**	**104**	70-130	
Method Blank	P121009-MB	**111**	**101**	**107**	70-130	
Lab Control Sample	P120928-LCS	**109**	**105**	**101**	70-130	
Lab Control Sample	P121001-LCS	**102**	**90**	**95**	70-130	
Lab Control Sample	P121009-LCS	**102**	**91**	**102**	70-130	
Indoor-C1	P1203938-001	**102**	**97**	**111**	70-130	
Outdoor-C1	P1203938-002	**107**	**95**	**106**	70-130	
SS-1C	P1203938-003	**97**	**95**	**104**	70-130	
SS-2C	P1203938-004	**98**	**96**	**103**	70-130	
SS-2C	P1203938-004DUP	**106**	**95**	**105**	70-130	
SS-3C	P1203938-005	**105**	**96**	**103**	70-130	
Indoor-1-BL	P1203938-006	**104**	**98**	**100**	70-130	
Indoor-1-PP	P1203938-007	**110**	**93**	**99**	70-130	
Indoor-1-NP	P1203938-008	**111**	**97**	**104**	70-130	
Dup 1	P1203938-009	**99**	**99**	**104**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Lab Control Sample**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P121009-LCS
Test Code:	EPA TO-15	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	NA
Analyst:	Lusine Hakobyan	Date Analyzed:	10/09/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.125 Liter(s)
Test Notes:			

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
115-07-1	Propene	204	**173**	**85**	59-137	
75-71-8	Dichlorodifluoromethane (CFC 12)	202	**172**	**85**	63-115	
74-87-3	Chloromethane	196	**153**	**78**	59-124	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	206	**173**	**84**	65-113	
75-01-4	Vinyl Chloride	200	**161**	**81**	59-121	
106-99-0	1,3-Butadiene	210	**182**	**87**	60-138	
74-83-9	Bromomethane	200	**166**	**83**	69-129	
75-00-3	Chloroethane	202	**158**	**78**	60-120	
64-17-5	Ethanol	958	**725**	**76**	58-121	
75-05-8	Acetonitrile	202	**167**	**83**	64-129	
107-02-8	Acrolein	204	**158**	**77**	54-127	
67-64-1	Acetone	1,040	**805**	**77**	59-114	
75-69-4	Trichlorofluoromethane	210	**173**	**82**	66-108	
67-63-0	2-Propanol (Isopropyl Alcohol)	396	**307**	**78**	50-113	
107-13-1	Acrylonitrile	206	**206**	**100**	72-135	
75-35-4	1,1-Dichloroethene	218	**181**	**83**	70-117	
75-09-2	Methylene Chloride	212	**180**	**85**	61-108	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	214	**170**	**79**	70-131	
76-13-1	Trichlorotrifluoroethane	212	**178**	**84**	70-113	
75-15-0	Carbon Disulfide	208	**160**	**77**	65-112	
156-60-5	trans-1,2-Dichloroethene	202	**184**	**91**	71-119	
75-34-3	1,1-Dichloroethane	206	**170**	**83**	71-116	
1634-04-4	Methyl tert-Butyl Ether	204	**180**	**88**	67-116	
108-05-4	Vinyl Acetate	988	**1010**	**102**	59-142	
78-93-3	2-Butanone (MEK)	212	**202**	**95**	68-125	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 2 of 3

Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

CAS Project ID: P1203938
CAS Sample ID: P121009-LCS

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 10/09/12
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount μg/m^3	**Result μg/m^3**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
156-59-2	cis-1,2-Dichloroethene	214	**191**	**89**	69-119	
141-78-6	Ethyl Acetate	412	**384**	**93**	63-130	
110-54-3	n-Hexane	206	**167**	**81**	57-120	
67-66-3	Chloroform	222	**189**	**85**	69-111	
109-99-9	Tetrahydrofuran (THF)	208	**179**	**86**	57-123	
107-06-2	1,2-Dichloroethane	208	**191**	**92**	70-118	
71-55-6	1,1,1-Trichloroethane	204	**195**	**96**	73-119	
71-43-2	Benzene	208	**170**	**82**	66-121	
56-23-5	Carbon Tetrachloride	212	**213**	**100**	74-129	
110-82-7	Cyclohexane	402	**341**	**85**	70-113	
78-87-5	1,2-Dichloropropane	204	**173**	**85**	69-118	
75-27-4	Bromodichloromethane	204	**201**	**99**	75-124	
79-01-6	Trichloroethene	198	**197**	**99**	73-115	
123-91-1	1,4-Dioxane	206	**191**	**93**	71-123	
80-62-6	Methyl Methacrylate	414	**380**	**92**	72-127	
142-82-5	n-Heptane	202	**175**	**87**	68-120	
10061-01-5	cis-1,3-Dichloropropene	196	**190**	**97**	71-130	
108-10-1	4-Methyl-2-pentanone	210	**188**	**90**	69-130	
10061-02-6	trans-1,3-Dichloropropene	218	**228**	**105**	76-133	
79-00-5	1,1,2-Trichloroethane	202	**184**	**91**	73-120	
108-88-3	Toluene	208	**160**	**77**	67-111	
591-78-6	2-Hexanone	228	**186**	**82**	70-123	
124-48-1	Dibromochloromethane	216	**193**	**89**	75-129	
106-93-4	1,2-Dibromoethane	208	**173**	**83**	73-122	
123-86-4	n-Butyl Acetate	228	**191**	**84**	68-132	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Page 3 of 3

Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Lab Control Sample**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**	CAS Sample ID:	P121009-LCS
Test Code:	EPA TO-15	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Date Received:	NA
Analyst:	Lusine Hakobyan	Date Analyzed:	10/09/12
Sampling Media:	6.0 L Summa Canister	Volume(s) Analyzed:	0.125 Liter(s)
Test Notes:			

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
111-65-9	n-Octane	206	**156**	**76**	68-116	
127-18-4	Tetrachloroethene	190	**154**	**81**	67-119	
108-90-7	Chlorobenzene	208	**177**	**85**	69-113	
100-41-4	Ethylbenzene	206	**171**	**83**	71-117	
179601-23-1	m,p-Xylenes	412	**337**	**82**	70-116	
75-25-2	Bromoform	216	**198**	**92**	69-127	
100-42-5	Styrene	208	**173**	**83**	71-125	
95-47-6	o-Xylene	200	**160**	**80**	70-116	
111-84-2	n-Nonane	202	**152**	**75**	68-116	
79-34-5	1,1,2,2-Tetrachloroethane	198	**155**	**78**	70-119	
98-82-8	Cumene	196	**159**	**81**	70-116	
80-56-8	alpha-Pinene	192	**158**	**82**	71-119	
103-65-1	n-Propylbenzene	198	**163**	**82**	71-119	
622-96-8	4-Ethyltoluene	204	**170**	**83**	71-119	
108-67-8	1,3,5-Trimethylbenzene	208	**170**	**82**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**169**	**85**	73-127	
100-44-7	Benzyl Chloride	206	**190**	**92**	65-137	
541-73-1	1,3-Dichlorobenzene	206	**176**	**85**	68-123	
106-46-7	1,4-Dichlorobenzene	212	**172**	**81**	65-120	
95-50-1	1,2-Dichlorobenzene	204	**174**	**85**	67-121	
5989-27-5	d-Limonene	206	**182**	**88**	67-130	
96-12-8	1,2-Dibromo-3-chloropropane	202	**177**	**88**	72-133	
120-82-1	1,2,4-Trichlorobenzene	200	**172**	**86**	62-133	
91-20-3	Naphthalene	178	**146**	**82**	56-138	
87-68-3	Hexachlorobutadiene	208	**174**	**84**	60-128	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.** CAS Project ID: P1203938
Client Project ID: **ESTCP CSIA / 0SA Demonstration / 3585/3669**

Method Blank Summary

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Lab File ID: 10091205.D
Analyst: Lusine Hakobyan Date Analyzed: 10/09/12
Sampling Media: 6.0 L Summa Canister(s) Time Analyzed: 10:48
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P121009-LCS	10091207.D	12:18
Indoor-1-PP	P1203938-007	10091227.D	23:35

RESULTS OF ANALYSIS

Page 1 of 1

Client:	**GSI Environmental Inc.**	CAS Project ID:	P1203938
Client Project ID:	**ESTCP CSIA / 0SA Demonstration / 3585/3669**		

Internal Standard Area and RT Summary

Test Code:	EPA TO-15		
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16	Lab File ID:	10091201.D
Analyst:	Lusine Hakobyan	Date Analyzed:	10/9/12
Sampling Media:	6.0 L Summa Canister(s)	Time Analyzed:	08:35
Test Notes:			

	IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
	AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
24 Hour Standard	157971		11.31		619977		13.51		294172		17.46	
Upper Limit	221159		11.64		867968		13.84		411841		17.79	
Lower Limit	94783		10.98		371986		13.18		176503		17.13	

	Client Sample ID												
01	Method Blank	146180		11.29		608230		13.51		277467		17.46	
02	Lab Control Sample	162919		11.31		618051		13.52		298465		17.46	
03	Indoor-1-PP	132869		11.33		538170		13.53		264233		17.46	
04													
05													
06													
07													
08													
09													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits.

```
                  Evaluate Continuing Calibration Report

    Data Path : J:\MS16\DATA\2012_10\09\
    Data File : 10091201.D
    Acq On    :  9 Oct 2012   8:35
    Operator  : LH
    Sample    : 25ng TO-15 CCV STD
    Misc      : S25-09261201/S25-09211205
    ALS Vial  : 2   Sample Multiplier: 1

    Quant Time: Oct 09 11:42:38 2012
    Quant Method : J:\MS16\METHODS\R16071312.M
    Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
    QLast Update : Mon Jul 16 09:59:54 2012
    Response via : Initial Calibration


    Min. RRF      :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
    Max. RRF Dev :  30%      Max. Rel. Area : 200%

           Compound                              AvgRF   CCRF      %Dev Area% Dev(min)
    -------------------------------------------------------------------------------
     1 IR  Bromochloromethane (IS1)              1.000   1.000      0.0  106  -0.02
     2 T   Propene                               1.554   1.258     19.0   71   0.00
     3 T   Dichlorodifluoromethane (CF           2.347   2.042     13.0   87   0.00
     4 T   Chloromethane                         1.646   1.313     20.2   80  -0.01
     5 T   1,2-Dichloro-1,1,2,2-tetraf           1.289   1.098     14.8   87  -0.01
     6 T   Vinyl Chloride                        1.576   1.299     17.6   81  -0.01
     7 T   1,3-Butadiene                         1.101   0.965     12.4   83  -0.01
     8 T   Bromomethane                          1.079   0.905     16.1   85  -0.02
     9 T   Chloroethane                          0.776   0.637     17.9   83  -0.01
    10 T   Ethanol                               0.853   0.663     22.3   84  -0.07
    11 T   Acetonitrile                          1.763   1.394     20.9   80  -0.05
    12 T   Acrolein                              0.579   0.466     19.5   80  -0.03
    13 T   Acetone                               0.722   0.587     18.7   83  -0.05
    14 T   Trichlorofluoromethane                2.130   1.973      7.4   93  -0.01
    15 T   2-Propanol (Isopropanol)              1.500   1.384      7.7   96  -0.05
    16 T   Acrylonitrile                         1.063   1.023      3.8   81  -0.03
    17 T   1,1-Dichloroethene                    1.025   0.858     16.3   83  -0.02
    18 T   2-Methyl-2-Propanol (tert-B           2.429   2.226      8.4  168  -0.04
    19 T   Methylene Chloride                    1.030   0.871     15.4   83  -0.02
    20 T   3-Chloro-1-propene (Allyl C           1.559   1.258     19.3   79  -0.02
    21 T   Trichlorotrifluoroethane              1.107   0.926     16.4   85  -0.02
    22 T   Carbon Disulfide                      4.044   3.310     18.2   83  -0.02
    23 T   trans-1,2-Dichloroethene              1.494   1.352      9.5   85  -0.02
    24 T   1,1-Dichloroethane                    1.979   1.649     16.7   84  -0.02
    25 T   Methyl tert-Butyl Ether               3.229   2.896     10.3   88  -0.02
    26 T   Vinyl Acetate                         0.200   0.212     -6.0   88  -0.03
    27 T   2-Butanone (MEK)                      0.589   0.574      2.5   88  -0.03
    28 T   cis-1,2-Dichloroethene                1.459   1.289     11.7   86  -0.02
    29 T   Diisopropyl Ether                     0.841   0.712     15.3   86  -0.02
    30 T   Ethyl Acetate                         0.354   0.327      7.6   82  -0.03
    31 T   n-Hexane                              1.822   1.463     19.7   82  -0.01
    32 T   Chloroform                            1.900   1.668     12.2   89  -0.03
    33 S   1,2-Dichloroethane-d4(SS1)            1.298   1.393     -7.3  114  -0.02
    34 T   Tetrahydrofuran (THF)                 0.635   0.636     -0.2   99  -0.02
    35 T   Ethyl tert-Butyl Ether                1.299   1.146     11.8   88  -0.02
    36 T   1,2-Dichloroethane                    1.442   1.385      4.0   94  -0.02

    37 IR  1,4-Difluorobenzene (IS2)             1.000   1.000      0.0  104  -0.02
    38 T   1,1,1-Trichloroethane                 0.433   0.398      8.1   89  -0.01
```

Added Page

LH 10/9/12

```
                    Evaluate Continuing Calibration Report

    Data Path : J:\MS16\DATA\2012_10\09\
    Data File : 10091201.D
    Acq On    :  9 Oct 2012   8:35
    Operator  : LH
    Sample    : 25ng TO-15 CCV STD
    Misc      : S25-09261201/S25-09211205
    ALS Vial  : 2   Sample Multiplier: 1

    Quant Time: Oct 09 11:42:38 2012
    Quant Method : J:\MS16\METHODS\R16071312.M
    Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
    QLast Update : Mon Jul 16 09:59:54 2012
    Response via : Initial Calibration


    Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
    Max. RRF Dev :  30%     Max. Rel. Area : 200%

          Compound                           AvgRF   CCRF      %Dev Area% Dev(min)
  --------------------------------------------------------------------------------
  39 T    Isopropyl Acetate                  0.159   0.136     14.5   80  -0.02
  40 T    1-Butanol                          0.244   0.228      6.6   83  -0.05
  41 T    Benzene                            1.081   0.835     22.8   82  -0.01
  42 T    Carbon Tetrachloride               0.353   0.351      0.6   92  -0.02
  43 T    Cyclohexane                        0.407   0.341     16.2   82  -0.02
  44 T    tert-Amyl Methyl Ether             0.778   0.720      7.5   88  -0.01
  45 T    1,2-Dichloropropane                0.271   0.235     13.3   84  -0.02
  46 T    Bromodichloromethane               0.362   0.355      1.9   91  -0.01
  47 T    Trichloroethene                    0.318   0.301      5.3   88  -0.02
  48 T    1,4-Dioxane                        0.212   0.192      9.4   86  -0.02
  49 T    2,2,4-Trimethylpentane (Iso        1.136   0.957     15.8   83  -0.01
  50 T    Methyl Methacrylate                0.114   0.102     10.5   83  -0.02
  51 T    n-Heptane                          0.262   0.216     17.6   80  -0.02
  52 T    cis-1,3-Dichloropropene            0.414   0.407      1.7   87  -0.01
  53 T    4-Methyl-2-pentanone               0.240   0.216     10.0   84  -0.01
  54 T    trans-1,3-Dichloropropene          0.365   0.372     -1.9   85  -0.01
  55 T    1,1,2-Trichloroethane              0.274   0.236     13.9   83  -0.01

  56 IR   Chlorobenzene-d5 (IS3)             1.000   1.000      0.0  110   0.00
  57 S    Toluene-d8 (SS2)                   2.309   2.145      7.1  103  -0.01
  58 T    Toluene                            2.621   2.046     21.9   84  -0.01
  59 T    2-Hexanone                         1.255   1.046     16.7   83  -0.02
  60 T    Dibromochloromethane               0.720   0.662      8.1   88  -0.01
  61 T    1,2-Dibromoethane                  0.713   0.626     12.2   87  -0.01
  62 T    n-Butyl Acetate                    1.477   1.295     12.3   85  -0.01
  63 T    n-Octane                           0.538   0.431     19.9   84  -0.01
  64 T    Tetrachloroethene                  0.921   0.785     14.8   89   0.00
  65 T    Chlorobenzene                      1.749   1.466     16.2   87  -0.01
  66 T    Ethylbenzene                       2.964   2.373     19.9   85   0.00
  67 T    m- & p-Xylenes                     2.340   1.907     18.5   86  -0.01
  68 T    Bromoform                          0.706   0.673      4.7   88  -0.01
  69 T    Styrene                            1.761   1.535     12.8   87  -0.01
  70 T    o-Xylene                           2.460   2.083     15.3   90   0.00
  71 T    n-Nonane                           1.313   1.048     20.2   84  -0.01
  72 T    1,1,2,2-Tetrachloroethane          1.147   0.978     14.7   86  -0.01
  73 S    Bromofluorobenzene (SS3)           1.191   1.235     -3.7  115   0.00
  74 T    Cumene                             3.298   2.715     17.7   89   0.00
  75 T    alpha-Pinene                       1.541   1.214     21.2   81   0.00
  76 T    n-Propylbenzene                    3.803   3.013     20.8   83   0.00
```

LH 10/9/12

Evaluate Continuing Calibration Report

```
Data Path : J:\MS16\DATA\2012_10\09\
Data File : 10091201.D
Acq On    :  9 Oct 2012   8:35
Operator  : LH
Sample    : 25ng TO-15 CCV STD
Misc      : S25-09261201/S25-09211205
ALS Vial  : 2   Sample Multiplier: 1

Quant Time: Oct 09 11:42:38 2012
Quant Method : J:\MS16\METHODS\R16071312.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Mon Jul 16 09:59:54 2012
Response via : Initial Calibration


Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%     Max. Rel. Area : 200%

        Compound                         AvgRF   CCRF       %Dev Area% Dev(min)
------------------------------------------------------------------------------
 77 T   3-Ethyltoluene                   2.995   2.464      17.7   84    0.00
 78 T   4-Ethyltoluene                   2.847   2.284      19.8   82    0.00
 79 T   1,3,5-Trimethylbenzene           2.493   1.979      20.6   84   -0.01
 80 T   alpha-Methylstyrene              1.311   1.063      18.9   79   -0.01
 81 T   2-Ethyltoluene                   3.154   2.473      21.6   84    0.00
 82 T   1,2,4-Trimethylbenzene           2.595   2.077      20.0   86    0.00
 83 T   n-Decane                         1.334   1.035      22.4   80   -0.01
 84 T   Benzyl Chloride                  1.934   1.828       5.5   83   -0.01
 85 T   1,3-Dichlorobenzene              1.557   1.277      18.0   84   -0.01
 86 T   1,4-Dichlorobenzene              1.613   1.299      19.5   84   -0.01
 87 T   sec-Butylbenzene                 3.339   2.729      18.3   84    0.00
 88 T   4-Isopropyltoluene (p-Cymen      3.300   2.764      16.2   85    0.00
 89 T   1,2,3-Trimethylbenzene           2.539   2.114      16.7   85    0.00
 90 T   1,2-Dichlorobenzene              1.503   1.251      16.8   84   -0.01
 91 T   d-Limonene                       0.915   0.736      19.6   80   -0.01
 92 T   1,2-Dibromo-3-Chloropropane      0.559   0.507       9.3   84    0.00
 93 T   n-Undecane                       1.345   1.080      19.7   80    0.00
 94 T   1,2,4-Trichlorobenzene           1.235   1.120       9.3   88    0.00
 95 T   Naphthalene                      3.967   3.418      13.8   88    0.00
 96 T   n-Dodecane                       1.274   1.145      10.1   83    0.00
 97 T   Hexachlorobutadiene              0.837   0.714      14.7   88    0.00
 98 T   Cyclohexanone                    0.919   0.747      18.7   83   -0.01
 99 T   tert-Butylbenzene                2.554   2.077      18.7   85    0.00
100 T   n-Butylbenzene                   2.531   2.129      15.9   85    0.00
------------------------------------------------------------------------------

  (#) = Out of Range                      SPCC's out = 0  CCC's out = 0
```

LH 10/9/12

ANALYTICAL REPORT

Lab Number:	L1216912
Client:	GSI Environmental Inc. 2211 Norfolk Street Suite 1000 Houston, TX 77098
ATTN:	Lila Beckley
Phone:	(713) 522-6300
Project Name:	G-3669
Project Number:	G-3669
Report Date:	09/27/12

Certifications & Approvals: NY (11627), CT (PH-0141), NH (2206), NJ NELAP (MA015), RI (LAO00299), PA (68-02089), LA NELAP (03090), FL (E87814), TX (T104704419), WA (C954), DOD (L2217.01), USDA (Permit #P330-11-00109), US Army Corps of Engineers.

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1216912-01	MW-16	SELFRIDGE BLD 1533	09/18/12 15:30

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Performance criteria for CAM and RCP methods allow for some LCS compound failures to occur and still be within method compliance. In these instances, the specific failures are not narrated but are noted in the associated QC table. This information is also incorporated in the Data Usability format for our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples free of charge for 30 days from the date the project is completed. After 30 days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples.

Please contact Client Services at 800-624-9220 with any questions.

Case Narrative (continued)

Sample Receipt

Headspace was noted in the sample containers submitted for Volatile Organics. The analysis was performed at the client's request.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Cynthia McQueen Cynthia McQueen

Title: Technical Director/Representative Date: 09/27/12

ORGANICS

VOLATILES

SAMPLE RESULTS

Lab ID:	L1216912-01	D	Date Collected:	09/18/12 15:30
Client ID:	MW-16		Date Received:	09/20/12
Sample Location:	SELFRIDGE BLD 1533		Field Prep:	Not Specified
Matrix:	Water			
Analytical Method:	1,8260C			
Analytical Date:	09/26/12 20:15			
Analyst:	PD			

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/l	120	--	40
1,1-Dichloroethane	ND		ug/l	30	--	40
Chloroform	ND		ug/l	30	--	40
Carbon tetrachloride	ND		ug/l	20	--	40
1,2-Dichloropropane	ND		ug/l	70	--	40
Dibromochloromethane	ND		ug/l	20	--	40
1,1,2-Trichloroethane	ND		ug/l	30	--	40
Tetrachloroethene	ND		ug/l	20	--	40
Chlorobenzene	ND		ug/l	20	--	40
Trichlorofluoromethane	ND		ug/l	100	--	40
1,2-Dichloroethane	ND		ug/l	20	--	40
1,1,1-Trichloroethane	ND		ug/l	20	--	40
Bromodichloromethane	ND		ug/l	20	--	40
trans-1,3-Dichloropropene	ND		ug/l	20	--	40
cis-1,3-Dichloropropene	ND		ug/l	20	--	40
1,1-Dichloropropene	ND		ug/l	100	--	40
Bromoform	ND		ug/l	80	--	40
1,1,2,2-Tetrachloroethane	ND		ug/l	20	--	40
Benzene	360		ug/l	20	--	40
Toluene	41		ug/l	30	--	40
Ethylbenzene	1400		ug/l	20	--	40
Chloromethane	ND		ug/l	100	--	40
Bromomethane	ND		ug/l	40	--	40
Vinyl chloride	ND		ug/l	40	--	40
Chloroethane	ND		ug/l	40	--	40
1,1-Dichloroethene	ND		ug/l	20	--	40
trans-1,2-Dichloroethene	ND		ug/l	30	--	40
Trichloroethene	ND		ug/l	20	--	40
1,2-Dichlorobenzene	ND		ug/l	100	--	40
1,3-Dichlorobenzene	ND		ug/l	100	--	40
1,4-Dichlorobenzene	ND		ug/l	100	--	40

SAMPLE RESULTS

Lab ID:	L1216912-01 D		Date Collected:	09/18/12 15:30
Client ID:	MW-16		Date Received:	09/20/12
Sample Location:	SELFRIDGE BLD 1533		Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/l	40	--	40
p/m-Xylene	4800		ug/l	40	--	40
o-Xylene	ND		ug/l	40	--	40
cis-1,2-Dichloroethene	ND		ug/l	20	--	40
Dibromomethane	ND		ug/l	200	--	40
1,4-Dichlorobutane	ND		ug/l	200	--	40
1,2,3-Trichloropropane	ND		ug/l	200	--	40
Styrene	ND		ug/l	40	--	40
Dichlorodifluoromethane	ND		ug/l	200	--	40
Acetone	ND		ug/l	200	--	40
Carbon disulfide	ND		ug/l	200	--	40
2-Butanone	ND		ug/l	200	--	40
Vinyl acetate	ND		ug/l	200	--	40
4-Methyl-2-pentanone	ND		ug/l	200	--	40
2-Hexanone	ND		ug/l	200	--	40
Ethyl methacrylate	ND		ug/l	200	--	40
Acrylonitrile	ND		ug/l	200	--	40
Bromochloromethane	ND		ug/l	100	--	40
Tetrahydrofuran	ND		ug/l	200	--	40
2,2-Dichloropropane	ND		ug/l	100	--	40
1,2-Dibromoethane	ND		ug/l	80	--	40
1,3-Dichloropropane	ND		ug/l	100	--	40
1,1,1,2-Tetrachloroethane	ND		ug/l	20	--	40
Bromobenzene	ND		ug/l	100	--	40
n-Butylbenzene	32		ug/l	20	--	40
sec-Butylbenzene	ND		ug/l	20	--	40
tert-Butylbenzene	ND		ug/l	100	--	40
o-Chlorotoluene	ND		ug/l	100	--	40
p-Chlorotoluene	ND		ug/l	100	--	40
1,2-Dibromo-3-chloropropane	ND		ug/l	100	--	40
Hexachlorobutadiene	ND		ug/l	20	--	40
Isopropylbenzene	68		ug/l	20	--	40
p-Isopropyltoluene	ND		ug/l	20	--	40
Naphthalene	680		ug/l	100	--	40
n-Propylbenzene	210		ug/l	20	--	40
1,2,3-Trichlorobenzene	ND		ug/l	100	--	40
1,2,4-Trichlorobenzene	ND		ug/l	100	--	40
1,3,5-Trimethylbenzene	570		ug/l	100	--	40
1,2,4-Trimethylbenzene	1800		ug/l	100	--	40

SAMPLE RESULTS

Lab ID:	L1216912-01 D		Date Collected:	09/18/12 15:30
Client ID:	MW-16		Date Received:	09/20/12
Sample Location:	SELFRIDGE BLD 1533		Field Prep:	Not Specified

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Volatile Organics by GC/MS - Westborough Lab						
trans-1,4-Dichloro-2-butene	ND		ug/l	100	--	40
Ethyl ether	ND		ug/l	100	--	40

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
1,2-Dichloroethane-d4	100		70-130
Toluene-d8	102		70-130
4-Bromofluorobenzene	99		70-130
Dibromofluoromethane	97		70-130

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 09/26/12 11:36
Analyst: PD

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG563554-3					
Methylene chloride	ND		ug/l	3.0	--
1,1-Dichloroethane	ND		ug/l	0.75	--
Chloroform	ND		ug/l	0.75	--
Carbon tetrachloride	ND		ug/l	0.50	--
1,2-Dichloropropane	ND		ug/l	1.8	--
Dibromochloromethane	ND		ug/l	0.50	--
1,1,2-Trichloroethane	ND		ug/l	0.75	--
Tetrachloroethene	ND		ug/l	0.50	--
Chlorobenzene	ND		ug/l	0.50	--
Trichlorofluoromethane	ND		ug/l	2.5	--
1,2-Dichloroethane	ND		ug/l	0.50	--
1,1,1-Trichloroethane	ND		ug/l	0.50	--
Bromodichloromethane	ND		ug/l	0.50	--
trans-1,3-Dichloropropene	ND		ug/l	0.50	--
cis-1,3-Dichloropropene	ND		ug/l	0.50	--
1,1-Dichloropropene	ND		ug/l	2.5	--
Bromoform	ND		ug/l	2.0	--
1,1,2,2-Tetrachloroethane	ND		ug/l	0.50	--
Benzene	ND		ug/l	0.50	--
Toluene	ND		ug/l	0.75	--
Ethylbenzene	ND		ug/l	0.50	--
Chloromethane	ND		ug/l	2.5	--
Bromomethane	ND		ug/l	1.0	--
Vinyl chloride	ND		ug/l	1.0	--
Chloroethane	ND		ug/l	1.0	--
1,1-Dichloroethene	ND		ug/l	0.50	--
trans-1,2-Dichloroethene	ND		ug/l	0.75	--
Trichloroethene	ND		ug/l	0.50	--
1,2-Dichlorobenzene	ND		ug/l	2.5	--
1,3-Dichlorobenzene	ND		ug/l	2.5	--
1,4-Dichlorobenzene	ND		ug/l	2.5	--

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 09/26/12 11:36
Analyst: PD

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG563554-3					
Methyl tert butyl ether	ND		ug/l	1.0	--
p/m-Xylene	ND		ug/l	1.0	--
o-Xylene	ND		ug/l	1.0	--
cis-1,2-Dichloroethene	ND		ug/l	0.50	--
Dibromomethane	ND		ug/l	5.0	--
1,4-Dichlorobutane	ND		ug/l	5.0	--
1,2,3-Trichloropropane	ND		ug/l	5.0	--
Styrene	ND		ug/l	1.0	--
Dichlorodifluoromethane	ND		ug/l	5.0	--
Acetone	ND		ug/l	5.0	--
Carbon disulfide	ND		ug/l	5.0	--
2-Butanone	ND		ug/l	5.0	--
Vinyl acetate	ND		ug/l	5.0	--
4-Methyl-2-pentanone	ND		ug/l	5.0	--
2-Hexanone	ND		ug/l	5.0	--
Ethyl methacrylate	ND		ug/l	5.0	--
Acrylonitrile	ND		ug/l	5.0	--
Bromochloromethane	ND		ug/l	2.5	--
Tetrahydrofuran	ND		ug/l	5.0	--
2,2-Dichloropropane	ND		ug/l	2.5	--
1,2-Dibromoethane	ND		ug/l	2.0	--
1,3-Dichloropropane	ND		ug/l	2.5	--
1,1,1,2-Tetrachloroethane	ND		ug/l	0.50	--
Bromobenzene	ND		ug/l	2.5	--
n-Butylbenzene	ND		ug/l	0.50	--
sec-Butylbenzene	ND		ug/l	0.50	--
tert-Butylbenzene	ND		ug/l	2.5	--
o-Chlorotoluene	ND		ug/l	2.5	--
p-Chlorotoluene	ND		ug/l	2.5	--
1,2-Dibromo-3-chloropropane	ND		ug/l	2.5	--
Hexachlorobutadiene	ND		ug/l	0.50	--

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 09/26/12 11:36
Analyst: PD

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG563554-3					
Isopropylbenzene	ND		ug/l	0.50	--
p-Isopropyltoluene	ND		ug/l	0.50	--
Naphthalene	ND		ug/l	2.5	--
n-Propylbenzene	ND		ug/l	0.50	--
1,2,3-Trichlorobenzene	ND		ug/l	2.5	--
1,2,4-Trichlorobenzene	ND		ug/l	2.5	--
1,3,5-Trimethylbenzene	ND		ug/l	2.5	--
1,2,4-Trimethylbenzene	ND		ug/l	2.5	--
trans-1,4-Dichloro-2-butene	ND		ug/l	2.5	--
Ethyl ether	ND		ug/l	2.5	--

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	99		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	105		70-130
Dibromofluoromethane	97		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: G-3669

Project Number: G-3669

Lab Number: L1216912

Report Date: 09/27/12

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG563554-1 WG563554-2								
Methylene chloride	105		100		70-130	5		20
1,1-Dichloroethane	108		102		70-130	6		20
Chloroform	106		100		70-130	6		20
Carbon tetrachloride	92		88		63-132	4		20
1,2-Dichloropropane	107		103		70-130	4		20
Dibromochloromethane	104		100		63-130	4		20
1,1,2-Trichloroethane	108		104		70-130	4		20
Tetrachloroethene	110		102		70-130	8		20
Chlorobenzene	106		102		75-130	4		25
Trichlorofluoromethane	109		102		62-150	7		20
1,2-Dichloroethane	104		100		70-130	4		20
1,1,1-Trichloroethane	103		99		67-130	4		20
Bromodichloromethane	103		100		67-130	3		20
trans-1,3-Dichloropropene	100		98		70-130	2		20
cis-1,3-Dichloropropene	102		99		70-130	3		20
1,1-Dichloropropene	107		100		70-130	7		20
Bromoform	99		95		54-136	4		20
1,1,2,2-Tetrachloroethane	107		101		67-130	6		20
Benzene	108		103		70-130	5		25
Toluene	109		104		70-130	5		25
Ethylbenzene	108		102		70-130	6		20

Lab Control Sample Analysis
Batch Quality Control

Project Name: G-3669
Project Number: G-3669

Lab Number: L1216912
Report Date: 09/27/12

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG563554-1 WG563554-2								
Chloromethane	115		104		64-130	10		20
Bromomethane	104		104		39-139	0		20
Vinyl chloride	114		102		55-140	11		20
Chloroethane	111		104		55-138	7		20
1,1-Dichloroethene	109		100		61-145	9		25
trans-1,2-Dichloroethene	105		98		70-130	7		20
Trichloroethene	107		100		70-130	7		25
1,2-Dichlorobenzene	106		102		70-130	4		20
1,3-Dichlorobenzene	107		100		70-130	7		20
1,4-Dichlorobenzene	106		99		70-130	7		20
Methyl tert butyl ether	90		91		63-130	1		20
p/m-Xylene	108		102		70-130	6		20
o-Xylene	110		102		70-130	8		20
cis-1,2-Dichloroethene	109		103		70-130	6		20
Dibromomethane	102		98		70-130	4		20
1,4-Dichlorobutane	106		100		70-130	6		20
1,2,3-Trichloropropane	106		100		64-130	6		20
Styrene	108		101		70-130	7		20
Dichlorodifluoromethane	106		99		36-147	7		20
Acetone	111		93		58-148	18		20
Carbon disulfide	105		94		51-130	11		20

Lab Control Sample Analysis
Batch Quality Control

Project Name: G-3669
Project Number: G-3669

Lab Number: L1216912
Report Date: 09/27/12

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG563554-1 WG563554-2								
2-Butanone	107		107		63-138	0		20
Vinyl acetate	90		97		70-130	7		20
4-Methyl-2-pentanone	96		100		59-130	4		20
2-Hexanone	109		106		57-130	3		20
Ethyl methacrylate	98		102		70-130	4		20
Acrylonitrile	102		99		70-130	3		20
Bromochloromethane	106		103		70-130	3		20
Tetrahydrofuran	96		94		58-130	2		20
2,2-Dichloropropane	95		92		63-133	3		20
1,2-Dibromoethane	104		102		70-130	2		20
1,3-Dichloropropane	106		103		70-130	3		20
1,1,1,2-Tetrachloroethane	109		103		64-130	6		20
Bromobenzene	109		101		70-130	8		20
n-Butylbenzene	94		104		53-136	10		20
sec-Butylbenzene	111		103		70-130	7		20
tert-Butylbenzene	111		103		70-130	7		20
o-Chlorotoluene	111		103		70-130	7		20
p-Chlorotoluene	106		97		70-130	9		20
1,2-Dibromo-3-chloropropane	93		94		41-144	1		20
Hexachlorobutadiene	111		105		63-130	6		20
Isopropylbenzene	115		103		70-130	11		20

Lab Control Sample Analysis

Batch Quality Control

Project Name: G-3669

Project Number: G-3669

Lab Number: L1216912

Report Date: 09/27/12

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG563554-1 WG563554-2								
p-Isopropyltoluene	104		103		70-130	1		20
Naphthalene	82		116		70-130	**34**	Q	20
n-Propylbenzene	110		102		69-130	8		20
1,2,3-Trichlorobenzene	91		110		70-130	19		20
1,2,4-Trichlorobenzene	94		109		70-130	15		20
1,3,5-Trimethylbenzene	104		105		64-130	1		20
1,2,4-Trimethylbenzene	101		105		70-130	4		20
trans-1,4-Dichloro-2-butene	99		96		70-130	3		20
Ethyl ether	104		102		59-134	2		20

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	98		99		70-130
Toluene-d8	101		100		70-130
4-Bromofluorobenzene	103		98		70-130
Dibromofluoromethane	100		100		70-130

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information

Cooler	**Custody Seal**
A	Absent

Container Information

Container ID	**Container Type**	**Cooler**	**pH**	**Temp deg C**	**Pres**	**Seal**	**Analysis(*)**
L1216912-01A	Vial HCl preserved	A	N/A	2.6	Y	Absent	8260(14)
L1216912-01B	Vial HCl preserved	A	N/A	2.6	Y	Absent	8260(14)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The RPD between the results for the two columns exceeds the method-specified criteria; however, the lower value has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

Data Qualifiers

P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
J	- Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
ND	- Not detected at the reporting limit (RL) for the sample.

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certificate/Approval Program Summary

Last revised August 3, 2012 – Mansfield Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0141.

Wastewater/Non-Potable Water (Inorganic Parameters: pH, Turbidity, Conductivity, Alkalinity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Suspended Solids (non-filterable). Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Acid Extractables, Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, PAHs, Haloethers, Chlorinated Hydrocarbons, Volatile Organics.)

Solid Waste/Soil (Inorganic Parameters: pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Titanium, Vanadium, Zinc, Total Organic Carbon, Corrosivity, TCLP 1311, SPLP 1312. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Volatile Organics, Acid Extractables, Benzidines, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Florida Department of Health Certificate/Lab ID: E87814. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SM2320B, SM2540D, SM2540G.)

Solid & Chemical Materials (Inorganic Parameters: 6020, 7470, 7471, 9045. Organic Parameters: EPA 8260, 8270, 8082, 8081.)

Air & Emissions (EPA TO-15.)

Louisiana Department of Environmental Quality Certificate/Lab ID: 03090. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 180.1, 245.7, 1631E, 3020A, 6020A, 7470A, 9040, 9050A, SM2320B, 2540D, 2540G, 4500H-B, Organic Parameters: EPA 3510C, 3580A, 3630C, 3640A, 3660B, 3665A, 5030B, 8015D, 3570, 8081B, 8082A, 8260B, 8270C, 8270D.)

Solid & Chemical Materials (Inorganic Parameters: EPA 1311, 3050B, 3051A, 3060A, 6020A, 7196A, 7470A, 7471B, 7474, 9040B, 9045C, 9060. Organic Parameters: EPA 3540C, 3570, 3580A, 3630C, 3640A, 3660, 3665A, 5035, 8015D, 8081B, 8082A, 8260B, 8270C, 8270D.)

Biological Tissue (Inorganic Parameters: EPA 6020A. Organic Parameters: EPA 3570, 3510C, 3610B, 3630C, 3640A, 8270C, 8270D.)

Air & Emissions (EPA TO-15.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 2206. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 180.1, 1631E, 6020A, 7470A, 9040B, 9050A, SM2540D, 2540G, 4500H+B, 2320B, 3020A, . Organic Parameters: EPA 3510C, 3630C, 3640A, 3660B, 8081B, 8082A, 8270C, 8270D, 8015D.)

Solid & Chemical Materials (Inorganic Parameters: SW-846 1311, 3050B, 3051A, 6020A, 7471B, 9040B, 9045C. Organic Parameters: SW-846 3540C, 3580A, 3630C, 3640A, 3660B, 3665A, 8270C, 8015D, 8082A, 8081B.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA015. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SW-846 1312, 3020A, SM2320B, SM2540D, 2540G, 4500H-B, EPA 180.1, 1631E, SW-846 7470A, 9040C, 6020A, 9050A. Organic Parameters: SW-846 3510C, 3580A, 3630C, 3640A, 3660B, 3665A, 8015D, 8081B, 8082A, 8270C, 8270D)

Solid & Chemical Materials (Inorganic Parameters: SW-846 1311, 1312, 3050B, 3051A, 6020A, 7471B, 7474, 9040B, 9040C, 9045C, 9045D, 9060. Organic Parameters: SW-846 3540C, 3570, 3580A, 3630C, 3640A, 3660B, 3665A, 8081B, 8082A, 8270C, 8270D, 8015D.)

Atmospheric Organic Parameters (EPA 3C, TO-15, TO-10A, TO-13A-SIM.)

Biological Tissue (Inorganic Parameters: SW-846 6020A. Organic Parameters: SW-846 8270C, 8270D, 3510C, 3570, 3610C, 3630C, 3640A)

New York Department of Health Certificate/Lab ID: 11627. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SM2320B, SM2540D, 6020A, 1631E, 7470A, 9050A, EPA 180.1, 3020A. Organic Parameters: EPA 8270C, 8270D, 8081B, 8082A, 3510C.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 6020A, 7471B, 7474, 9040C, 9045D. Organic Parameters: EPA 8270C, 8270D, 8081B, 8082A, 1311, 3050B, 3580A, 3570, 3051A.)

Air & Emissions (EPA TO-15, TO-10A.)

Pennsylvania Certificate/Lab ID: 68-02089 ***NELAP Accredited***

Non-Potable Water (Inorganic Parameters: 1312, 1631E, 180.1, 3020A, 6020A, 7470A, 9040B, 9050A, 2320B, 2540D, 2540G, SM4500H+-B. Organic Parameters: 3510C, 3580A, 3630C, 3640A, 3660B, 3665A, 8015D, 8081B, 8082A, 8270C, 8270D .)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 3051A, 6020A, 7471B, 7474 9040B, 9045C, 9060. Organic Parameters: EPA3050B, 3540C, 3570, 3580A, 3630C, 3640A, 3660B, 3665A, 8270C, 8270D, 8081B, 8015D, 8082A.)

Rhode Island Department of Health Certificate/Lab ID: LAO00299. ***NELAP Accredited via NJ-DEP.***

Refer to NJ-DEP Certificate for Non-Potable Water.

Texas Commission of Environmental Quality Certificate/Lab ID: T104704419-08-TX. ***NELAP Accredited.***

Solid & Chemical Materials (Inorganic Parameters: EPA 6020, 7470, 7471, 1311, 9040, 9045, 9060. Organic Parameters: EPA 8015, 8270, 8081, 8082.)

Air (Organic Parameters: EPA TO-15)

Virginia Division of Consolidated Laboratory Services Certificate/Lab ID:460194. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters:EPA 3020A, 6020A, 245.7, 9040B. Organic Parameters: EPA 3510C, 3640A, 3660B, 3665A, 8270C, 8270D, 8082A, 8081B, 8015D.)

Solid & Chemical Materials (Inorganic Parameters: EPA 6020A,7470A,7471B,9040B,9045C,3050B,3051, 9060. Organic Parameters: EPA 3540C, 3580A, 3630C, 3640A, 3660B, 3665A, 3570, 8270C, 8270D, 8081B, 8082A, 8015D.)

Washington State Department of Ecology Certificate/Lab ID: C954. *Non-Potable Water* (Inorganic Parameters: SM2540D, 180.1, 1631E.)

Solid & Chemical Materials (Inorganic Parameters: EPA 6020, 7470, 7471, 7474, 9045C, 9050A, 9060. Organic Parameters: EPA 8081, 8082, 8015, 8270.)

U.S. Army Corps of Engineers

Department of Defense, L-A-B Certificate/Lab ID: L2217.01.

Non-Potable Water (Inorganic Parameters: EPA 6020A, SM4500H-B. Organic Parameters: 3020A, 3510C, 8270C, 8270D, 8270C-ALK-PAH, 8270D-ALK-PAH, 8082A, 8081B, 8015D-SHC, 8015D.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 3050B, 6020A, 7471A, 9045C, 9060, SM 2540G, ASTM D422-63. Organic Parameters: EPA 3580A, 3570, 3540C, 8270C, 8270D, 8270C-ALK-PAH, 8270D-ALK-PAH 8082A, 8081B, 8015D-SHC, 8015D.

Air & Emissions (EPA TO-15.)

Analytes Not Accredited by NELAP

Certification is not available by NELAP for the following analytes: **8270C:** Biphenyl. **TO-15:** Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 2-Methylnaphthalene, 1-Methylnaphthalene.

Certificate/Approval Program Summary

Last revised August 16, 2012 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Selenium, Silver, Sodium, Thallium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP) 504.1, Ethylene Dibromide (EDB) 504.1, 1,4-Dioxane (Mod 8270). Microbiology Parameters: Total Coliform-MF mEndo (SM9222B), Total Coliform – Colilert (SM9223, Enumeration and P/A), E. Coli. – Colilert (SM9223, Enumeration and P/A), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform-EC Medium (SM 9221E).

Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics, TPH (HEM/SGT), CT-Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH. Microbiology Parameters: Total Coliform – MF mEndo (SM9222B), Total Coliform – MTF (SM9221B), E. Coli – Colilert (SM9223 Enumeration), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform – A-1 Broth (SM9221E), Enterococcus - Enterolert.

Solid Waste/Soil (Inorganic Parameters: pH, Sulfide, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), SPLP Leach (1312 metals only), Reactivity. Organic Parameters: PCBs, PCBs in Oil, Organochlorine Pesticides, Technical Chlordane, Toxaphene, CT-Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH, Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Dalapon, Volatile Organics (SW 8260), Acid Extractables (Phenols) (SW 8270), Benzidines (SW 8270), Phthalates (SW 8270), Nitrosamines (SW 8270), Nitroaromatics & Cyclic Ketones (SW 8270), PAHs (SW 8270), Haloethers (SW 8270), Chlorinated Hydrocarbons (SW 8270).)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9222D, 9223B, EPA 180.1, 353.2, SM2130B, 2320B, 2540C, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B, 4500NO3-F, EPA 200.7, EPA 200.8, 245.1, EPA 300.0. Organic Parameters: 504.1, 524.2.)

Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, SM2320B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NO3-F, 4500P-B, 4500P-E, 5210B, 5220D, 5310C, 9010B, 9040B, 9030B, 7470A, 7196A, 2340B, EPA 200.7, 6010B, 200.8, 6020, 245.1, 1311, 1312, 3005A, Enterolert, 9223D, 9222D. Organic Parameters: 608, 624, 625, 8081A, 8082, 8330, 8151A, 8260B, 8270C, 3510C, 3630C, 5030B, ME-DRO, ME-GRO, MA-EPH, MA-VPH.)

Solid Waste/Soil (Inorganic Parameters: 9010B, 9012A, 9014A, 9030B, 9040B, 9045C, 6010B, 7471A, 7196A, 9050A, 1010, 1030, 9065, 1311, 1312, 3005A, 3050B. Organic Parameters: ME-DRO, ME-GRO, MA-EPH, MA-VPH, 8260B, 8270C, 8330, 8151A, 8081A, 8082, 3540C, 3546, 3580A, 3630C, 5030B, 5035.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
*Drinking Water (*Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl) (EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Fluoride, Sulfate); (EPA 353.2 for: Nitrate-N, Nitrite-N); (SM4500NO3-F for: Nitrate-N and Nitrite-N); 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, SM4500H-B. Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics); (504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), EPA 332. Microbiology Parameters: SM9215B; ENZ. SUB. SM9223; ColilertQT SM9223B; MF-SM9222D.)

*Non-Potable Water (*Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn); (EPA 200.7

for: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn); 245.1, SM4500H,B, EPA 120.1, SM2510B, 2540C, 2340B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Ammonia-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics),(608 for: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT,Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs-Water), (EPA 625 for SVOC Acid Extractables and SVOC Base/Neutral Extractables), 600/4-81-045-PCB-Oil. Microbiology Parameters: (ColilertQT SM9223B; Enterolert-QT: SM9222D-MF.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM 9222B, 9223B, 9215B, EPA 200.7, 200.8, 300.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 332.0. Organic Parameters: 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 3005A, 200.7, 200.8, 245.1, SW-846 6010B, 6010C, 6020, 6020A, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 300.0, 350.1, 350.2, 351.1, 353.2, 410.4, 420.1, 426C, 1664A, SW-846 9010B, 9030B, 9040B, SM2120B, 2310B, 2320B, 2540B, 2540D, 4500H+B, 4500CL-E, 4500CN-E, 4500NH3-H, 4500NO3-F, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 5220D, 2510B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D, 3060A. Organic Parameters: SW-846 3510C, 3630C, 5030B, 8260B, 8270C, 8270D, 8330, EPA 624, 625, 608, SW-846 8082, 8082A, 8081A, 8081B, 8151A, 8330, 8270C-SIM, 8270D-SIM.)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 6010C, 7196A, 7471A, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040B, 9045C, 9050, 9065,1311, 1312, 3005A, 3050B, 3060A. Organic Parameters: SW-846 3540C, 3546, 3050B, 3580A, 3630C, 5030B, 5035, 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330, 8151A, 8015B, 8015C, 8082, 8082A, 8081A, 8081B.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500CN-CE, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 200.8, 245.1, 2540C, SM2120B, 2320B, 2510B, 5310C, SM4500H-B. Organic Parameters: EPA 332, 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.4, SM5220D, 4500Cl-E, EPA 300.0, SM2120B, 2340B, SM4500F-BC, EPA 200.7, 200.8, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM510ABC, SM4500P-B5+E, 2540B, 2540C, 2540D, 2540G, EPA 120.1, SM2510B, SM2520B, SM15 426C, 9222D, 9221B, 9221C, 9221E, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.1, 350.2, SW-846 1312, 7470A, 5540C, SM4500H-B, 4500SO3-B, SM3500Cr-D, 4500CN-CE, EPA 245.1, SW-846 9040B, 3005A, 3015, EPA 6010B, 6010C, 6020, 6020A, 7196A, 3060A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3510C, EPA 608, 624, 625, SW-846 3630C, 5030B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 1,4-Dioxane by NJ Modified 8270, 8015B, NJ EPH.)

Solid & Chemical Materials (Inorganic Parameters: SW-846, 6010B, 6010C, 6020, 6020A, 7196A, 3060A, 9010B, 9030B, 1010, 1030, 1311, 1312, 3005A, 3050B, 7471A, 7471B, 9014, 9012A, 9040B, 9040C, 9045C, 9045D, 9050A, 9065, 9251. Organic Parameters: SW-846 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3540C, 3546, 3580A, 3630C, 5030B, 5035L, 5035H, NJ OQA-QAM-025 Rev.7, NJ EPH.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 9215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 332.0, SM2320B, EPA 300.0, SM2120B, 4500CN-E, 4500F-C, 4500NO3-F, 2540C, SM 2510B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, 5210B, 5310C, EPA 410.4, SM5220D, 2310B-4a, 2320B, EPA 200.7, 300.0, SM4500CL-E, 4500F-C, SM15 426C, EPA 350.1, SM4500NH3-BH, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, SM4500-NO3-F, 4500-NO2-B, 4500P-E, 2540C, 2540B, 2540D, EPA 200.8, EPA 6010B, 6010C, 6020, 6020A, EPA 7196A, SM3500Cr-D, EPA 245.1, 245.2, 7470A, SM2120B, LACHAT 10-204-00-1-A, 4500CN-CE, EPA 1664A, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, SM4500S-D, SM5540C, EPA 3005A, 3015, 9010B, 9030B. Organic Parameters: EPA 624, 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 625, 608, 8081A, 8081B, 8151A, 8330, 8082, 8082A, EPA 3510C, 5030B.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1010, 1030, EPA 6010B, 6010C, 7196A, 7471A, 7471B, 9012A, 9014, 9065, 9050A, EPA 1311, 1312, 3005A, 3050B, 9010B, 9040C, 9045D. Organic Parameters: EPA 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8015B, 8015C, 8081A, 8081B, 8151A, 8330, 8082 8082A, 3540C, 3546, 3580, 3580A, 5030B, 5035A-H, 5035A-L.)

North Carolina Department of the Environment and Natural Resources Certificate/Lab ID : 666. (Inorganic Parameters: SM2310B, 2320B, 4500Cl-E, 4500Cn-E, 9014, Lachat 10-204-00-1-X, 1010A, 1030, 4500NO3-F, 353.2, 4500P-E, 4500SO4-E, 300.0, 4500S-D, 5310B, 5310C, 6010C, 6020A, 200.7, 200.8, 3500Cr-B, 7196A, 245.1, 7471A, 7471B, 1311,1312. Organic Parameters: 608, 8081B, 8082A, 624, 8260B, 625, 8270D, 8151A, 8015C, 504.1, MA-EPH, MA-VPH.)

Drinking Water Program Certificate/Lab ID: 25700. (Inorganic Parameters: Chloride EPA 300.0. Organic Parameters: 524.2)

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: 200.7, 200.8, 245.2, 300.0, 332.0, 2120B, 2320B, 2510B, 2540C, 4500-CN-CE, 4500F-C, 4500H+-B, 4500NO3-F, 5310C. Organic Parameters: EPA 524.2, 504.1)

Non-Potable Water (Inorganic Parameters: EPA 120.1, 1312, 3005A,3015, 3060A, 200.7, 200.8, 410.4, 1664A, SM2540D, 5210B, 5220D, 4500-P,BE, 245.1, 300.0, 3501., 350.2, 353.2, 420.1, 6010B, 6010C, 6020, 6020A, 7196A, 7470A, 9010B, 9030B, 9040B, Lachat 10-107-06-2-D, NJ-EPH, 2120B, 2310B, 2320B, 2340B, 2510C, 2540B, 2540C, 3500Cr-D, 436C, 4500CN-CE, 4500Cl-E, 4500F-B, 4500F-C, 4500H+-B, 4500NO2-B, 4500NO3-F, 4500S-D, 4500SO3-B, 5310BCD, 5540C. Organic Parameters: EPA 3510C, 3630C, 5030B, 625, 624, 608, 8081A, 8081B, 8082, 8082A, 8151A, 8260B, 8270C, 8270D, 8330, 8015B,)

Solid & Hazardous Waste (Inorganic Parameters: EPA 350.1, 1010, 1030, 1311, 1312, 3005A, 3050B, 3060A, 6010B, 6010C, 6020A, 7196A, 7471A, 7471B, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065, SM 4500NH3-BH, 9030B, 9038, 9251. Organic Parameters: 3540C, 3546, 3580A, 3630C, 5035, 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8260B, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330, NJ-EPH.)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NJ-DEP.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NJ-DEP Certificate for Potable and Non-Potable Water.

Texas Commisson on Environmental Quality Certificate/Lab ID: T104704476-09-1. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664, 200.7, 200.8, 245.1, 245.2, 300.0, 350.1, 351.1, 353.2, 410.4, 420.1, 6010, 6020, 7196, 7470, 9040, SM 2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 426C, 4500CL-E, 4500CN-E, 4500F-C, 4500H+B, 4500NH3-H, 4500NO2B, 4500P-E, 4500 S2¯D, 510C, 5210B, 5220D, 5310C, 5540C. Organic Parameters: EPA 608, 624, 625, 8081, 8082, 8151, 8260, 8270, 8330.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 1312, 9012, 9014, 9040, 9045, 9050, 9065.)

Virginia Division of Consolidated Laboratory Services Certificate/Lab ID: 460195. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: EPA 200.7, 200.8, 300.0, 2510B, 2120B, 2540C, 4500CN-CE, 245.2, 2320B, 4500F-C, 4500F-C, 4500NO3-F, 5310C. Organic Parameters: EPA 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 200.7, 2..08, 245.1, 300.0, 3005A, 3015, 1312, 6010B, 6010C, 3060A, 353.2, 420.1, 6020, 6020A, SM4500S-D, SM4500-CN-CE, Lachat 10-204-00-1-X, 7196A, 7470A, 9010B, 9040B, 2310B, 2320B, 2510B, 2540B, 2540C, 3500Cr-D, 426C, 4500Cl-E, 4500F-B, 4500F-C, 4500PE, 510AC, 5210B, 5310B 5310C, 5540C. Organic Parameters: EPA 3510C, 3630C, 5030B, 8260B, 608, 624, 625, 8081A, 8081B, 8082, 8082A, 8151A, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330,)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1010A, 1030, 3060A, 3050B, 1311, 1312, 6010B, 6010C, 6020, , 7196A, 7471A, 7471B, 6020A, 9030B, 9010B, 9012A, 9014 9040B, 9045C, 9050A, 9065. Organic Parameters: EPA 5035, 3540C, 3546, 3550, 3580, 3630C, 8260B, 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330.)

Department of Defense, L-A-B Certificate/Lab ID: L2217.
Drinking Water (Inorganic Parameters: SM 4500H-B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: EPA 200.7, 200.8, 6010B, 6010C, 6020, 6020A, 245.1, 245.2, 7470A, 9040B, 9010B, 180.1. 300.0, 332.0, 6860, 353.2, 410.4, 9060, 1664A, SM 4500CN-E, 4500H-B, 4500NO3-F, 4500CL-D, 5220D, 5310C, 2130B, 2320B, 2540C, 3005A, 3015, 9010B, 9056. Organic Parameters: EPA 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330A, 8082, 8082A, 8081A, 8081B, 3510C, 5030B, MassDEP EPH, MassDEP VPH.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 200.7, 6010B, 6010C, 7471A, 6860, 1311, 1312, 3050B, 7196A, 9010B, 9012A, 9040B, 9045C, 3500-CR-D, 4500CN-CE, 2540G, Organic Parameters: EPA 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330A/B-prep, 8082, 8082A, 8081A, 8081B, 3540C, 3546, 3580A, 5035A, MassDEP EPH, MassDEP VPH.)

The following analytes are not included in our current NELAP/TNI Scope of Accreditation:
EPA 8260B: Freon-113, 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene. **EPA 8330A:** PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT. **EPA 8270C:** Methyl naphthalene, Dimethyl naphthalene, Total Methylnapthalenes, Total Dimethylnaphthalenes, 1,4-Diphenylhydrazine (Azobenzene). **EPA 625:** 4-Chloroaniline, 4-Methylphenol. Total Phosphorus in a soil matrix, Chloride in a soil matrix, TKN in a soil matrix, NO2 in a soil matrix, NO3 in a soil matrix, SO4 in a soil matrix. **EPA 9071:** Total Petroleum Hydrocarbons, Oil & Grease.

L1216912

CHAIN OF CUSTODY RECORD

Proj No. G-3669

Project Name Selfridge Bld 1533

Samplers *(Signature)*

Sta. No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	8260						Remarks
MW-16	9/18	15:30			MW-16	2	X						

Relinquished by: *(Signature)*	**Date Time** 9/18 16:30	**Received by:** *(Signature)* Will Elcoate 16:30	**Relinquished by:** *(Signature)* Will Elcoate/Fedex	**Date Time** 9-19. 10.25	**Received by:** *(Signature)* FED EX
Relinquished by: *(Signature)* FED EX	**Date Time** 9/20/12 1000	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date Time**	**Received for Laboratory by:** *(Signature)*		**Remarks**	

L1216912

CHAIN OF CUSTODY RECORD

Proj No. G-3669

Project Name Selfridge Bld 1533

Samplers *(Signature)*

Sta. No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	8260						Remarks
MW-16	9/18	15:30			MW-16	2	X						

Relinquished by: *(Signature)*	Date Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date Time	Received by: *(Signature)*
	9/18 16:30	Will Ecoate 16.30	Will Ecoate/Fedex	9-19. 10.25	FED Ex
FED Ex	9/20/12 1000			9/21/12 1215	J Watt 9/21/12 12[illegible]
	9/21/12 1525	Received for Laboratory by: *(Signature)*			

Remarks

Radon Analysis (EPA Method GS: Grab Sample/Scintillation Cell counting)

For GSI Environmental

Samples Collected by: T. McHugh/L. Beckley

Site: Mt. Clement, MI

Analysts: Doug Hammond

Phone: 310-490-7896

email: dhammond@usc.edu

Client Project Number: ESTCP C51A/OSA Dem

Sample Dates: 09/19/12

Sample containers: Tedlar bags w/ nylon fittings

Assumed Site Pressure **0.97** atm

based on an elevation of 608 ft

Time Zone adjustment: add to decay time

3 hours Collect (EDT)

Run (PDT)

	Summary	Collection		Analysis					Lab Duplicates		
		Date	time (EDT)	Date	time (PDT)	Vol run (cc)	Conc. pCi/L	±1 sig pCi/L	mean pCi/L	±1ssd pCi/L	Notes
Received 09/20/12											
1	Amb-1-BL	9/19/12	11:10	9/20/12	12:08	120	0.08	0.04			
2	Ind-1-BL	9/19/12	11:10	9/20/12	12:11	120	0.42	0.06	0.37	0.07	
	lab dupe	9/19/12	11:10	9/21/12	8:35	120	0.32	0.09			
3	Ind-1-PP	9/19/12	14:05	9/20/12	14:05	60	0.19	0.07			
4	Ind-1-NP	9/19/12	16:30	9/20/12	12:16	120	0.28	0.05			
5	Dup-1 (field duplicate)	9/19/12	14:05	9/20/12	12:19	120	0.09	0.04			

Uncertainty given in pCi/liter is based on counting statistics for low activity samples. For high activity samples uncertainty is ±5%.

The Lower Limit of Detection for Rn (95% confidence level as recommended by EPA 402-R-95-012, Oct. 97) is 0.14 pCi/liter.

Results are reported based on standardization with NIST-traceable radon sources.

These results are for application of naturally-occurring radon as a tracer of soil vapor intrusion, but are not intended for evaluation of radon hazards.

Note Details:

Results corrected to in situ pressure as noted above

Raw Data, Calculation factors, and Analytical Details

	Sample ID	Collection Date	Time (EDT)	Analysis Date	Time (PDT)	Count in cell/ch	He eff	Air/He eff	Vol run (cc)	Press factor	obs dpm	sig dpm	Decay T (hours)	Decay factor	Concentration dpm/liter	pCi/liter	count stats pCi/liter ±1 sig	Notes
Received 09/20/12																		
1	Amb-1-BL	9/19/12	11:10	9/20/12	12:08	82/32	0.743	0.95	120	0.97	0.012	0.006	28.0	1.235	0.17	0.08	0.04	
2	Ind-1-BL	9/19/12	11:10	9/20/12	12:11	81/31	0.818	0.95	120	0.97	0.072	0.010	28.0	1.236	0.93	0.42	0.06	
	lab dupe	9/19/12	11:10	9/21/12	8:35	82/32	0.743	0.95	120	0.97	0.043	0.012	48.4	1.442	0.71	0.32	0.09	
3	Ind-1-PP	9/19/12	14:05	9/20/12	14:05	76/22	0.912	0.98	60	0.97	0.019	0.007	27.0	1.226	0.42	0.19	0.07	
4	Ind-1-NP	9/19/12	16:30	9/20/12	12:16	84/11	0.785	0.95	120	0.97	0.048	0.008	22.8	1.188	0.62	0.28	0.05	
5	Dup-1 (field duplicate)	9/19/12	14:05	9/20/12	12:19	83/33	0.806	0.95	120	0.97	0.015	0.007	25.2	1.210	0.19	0.09	0.04	

Decay correctiions based on Rn decay constant of 0.1813 per day

Conversion from dpm based on 0.4504 pCi/dpm

Radon Conc = {(0.4504)(1000)(obs dpm)(decay factor)(Press factor)}/{(cc used)(He eff)(Air/He)}
(in pCi/liter)

Blanks are negligible.

Definitions:

Cell/ch:	Counting cell and channel used	sig dpm	uncertainty (± 1 sig) in dpm based on counting statistics
He eff:	Cell and counter efficiency using helium matrix	Decay T:	time elapsed from sampling to analysis
Air/He:	Correction for matrix counting gas density	Decay factor:	Correction factor for decay from collection to analysis
Sample vol:	Volume analyzed (cc)	dpm/liter:	Radon concentration in disintigrations per minute per liter of sample
Press factor:	Correction to in situ pressure based on collection altitude	piC/liter:	Radon concentration in picoCuries per liter
obs dpm:	observed radon activity (disintigrations per minute) when analyzed	count stats:	uncertainty in observed radon based on counting statistics

CHAIN OF CUSTODY RECORD

Proj No. 3669	**Project Name** ESTCP CSIA/OSR Dem
Samplers *(Signature)* TEM/LMB	Selfridge ANG Base Building 1533

Results to:
Tom McHugh temchugh@gsi-net.com
Lila Beckley lmbeckley@gsi-net.com
FAX to 512 346-4476

Sta. No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	[illegible]	[illegible]					Remarks
Amb-1-BL	9/19	1110		✓		1		✓					Ambient-1-BL 500mL in 1L Tedlar
Ind-1-BL	9/19	1110		✓		1		✓					Indoor-1-BL
Ind-1-PP	9/19	1405		✓		1		✓					Indoor-1-PP
Ind-1-NP	9/19	1630		✓		1		✓					Indoor-1-NP
Dup 1	9/19			✓		1		✓					Dup 1

Relinquished by: *(Signature)*	**Date Time** 9/19/12 1800	**Received by** *(Signature)* Doug 9/20/12 11:30	**Relinquished by:** *(Signature)*	**Date Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date Time**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date Time**	**Received for Laboratory by:** *(Signature)*		**Remarks**	

reruns of OU#613 (the older sample set), analyzed in the week of October 22nd

RUN #	Date of Analysis	SAMPLE ID	AIRTUBE #	TCE
9068	10/22/2012	3-SS-2-CSI	C16_J03553	-19.5
9069	10/22/2012	1-SS-2-CSI	C16_J07342	no peak
9071	10/22/2012	1-IA-1-CSI	C16_J07242	peak coelutes

OU#631 (the newer sample set)

Dup = split of the sample recollected on Cx1016

Benzene

RUN #	Date of Analysis	SAMPLE ID	AIRTUBE #	Benzene
9020	10/9/2012	SS-2 Low	C16_J04853	-28.9
9024	10/10/2012	SS-2 1hr	C16_K08430	-29.4
9025	10/10/2012	SS-2 High	C16_J06645	-31.1
9029	10/11/2012	Dup of SS-2 High	C16_J03770	-31.0
9082	10/24/2012	Dup of SS-2 High	C16_J03770	-31.4
9030	10/11/2012	SS-1	C16_J03738	-29.8
9023	10/10/2012	SS-1	C16_J03973	-29.9
9038	10/15/2012	Dup of Indoor 1	C16_K08440	-29.4
9042	10/16/2012	Indoor 1	C16_K08448	-29.0
9043	10/16/2012	Indoor 1 overnight	C16_J03120	-29.9
9081	10/24/2012	Dup of Indoor 1 overnight	C16_K08412	-29.7
1876	10/24/2012	ground water sample		-26.5
1878	10/24/2012	ground water sample		-26.6

TCE

RUN #	Date of Analysis	SAMPLE ID	AIRTUBE #	TCE	
9076	10/23/2012	SS-2 1 hr	C16_J03150	-26.0	
9065	10/21/2012	Dup of SS-2 High	C16_J03770	-25.0	
9066	10/21/2012	Dup of SS-2 High	C16_J03770	-25.6	
9074	10/22/2012	Dup of SS-1	C16_J03738	-18.8	
9072	10/22/2012	Dup of Indoor 1	C16_K08440	-32.3	
9077	10/23/2012	Dup of Indoor 1	C16_K08448	-32.4	
9079	10/24/2012	Indoor 1 overnight	C16_K08412	-30.7	this number is likely 1-2 permil to peak was too tall, resulting with c may be rerun if there is spare ma

o heavy;
ombusion problem;
terial after PCE analysis.

Received by GSI, 3 May 2013
Results of additional analyses of SANG samples:

OU#631 benzene

Dup = split of the sample recollected on Cx1016
all tube numbers refer to the original samples collected in the field
analytical uncertainty defined by the standards ± 0.2 (2 stdevs at n=13 in Oct-12, n=6 in April-13)
NOTE: Only 10-20 ng of benzene on "SS-2 low". Possible problems caused by low level carryover or adsorbent pyrolysis byproduct

run #	date analyzed	sample ID	original airtube #	del benzene VPDB	remarks
1876		ground water sample	na	-26.5	
1878		ground water sample	na	-26.6	
9042	10/16/2012	Indoor 1	C16_K08448	-29.1	intact original tube
9038	10/15/2012	Dup Indoor 1	C16_K08440	-29.0	
9498	4/24/2013	Dup Indoor 1	C16_K08421	-28.9	split of an intact original tube, collected in April 2013
9500	4/24/2013	Dup Indoor 1	C16_K08421	-28.8	split of run #9498
9043	10/16/2012	Indoor 1 overnight	C16_J03120	-30.0	intact original tube
9081	10/24/2012	Dup Indoor 1 overnight	C16_K08412	-29.8	
9023	10/10/2012	SS-1	C16_J03973	-29.9	intact original tube
9030	10/11/2012	SS-1	C16_J03738	-29.8	intact original tube
9491	4/19/2013	SS-1	C16_K08431	-29.7	intact original tube
9493	4/19/2013	Dup SS-1	C16_K08431	-29.8	split of run #9491
9024	10/10/2012	SS-2 1hr	C16_K08430	-29.4	intact original tube
9496	4/23/2013	SS-2 1 hr	C16_J03150	-29.4	split of the original tube, collected in October 2012
9499	4/24/2013	Dup SS-2 1 hr	C16_J03150	-29.3	split of run #9496
9020	10/9/2012	SS-2 Low	C16_J04853	-28.9	intact original tube
9492	4/19/2013	SS-2 Low	C16_J07661	-30.2	intact original tube
9025	10/10/2012	SS-2 High	C16_J06645	-31.1	intact original tube
9029	10/11/2012	Dup SS-2 High	C16_J03770	-31.0	
9082	10/24/2012	Dup SS-2 High	C16_J03770	-31.5	

Received by GSI, 3 May 2013
Results of additional analyses of SANG samples:

OU#631 TCE

Dup = split of the sample recollected on Cx1016

all tube numbers refer to the original samples collected in the field

analytical uncertainty defined by the standards: Oct-12 ± 0.6 (2 stdevs at n=7); April-13 ± 0.4 (2 stdevs at n=10)

NOTE: samples from Oct-2012 suffered from noisy background. Possible accuracy offsets by a few tenths of permil

run #	date analyzed	sample ID	original airtube #	del TCE VPDB	remarks	
9072	10/22/2012	Dup Indoor 1	C16_K08440	-32.5		
9077	10/23/2012	Dup Indoor 1	C16_K08448	-32.6		
9485	4/17/2013	Indoor 1	C16_K08457	-31.8	intact original tube	
9488	4/18/2013	Dup Indoor 1	C16_J03146	-31.8	split of run #9485	
9079	10/23/2012	Indoor 1 overnight	C16_K08412	-31.0	intact original tube	this number is likely 1-2 permil too heavy; peak was too tall, resultin
9074	10/22/2012	Dup SS-1	C16_J03738	-18.7		
9076	10/23/2012	SS-2 1 hr	C16_J03150	-26.2	intact original tube	
9065	10/21/2012	Dup SS-2 High	C16_J03770	-25.2		
9066	10/21/2012	Dup SS-2 High	C16_J03770	-25.8		
9484	4/17/2013	SS-2 High	C16_J07356	-24.6	intact original tube	

Received by GSI, 3 May 2013
Results of additional analyses of SANG samples:

OU#631 PCE

Dup = split of the sample recollected on Cx1016
all tube numbers refer to the original samples collected in the field
analytical uncertainty defined by the standards: ± 0.3 (2 stdevs at n=8)

NOTE: the indoor samples likely affected by too low signal and proportionally high background noise.

run #	date analyzed	sample ID	original airtube #	del PCE VPDB	remarks	
9421	4/1/2013	Indoor 1	C16_K08448	-27.8	split of an intact original tube, collected in Oct 2012	peak amplitude below the calibration range
9414	3/29/2013	Indoor 1 overnight	C16_J03120	-27.8	split of an intact original tube, collected in Oct 2012	peak amplitude below the calibration range
9434	4/4/2013	Indoor 1 overnight	C16_J07366	-26.3	intact original tube	peak amplitude at the lower end of calibratio
9436	4/5/2013	Indoor 1 overnight	C16_J07064	-26.2	intact original tube	peak amplitude below the calibration range
9427	4/3/2013	SS-1	C16_J03738	-26.5	split of an intact original tube, collected in Oct 2012	
9429	4/3/2013	Dup SS-1	C16_J03703	-26.8	split of run #9427	
9437		SS-1	C16_M17689	-26.1	split of run #9429	
9425	4/1/2013	SS-2 1 hr	C16_J03116	-25.3	split of an intact original tube, collected in April 2013	
9433	4/4/2013	Dup SS-2 1 hr (#9425)	C16_J03116	-25.3	split of run #9425	
9428	4/3/2013	SS-2 Low (#9415)	C16_J04342	-25.7	split of an intact original tube, collected in April 2013	
9438	4/5/2013	SS-2 Low (NEW)	C16_J03146	-25.5	intact original tube	
9419	4/1/2013	SS-2 High	C16_J03770	-25.5	split of an intact original tube, collected in Oct 2012	

Tyndall Air Force Base, Florida

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LABORATORY REPORT

March 13, 2013

Tom McHugh
GSI Environmental Inc.
2211 Norfolk, Suite 1000
Houston, TX 77098

RE: ESTCP VI Study - Tyndall AFB / 3585/3669

Dear Tom:

Enclosed are the results of the samples submitted to our laboratory on February 28, 2013. For your reference, these analyses have been assigned our service request number P1300816.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Sue Anderson
By Sue Anderson at 2:55 pm, Mar 13, 2013

Sue Anderson
Project Manager

Client:	GSI Environmental Inc.	Service Request No: P1300816
Project:	ESTCP VI Study - Tyndall AFB / 3585/3669	

CASE NARRATIVE

The samples were received intact under chain of custody on February 28, 2013 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Volatile Organic Compound Analysis

The samples were analyzed in SIM mode for selected volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

The response for the 3rd internal standard in samples 219-SS-2 (P1300816-013) and 219-SS-3 (P1300816-014) was outside control criteria because of suspected matrix interference. The samples were diluted in an attempt to eliminate the effects of the matrix interference. The results are reported from the dilution; therefore, the associated method reporting limits have been elevated accordingly.

The Summa canisters were cleaned, prior to sampling, down to the method reporting limit (MRL) reported for this project. Please note, projects which require reporting below the MRL could have results between the MRL and method detection limit (MDL) that are biased high.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of Columbia Analytical Services, Inc. dba ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to ALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

Columbia Analytical Services, Inc. dba ALS Environmental – Simi Valley

Certifications, Accreditations, and Registrations

Agency	Web Site	Number
AIHA	http://www.aihaaccreditedlabs.org	101661
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0694
DoD ELAP	http://www.pjlabs.com/search-accredited-labs	L11-203
Florida DOH (NELAP)	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E871020
Maine DHHS	http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/labcert.htm	2012039
Minnesota DOH (NELAP)	http://www.health.state.mn.us/accreditation	494864
New Jersey DEP (NELAP)	http://www.nj.gov/dep/oqa/	CA009
New York DOH (NELAP)	http://www.wadsworth.org/labcert/elap/elap.html	11221
Oregon PHD (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	CA200007
Pennsylvania DEP	http://www.depweb.state.pa.us/labs	68-03307 (Registration)
Texas CEQ (NELAP)	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704413-12-3
Utah DOH (NELAP)	http://www.health.utah.gov/lab/labimp/certification/index.html	CA015272012-2
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C946

Analyses were performed according to our laboratory's NELAP and DoD-ELAP approved quality assurance program. A complete listing of specific NELAP and DoD-ELAP certified analytes can be found in the certifications section at www.caslab.com, www.alsglobal.com, or at the accreditation body's website.

Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact the laboratory for information corresponding to a particular certification.

DETAIL SUMMARY REPORT

Client: GSI Environmental Inc.
Service Request: P1300816
Project ID: ESTCP VI Study - Tyndall AFB / 3585/3669

Date Received: 2/28/2013
Time Received: 09:05

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-15 - VOC SIM
156-IA-1	P1300816-001	Air	2/20/2013	16:18	AS00290	-1.97	3.63	X
156-IA-2	P1300816-002	Air	2/20/2013	16:19	AS00217	-4.69	3.50	X
156-IA-3	P1300816-003	Air	2/20/2013	16:19	AC01816	-3.63	3.50	X
219-AA-1	P1300816-004	Air	2/20/2013	16:41	AS00341	-3.12	3.50	X
219-IA-1	P1300816-005	Air	2/20/2013	16:00	AS00230	-3.02	3.59	X
219-IA-3	P1300816-006	Air	2/20/2013	16:38	AC01904	-3.58	3.60	X
156-IA-4-NP	P1300816-007	Air	2/21/2013	15:57	AS00216	0.18	3.60	X
156-IA-5-NP	P1300816-008	Air	2/21/2013	15:57	AS00166	-0.67	3.64	X
156-SS-1	P1300816-009	Air	2/21/2013	11:53	AS00198	-0.40	3.78	X
156-SS-2	P1300816-010	Air	2/21/2013	11:42	AS00141	-0.02	3.82	X
156-SS-3	P1300816-011	Air	2/21/2013	11:26	AS00336	-1.37	3.56	X
219-SS-1	P1300816-012	Air	2/21/2013	16:16	AS00168	-0.25	3.62	X
219-SS-2	P1300816-013	Air	2/21/2013	16:28	AS00182	0.02	3.67	X
219-SS-3	P1300816-014	Air	2/21/2013	16:45	AS00310	0.12	3.81	X
156-IA-4-BL	P1300816-015	Air	2/22/2013	08:04	AS00199	-0.03	3.75	X

Columbia Analytical Services™

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 2

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1300816

CAS Contact: Sue Anderson

Company Name & Address (Reporting Information)
GSI Environmental
2211 Norfolk St. 1000
Houston TX 77098

Project Name: ESTCP VI Study - Tyndall AFB

Project Number: 3585/3669

Project Manager: Tom McHugh / Lila Beckley

P.O. # / Billing Information:

Phone: 713-522-6300

Fax:

Email Address for Result Reporting: lmbeckley@gsi-net.com

Sampler (Print & Sign): TEM/IRD/LMB/VPS

Analysis Method

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	TO-15 SIM * ~~(see quote for analyte list)~~	*PCE, TCE, cis, trans, 11DCE, VC	Comments e.g. Actual Preservative or specific instructions
156-IA-1	① -7.91	2/20/2013	0816-1618	AS00290	FCA00469	-29.5	-3	6L	✓		
156-IA-2	② -4.59		0820-1619	AS00217	FCA00639	-30	-9	6L			
156-IA-3	③ -3.57		0820-1619	AC01816	FCA00675	-30	-7	6L			
219-AA-1	④ -3.08		0855-1641	AS00341	FCA00671	-29.5	-7	6L			
219-IA-1	⑤ -3.30		0850-1600	AS00230	FCA00575	-30	-6.5	6L			
219-IA-3	⑥ -3.81	↓	0848-1638	AC01904	FCA00264	-29.5	-8	6L			
156-IA-4-NP	⑦ -0.11	2/21/2013	1557	AS00216	—	-29.5	0	6L			
156-IA-5-NP	⑧ -0.96	2/21/2013	1557	AS00166	—	-29.5	-0.25	6L			
156-SS-1	⑨ -0.67	2/21/2013	1153	AS00198	—	-30	-0.25	6L			
156-SS-2	⑩ -0.26	2/21/2013	1142	AS00141	—	-30	0	6L			
156-SS-3	⑪ -1.62	2/21/2013	1126	AS00336	—	-29	-2.5	6L			
219-SS-1	⑫ -0.60	2/21/2013	1616	AS00168	—	-30	0	6L			
219-SS-2	⑬ -0.28	2/21/2013	1628	AS00182	—	-29.5	0	6L			
219-SS-3	⑭ -0.17	2/21/2013	1645	AS00310	—	-30	0	6L	↓		

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ✓
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required [✓ Yes] No
Type: µg/m³

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	2/22/13	1050		2/28/13	0905
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____ °C

Columbia Analytical Services
2655 Park Center Drive, Suite A
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Air - Chain of Custody Record & Analytical Service Request

Page 2 of 2

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1300816

Company Name & Address (Reporting Information): GSI Environmental
2211 Norfolk Ste 1000
Houston TX 77098

Project Name: ESTCP VI Study - Tyndall AFB

Project Number: 3585/3669

CAS Contact: Sue Anderson

Project Manager: T. McHugh / L. Beckley

P.O. # / Billing Information:

Phone: 713-522-6300

Fax:

Email Address for Result Reporting: lmbeckley@gsi-net.com

Sampler (Print & Sign): TEM/IKD/LMB/VPS

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method: TO-15SIM		Comments e.g. Actual Preservative or specific instructions
156-IA-4-BL	(15)-0.29	2/22/13	0804	AS00199	–	-29.5	0	6L	✓		
	-14.70										
	-14.72										
	-14.77										
	-14.80										
	-14.78										
5 returned cans											

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ✓
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required [✓ Yes] / No
Type: µg/m3

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	2/22/13	1030		2/28/13	0905

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____ °C

COC AIR REV 3-11

Sample Acceptance Check Form

Client: GSI Environmental Inc. Work order: P1300816
Project: ESTCP VI Study - Tyndall AFB / 3585/3669
Sample(s) received on: 2/28/13 Date opened: 2/28/13 by: RMARTENIES

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	**No**	**N/A**
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by ALS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **<u>VOA vials</u>** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and <u>if necessary</u> alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	**Container Description**	**Required pH ***	**Received pH**	**Adjusted pH**	**VOA Headspace** (Presence/Absence)	**Receipt / Preservation Comments**
P1300816-001.01	6.0 L Silonite Can					
P1300816-002.01	6.0 L Silonite Can					
P1300816-003.01	6.0 L Ambient Can					
P1300816-004.01	6.0 L Silonite Can					
P1300816-005.01	6.0 L Silonite Can					
P1300816-006.01	6.0 L Ambient Can					
P1300816-007.01	6.0 L Silonite Can					
P1300816-008.01	6.0 L Silonite Can					

Explain any discrepancies: (include lab sample ID numbers): ______

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

Sample Acceptance Check Form

Client: GSI Environmental Inc. Work order: P1300816

Project: ESTCP VI Study - Tyndall AFB / 3585/3669

Sample(s) received on: 2/28/13 Date opened: 2/28/13 by: RMARTENIES

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1300816-009.01	6.0 L Silonite Can					
P1300816-010.01	6.0 L Silonite Can					
P1300816-011.01	6.0 L Silonite Can					
P1300816-012.01	6.0 L Silonite Can					
P1300816-013.01	6.0 L Silonite Can					
P1300816-014.01	6.0 L Silonite Can					
P1300816-015.01	6.0 L Silonite Can					
P1300816-016.01	6.0 L Ambient Can					
P1300816-017.01	6.0 L Ambient Can					
P1300816-018.01	6.0 L Silonite Can					
P1300816-019.01	6.0 L Silonite Can					
P1300816-020.01	6.0 L Silonite Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **156-IA-1**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-001

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00290

Date Collected: 2/20/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -1.97 Final Pressure (psig): 3.63

Canister Dilution Factor: 1.44

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.036	ND	0.014	
75-35-4	1,1-Dichloroethene	ND	0.036	ND	0.0091	
156-60-5	trans-1,2-Dichloroethene	ND	0.036	ND	0.0091	
156-59-2	cis-1,2-Dichloroethene	ND	0.036	ND	0.0091	
79-01-6	Trichloroethene	ND	0.036	ND	0.0067	
127-18-4	Tetrachloroethene	**0.054**	0.036	**0.0080**	0.0053	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **156-IA-2**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-002

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00217

Date Collected: 2/20/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.69 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.82

CAS #	**Compound**	**Result** **μg/m³**	MRL μg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.046	ND	0.018	
75-35-4	1,1-Dichloroethene	ND	0.046	ND	0.011	
156-60-5	trans-1,2-Dichloroethene	ND	0.046	ND	0.011	
156-59-2	cis-1,2-Dichloroethene	ND	0.046	ND	0.011	
79-01-6	Trichloroethene	ND	0.046	ND	0.0085	
127-18-4	Tetrachloroethene	**0.063**	0.046	**0.0092**	0.0067	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **156-IA-3**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-003

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01816

Date Collected: 2/20/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.63 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.64

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.041	ND	0.016	
75-35-4	1,1-Dichloroethene	ND	0.041	ND	0.010	
156-60-5	trans-1,2-Dichloroethene	ND	0.041	ND	0.010	
156-59-2	cis-1,2-Dichloroethene	ND	0.041	ND	0.010	
79-01-6	Trichloroethene	ND	0.041	ND	0.0076	
127-18-4	Tetrachloroethene	**0.60**	0.041	**0.088**	0.0060	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **219-AA-1** CAS Project ID: P1300816
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669** CAS Sample ID: P1300816-004

Test Code: EPA TO-15 SIM Date Collected: 2/20/13
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Date Received: 2/28/13
Analyst: Wida Ang Date Analyzed: 3/6/13
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AS00341
Initial Pressure (psig): -3.12 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.57

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.039	ND	0.015	
75-35-4	1,1-Dichloroethene	ND	0.039	ND	0.0099	
156-60-5	trans-1,2-Dichloroethene	ND	0.039	ND	0.0099	
156-59-2	cis-1,2-Dichloroethene	ND	0.039	ND	0.0099	
79-01-6	Trichloroethene	ND	0.039	ND	0.0073	
127-18-4	Tetrachloroethene	ND	0.039	ND	0.0058	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **219-IA-1**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-005

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00230

Date Collected: 2/20/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.02
Final Pressure (psig): 3.59

Canister Dilution Factor: 1.57

CAS #	**Compound**	**Result** µg/m^3	MRL µg/m^3	**Result ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.039	ND	0.015	
75-35-4	1,1-Dichloroethene	ND	0.039	ND	0.0099	
156-60-5	trans-1,2-Dichloroethene	ND	0.039	ND	0.0099	
156-59-2	cis-1,2-Dichloroethene	ND	0.039	ND	0.0099	
79-01-6	Trichloroethene	**0.086**	0.039	**0.016**	0.0073	
127-18-4	Tetrachloroethene	**0.048**	0.039	**0.0071**	0.0058	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **219-IA-3**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-006

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01904

Date Collected: 2/20/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.58 Final Pressure (psig): 3.60

Canister Dilution Factor: 1.65

CAS #	**Compound**	**Result** $\mu g/m^3$	MRL $\mu g/m^3$	**Result ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.041	ND	0.016	
75-35-4	1,1-Dichloroethene	ND	0.041	ND	0.010	
156-60-5	trans-1,2-Dichloroethene	ND	0.041	ND	0.010	
156-59-2	cis-1,2-Dichloroethene	ND	0.041	ND	0.010	
79-01-6	Trichloroethene	**0.087**	0.041	**0.016**	0.0077	
127-18-4	Tetrachloroethene	ND	0.041	ND	0.0061	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **156-IA-4-NP**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-007

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00216
Initial Pressure (psig): 0.18 Final Pressure (psig): 3.60

Date Collected: 2/21/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.23

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.031	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.031	ND	0.0078	
156-60-5	trans-1,2-Dichloroethene	ND	0.031	ND	0.0078	
156-59-2	cis-1,2-Dichloroethene	ND	0.031	ND	0.0078	
79-01-6	Trichloroethene	ND	0.031	ND	0.0057	
127-18-4	Tetrachloroethene	**0.061**	0.031	**0.0090**	0.0045	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **156-IA-5-NP**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-008

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00166

Date Collected: 2/21/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -0.67 Final Pressure (psig): 3.64

Canister Dilution Factor: 1.31

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.033	ND	0.013	
75-35-4	1,1-Dichloroethene	ND	0.033	ND	0.0083	
156-60-5	trans-1,2-Dichloroethene	ND	0.033	ND	0.0083	
156-59-2	cis-1,2-Dichloroethene	ND	0.033	ND	0.0083	
79-01-6	Trichloroethene	ND	0.033	ND	0.0061	
127-18-4	Tetrachloroethene	**0.062**	0.033	**0.0092**	0.0048	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **156-SS-1**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-009

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00198

Date Collected: 2/21/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -0.40 Final Pressure (psig): 3.78

Canister Dilution Factor: 1.29

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	**Result ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.032	ND	0.013	
75-35-4	1,1-Dichloroethene	ND	0.032	ND	0.0081	
156-60-5	trans-1,2-Dichloroethene	ND	0.032	ND	0.0081	
156-59-2	cis-1,2-Dichloroethene	ND	0.032	ND	0.0081	
79-01-6	Trichloroethene	**0.37**	0.032	**0.068**	0.0060	
127-18-4	Tetrachloroethene	**0.26**	0.032	**0.039**	0.0048	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **156-SS-2**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-010

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00141

Date Collected: 2/21/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -0.02 Final Pressure (psig): 3.82

Canister Dilution Factor: 1.26

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.032	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.032	ND	0.0079	
156-60-5	trans-1,2-Dichloroethene	ND	0.032	ND	0.0079	
156-59-2	cis-1,2-Dichloroethene	ND	0.032	ND	0.0079	
79-01-6	Trichloroethene	**1.2**	0.032	**0.23**	0.0059	
127-18-4	Tetrachloroethene	**0.16**	0.032	**0.023**	0.0046	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**

Client Sample ID: **156-SS-3** CAS Project ID: P1300816

Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669** CAS Sample ID: P1300816-011

Test Code: EPA TO-15 SIM

Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19

Analyst: Wida Ang

Sample Type: 6.0 L Summa Canister

Test Notes:

Container ID: AS00336

Date Collected: 2/21/13

Date Received: 2/28/13

Date Analyzed: 3/6/13

Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -1.37 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.37

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.034	ND	0.013	
75-35-4	1,1-Dichloroethene	ND	0.034	ND	0.0086	
156-60-5	trans-1,2-Dichloroethene	**0.051**	0.034	**0.013**	0.0086	
156-59-2	cis-1,2-Dichloroethene	**0.085**	0.034	**0.021**	0.0086	
79-01-6	Trichloroethene	**24**	0.034	**4.4**	0.0064	
127-18-4	Tetrachloroethene	**0.45**	0.034	**0.066**	0.0051	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**219-SS-1**	CAS Project ID:	P1300816
Client Project ID:	**ESTCP VI Study - Tyndall AFB / 3585/3669**	CAS Sample ID:	P1300816-012
Test Code:	EPA TO-15 SIM	Date Collected:	2/21/13
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19	Date Received:	2/28/13
Analyst:	Wida Ang	Date Analyzed:	3/6/13
Sample Type:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AS00168		

Initial Pressure (psig): -0.25 Final Pressure (psig): 3.62

Canister Dilution Factor: 1.27

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.032	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.032	ND	0.0080	
156-60-5	trans-1,2-Dichloroethene	**0.14**	0.032	**0.036**	0.0080	
156-59-2	cis-1,2-Dichloroethene	ND	0.032	ND	0.0080	
79-01-6	Trichloroethene	**0.083**	0.032	**0.015**	0.0059	
127-18-4	Tetrachloroethene	**4.5**	0.032	**0.67**	0.0047	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **219-SS-2**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-013

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00182

Date Collected: 2/21/13
Date Received: 2/28/13
Date Analyzed: 3/7/13
Volume(s) Analyzed: 0.25 Liter(s)

Initial Pressure (psig): 0.02 Final Pressure (psig): 3.67

Canister Dilution Factor: 1.25

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.13	ND	0.049	
75-35-4	1,1-Dichloroethene	ND	0.13	ND	0.032	
156-60-5	trans-1,2-Dichloroethene	**0.41**	0.13	**0.10**	0.032	
156-59-2	cis-1,2-Dichloroethene	ND	0.13	ND	0.032	
79-01-6	Trichloroethene	**0.31**	0.13	**0.057**	0.023	
127-18-4	Tetrachloroethene	**7.5**	0.13	**1.1**	0.018	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **219-SS-3**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-014

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00310

Date Collected: 2/21/13
Date Received: 2/28/13
Date Analyzed: 3/7/13
Volume(s) Analyzed: 0.50 Liter(s)

Initial Pressure (psig): 0.12 Final Pressure (psig): 3.81

Canister Dilution Factor: 1.25

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.063	ND	0.024	
75-35-4	1,1-Dichloroethene	ND	0.063	ND	0.016	
156-60-5	trans-1,2-Dichloroethene	ND	0.063	ND	0.016	
156-59-2	cis-1,2-Dichloroethene	ND	0.063	ND	0.016	
79-01-6	Trichloroethene	**1.3**	0.063	**0.24**	0.012	
127-18-4	Tetrachloroethene	**0.97**	0.063	**0.14**	0.0092	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **156-IA-4-BL**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P1300816-015

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00199

Date Collected: 2/22/13
Date Received: 2/28/13
Date Analyzed: 3/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -0.03 Final Pressure (psig): 3.75

Canister Dilution Factor: 1.26

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data** **Qualifier**
75-01-4	Vinyl Chloride	ND	0.032	ND	0.012	
75-35-4	1,1-Dichloroethene	ND	0.032	ND	0.0079	
156-60-5	trans-1,2-Dichloroethene	ND	0.032	ND	0.0079	
156-59-2	cis-1,2-Dichloroethene	ND	0.032	ND	0.0079	
79-01-6	Trichloroethene	ND	0.032	ND	0.0059	
127-18-4	Tetrachloroethene	**0.077**	0.032	**0.011**	0.0046	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P130305-MB

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/5/13
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	**Result** ppbV	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.025	ND	0.0098	
75-35-4	1,1-Dichloroethene	ND	0.025	ND	0.0063	
156-60-5	trans-1,2-Dichloroethene	ND	0.025	ND	0.0063	
156-59-2	cis-1,2-Dichloroethene	ND	0.025	ND	0.0063	
79-01-6	Trichloroethene	ND	0.025	ND	0.0047	
127-18-4	Tetrachloroethene	ND	0.025	ND	0.0037	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**Method Blank**	CAS Project ID:	P1300816
Client Project ID:	**ESTCP VI Study - Tyndall AFB / 3585/3669**	CAS Sample ID:	P130306-MB
Test Code:	EPA TO-15 SIM	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19	Date Received:	NA
Analyst:	Wida Ang	Date Analyzed:	3/6/13
Sample Type:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	**Result** **ppbV**	MRL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.025	ND	0.0098	
75-35-4	1,1-Dichloroethene	ND	0.025	ND	0.0063	
156-60-5	trans-1,2-Dichloroethene	ND	0.025	ND	0.0063	
156-59-2	cis-1,2-Dichloroethene	ND	0.025	ND	0.0063	
79-01-6	Trichloroethene	ND	0.025	ND	0.0047	
127-18-4	Tetrachloroethene	ND	0.025	ND	0.0037	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**
CAS Project ID: P1300816

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 2/20 - 2/22/13
Date(s) Received: 2/28/13
Date(s) Analyzed: 3/5 - 3/7/13

Client Sample ID	**CAS Sample ID**	**1,2-Dichloroethane-d4** % Recovered	**Toluene-d8** % Recovered	**Bromofluorobenzene** % Recovered	Acceptance Limits	**Data Qualifier**
Method Blank	P130305-MB	**97**	**100**	**106**	70-130	
Method Blank	P130306-MB	**100**	**101**	**98**	70-130	
Lab Control Sample	P130305-LCS	**99**	**99**	**107**	70-130	
Lab Control Sample	P130306-LCS	**99**	**100**	**99**	70-130	
156-IA-1	P1300816-001	**98**	**101**	**99**	70-130	
156-IA-2	P1300816-002	**97**	**100**	**94**	70-130	
156-IA-3	P1300816-003	**97**	**101**	**97**	70-130	
219-AA-1	P1300816-004	**97**	**101**	**99**	70-130	
219-AA-1	P1300816-004DUP	**99**	**101**	**99**	70-130	
219-IA-1	P1300816-005	**95**	**100**	**104**	70-130	
219-IA-3	P1300816-006	**96**	**101**	**100**	70-130	
156-IA-4-NP	P1300816-007	**96**	**102**	**99**	70-130	
156-IA-5-NP	P1300816-008	**99**	**105**	**95**	70-130	
156-SS-1	P1300816-009	**96**	**105**	**96**	70-130	
156-SS-2	P1300816-010	**90**	**99**	**92**	70-130	
156-SS-3	P1300816-011	**97**	**102**	**97**	70-130	
219-SS-1	P1300816-012	**100**	**103**	**96**	70-130	
219-SS-2	P1300816-013	**101**	**106**	**82**	70-130	
219-SS-3	P1300816-014	**98**	**101**	**73**	70-130	
156-IA-4-BL	P1300816-015	**98**	**103**	**96**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

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Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P130305-LCS

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/05/13
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
75-01-4	Vinyl Chloride	4.00	**3.19**	**80**	56-117	
75-35-4	1,1-Dichloroethene	4.36	**3.52**	**81**	62-113	
156-60-5	trans-1,2-Dichloroethene	4.04	**3.11**	**77**	61-111	
156-59-2	cis-1,2-Dichloroethene	4.28	**3.30**	**77**	63-112	
79-01-6	Trichloroethene	3.96	**3.04**	**77**	58-113	
127-18-4	Tetrachloroethene	3.80	**3.12**	**82**	60-111	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

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Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669**

CAS Project ID: P1300816
CAS Sample ID: P130306-LCS

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 3/06/13
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
75-01-4	Vinyl Chloride	4.00	**3.18**	**80**	56-117	
75-35-4	1,1-Dichloroethene	4.36	**3.58**	**82**	62-113	
156-60-5	trans-1,2-Dichloroethene	4.04	**3.15**	**78**	61-111	
156-59-2	cis-1,2-Dichloroethene	4.28	**3.33**	**78**	63-112	
79-01-6	Trichloroethene	3.96	**3.04**	**77**	58-113	
127-18-4	Tetrachloroethene	3.80	**3.00**	**79**	60-111	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY DUPLICATE SUMMARY RESULTS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**219-AA-1**	CAS Project ID:	P1300816
Client Project ID:	**ESTCP VI Study - Tyndall AFB / 3585/3669**	CAS Sample ID:	P1300816-004DUP

Test Code:	EPA TO-15 SIM	Date Collected:	2/20/13
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19	Date Received:	2/28/13
Analyst:	Wida Ang	Date Analyzed:	3/6/13
Sample Type:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AS00341		

Initial Pressure (psig): -3.12 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.57

CAS #	**Compound**	Sample Result µg/m³	Sample Result ppbV	**Duplicate Sample Result µg/m³**	**Duplicate Sample Result ppbV**	Average µg/m³	**% RPD**	RPD Limit	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	ND	ND	ND	-	-	25	
75-35-4	1,1-Dichloroethene	ND	ND	ND	ND	-	-	25	
156-60-5	trans-1,2-Dichloroethene	ND	ND	ND	ND	-	-	25	
156-59-2	cis-1,2-Dichloroethene	ND	ND	ND	ND	-	-	25	
79-01-6	Trichloroethene	ND	ND	ND	ND	-	-	25	
127-18-4	Tetrachloroethene	ND	ND	ND	ND	-	-	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669** CAS Project ID: P1300816

Method Blank Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Lab File ID: 03051334.D
Analyst: Wida Ang Date Analyzed: 3/05/13
Sample Type: 6.0 L Summa Canister(s) Time Analyzed: 23:20
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P130305-LCS	03051335.D	23:52
156-IA-1	P1300816-001	03051340.D	07:10
156-IA-2	P1300816-002	03051341.D	07:43
156-IA-3	P1300816-003	03051342.D	08:15
219-AA-1	P1300816-004	03051343.D	08:47
219-AA-1 (Lab Duplicate)	P1300816-004DUP	03051344.D	09:19
219-IA-1	P1300816-005	03051345.D	09:51
219-IA-3	P1300816-006	03051346.D	10:24
156-IA-4-NP	P1300816-007	03051347.D	10:57
156-IA-5-NP	P1300816-008	03051348.D	11:29
156-SS-1	P1300816-009	03051349.D	12:01
156-SS-2	P1300816-010	03051350.D	12:34
156-SS-3	P1300816-011	03051351.D	13:07
219-SS-1	P1300816-012	03051352.D	13:39
156-IA-4-BL	P1300816-015	03051355.D	16:14

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669** CAS Project ID: P1300816

Method Blank Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Lab File ID: 03061304.D
Analyst: Wida Ang Date Analyzed: 3/06/13
Sample Type: 6.0 L Summa Canister(s) Time Analyzed: 19:18
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P130306-LCS	03061305.D	19:50
219-SS-3	P1300816-014	03061316.D	08:09
219-SS-2	P1300816-013	03061318.D	09:40

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669** CAS Project ID: P1300816

Internal Standard Area and RT Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Lab File ID: 03051332.D
Analyst: Wida Ang Date Analyzed: 3/5/13
Sample Type: 6.0 L Summa Canister(s) Time Analyzed: 22:14
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	59632		11.66		246745		13.40		27518		17.09	
	Upper Limit	83485		11.99		345443		13.73		38525		17.42	
	Lower Limit	35779		11.33		148047		13.07		16511		16.76	
	Client Sample ID												
01	Method Blank	59530		11.66		243742		13.41		27667		17.09	
02	Lab Control Sample	60103		11.66		250192		13.40		27840		17.09	
03	156-IA-1	66682		11.65		279416		13.40		32769		17.09	
04	156-IA-2	64825		11.66		276641		13.40		31874		17.09	
05	156-IA-3	63874		11.66		272688		13.40		32519		17.09	
06	219-AA-1	63890		11.65		273069		13.40		32084		17.09	
07	219-AA-1 (Lab Duplicate)	61616		11.65		278003		13.40		33030		17.09	
08	219-IA-1	61631		11.66		256625		13.40		29557		17.09	
09	219-IA-3	62201		11.65		260120		13.40		30924		17.09	
10	156-IA-4-NP	63527		11.66		268633		13.40		32561		17.09	
11	156-IA-5-NP	63520		11.66		276155		13.41		34052		17.09	
12	156-SS-1	60341		11.66		256493		13.41		34419		17.09	
13	156-SS-2	66494		11.66		272563		13.41		33185		17.09	
14	156-SS-3	65624		11.67		277989		13.41		33982		17.09	
15	219-SS-1	65859		11.66		287746		13.41		35714		17.09	
16	156-IA-4-BL	65583		11.66		281342		13.40		35185		17.09	
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits. See case narrative.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Tyndall AFB / 3585/3669** CAS Project ID: P1300816

Internal Standard Area and RT Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Lab File ID: 03061302.D
Analyst: Wida Ang Date Analyzed: 3/6/13
Sample Type: 6.0 L Summa Canister(s) Time Analyzed: 18:13
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	64786		11.66		276779		13.40		32082		17.09	
	Upper Limit	90700		11.99		387491		13.73		44915		17.42	
	Lower Limit	38872		11.33		166067		13.07		19249		16.76	
	Client Sample ID												
01	Method Blank	64670		11.66		271639		13.41		31480		17.09	
02	Lab Control Sample	65455		11.66		274873		13.40		31913		17.09	
03	219-SS-3	66099		11.66		278647		13.41		43029		17.09	
04	219-SS-2	65278		11.66		267574		13.41		39092		17.09	
05													
06													
07													
08													
09													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits. See case narrative.

```
                         Response Factor Report MS19

Method Path : J:\MS19\METHODS\
Method File : X19022213.M
Title       : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
Last Update  : Mon Feb 25 07:18:53 2013
Response Via : Initial Calibration

Calibration Files
10   =02221314.D  20   =02221315.D  50   =02221316.D  100  =02221317.D  500  =02221318.D  1000=02221319.D
2500=02221320.D  9999=02221321.D  20K  =02221322.D

      Compound              10    20    50    100   500   1000  2500  9999  20K   Avg       %RSD
-----------------------------------------------------------------------------------------------

  1) I   Bromochloromethane... ----------------ISTD--------------------
  2) T   Dichlorodifluo... 2.711 2.546 2.436 2.153 2.239 2.220 2.168 2.089 2.071 2.293    9.67
  3) T   Chloromethane           0.608 0.483 0.417 0.413 0.445 0.335 0.427 0.402 0.441   17.98
  4) T   Vinyl Chloride    1.909 1.786 1.713 1.531 1.461 1.579 1.529 1.419 1.355 1.587   11.45
  5) T   Bromomethane            1.203 0.898 0.854 0.876 0.866 0.786 0.786 0.836 0.888   15.02
  6) T   Chloroethane      0.753 0.708 0.617 0.580 0.605 0.599 0.538 0.526 0.563 0.610   12.40
  7) T   Acetone                       0.679 0.520 0.495 0.470 0.439 0.376 0.376 0.479   21.68
  8) T   Trichlorofluor... 1.925 1.853 1.738 1.588 1.688 1.675 1.594 1.589 1.565 1.691    7.52
  9) T   1,1-Dichloroet... 1.369 1.254 1.167 1.057 1.120 1.126 1.079 1.111 1.089 1.152    8.66
 10) T   Methylene Chlo...             1.687 1.179 1.182 1.139 1.075 1.070 1.074 1.201   18.32
 11) T   Trichlorotrifl... 1.529 1.501 1.405 1.182 1.290 1.287 1.213 1.192 1.197 1.311   10.34
 12) T   trans-1,2-Dich... 1.982 1.671 1.423 1.182 1.274 1.257 1.202 1.234 1.251 1.386   19.50
 13) T   1,1-Dichloroet... 1.918 1.828 1.648 1.536 1.578 1.551 1.489 1.587 1.580 1.635    8.76
 14) T   Methyl tert-Bu... 3.105 3.009 2.886 2.503 2.735 2.705 2.794 2.847 2.941 2.836    6.30
 15) T   cis-1,2-Dichlo... 1.999 1.649 1.430 1.183 1.281 1.265 1.218 1.257 1.256 1.393   19.25
 16) T   Chloroform        2.217 2.076 1.882 1.659 1.776 1.709 1.653 1.706 1.707 1.821   11.00
 17) S   1,2-Dichloroet... 1.004 1.006 0.999 0.997 0.990 0.956 0.935 0.973 0.932 0.977    2.99
 18) T   1,2-Dichloroet... 1.746 1.517 1.332 1.109 1.192 1.156 1.118 1.144 1.099 1.268   17.74
 19) T   1,1,1-Trichlor... 1.952 1.902 1.776 1.550 1.678 1.688 1.648 1.706 1.658 1.729    7.38
 20) T   Benzene                       4.718 3.881 4.021 3.951 3.825 3.733 3.569 3.957    9.27
 21) T   Carbon Tetrach... 1.331 1.381 1.337 1.192 1.372 1.389 1.379 1.438 1.422 1.360    5.29

 22) I   1,4-Difluorobenzen... ----------------ISTD--------------------
 23) T   1,2-Dichloropr... 0.275 0.260 0.235 0.209 0.217 0.214 0.210 0.215 0.216 0.228   10.54
 24) T   Bromodichlorom... 0.365 0.344 0.315 0.283 0.305 0.303 0.305 0.326 0.329 0.319    7.70
 25) T   Trichloroethene   0.596 0.525 0.442 0.373 0.374 0.363 0.349 0.359 0.363 0.416   21.14
 26) T   1,4-Dioxane       0.286 0.253 0.230 0.182 0.202 0.208 0.201 0.219 0.217 0.222   14.14
 27) T   cis-1,3-Dichlo... 0.449 0.389 0.354 0.286 0.341 0.351 0.360 0.379 0.389 0.367   12.04
 28) T   trans-1,3-Dich... 0.324 0.297 0.286 0.202 0.274 0.298 0.314 0.349 0.364 0.301   15.69
 29) T   1,1,2-Trichlor... 0.267 0.245 0.228 0.198 0.212 0.214 0.207 0.215 0.219 0.223    9.50
 30) S   Toluene-d8 (SS2)  0.940 0.940 0.931 0.951 0.924 0.915 0.924 0.943 0.976 0.938    1.93
```

Response Factor Report MS19

```
Method Path : J:\MS19\METHODS\
Method File : X19022213.M
Title       : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
31) T   Toluene                 1.505 1.281 1.091 1.109 1.081 1.058 1.069 1.075 1.159    13.57
32) T   1,2-Dibromoethane 0.439 0.372 0.332 0.258 0.297 0.302 0.299 0.317 0.328 0.327    15.92
33) T   Tetrachloroethene 0.555 0.521 0.472 0.431 0.443 0.431 0.418 0.430 0.442 0.460    10.24

34) I   Chlorobenzene-d5 (... ----------------ISTD---------------------
35) T   Chlorobenzene           9.369 8.309 7.010 7.474 7.359 7.089 6.961 6.498 7.509    12.20
36) T   Ethylbenzene      1.261 1.180 1.085 0.957 1.077 1.091 1.077 1.053 0.971 1.084 E1   8.68
37) T   m,p-Xylene        9.563 8.980 8.460 7.418 8.708 8.857 8.578 8.240 7.560 8.485     7.97
38) T   o-Xylene          1.084 1.069 0.987 0.828 0.902 0.944 0.899 0.863 0.806 0.931 E1  10.61
39) T   1,1,2,2-Tetrac... 3.326 3.493 3.460 3.182 3.761 4.095 3.915 3.847 3.665 3.638     8.15
40) S   Bromofluoroben... 4.733 4.764 4.813 4.564 4.865 4.942 4.762 4.569 4.401 4.712     3.61
41) T   1,3-Dichlorobe...       8.921 7.734 6.525 7.059 6.988 6.307 6.486 6.039 7.007    13.35
42) T   1,4-Dichlorobe...       9.757 7.984 6.566 7.161 7.099 6.449 6.545 6.091 7.206    16.41
43) T   1,2-Dichlorobe...       8.265 7.172 6.290 6.852 6.752 6.223 6.243 5.814 6.701    11.40
44) T   1,2,4-Trichlor...       6.540 5.369 4.387 4.705 4.826 4.652 5.106 4.850 5.054    13.24
45) T   Naphthalene             1.779 1.420 1.156 1.308 1.387 1.340 1.629 1.521 1.442 E1  13.58
46) T   Hexachlorobuta... 3.649 3.575 3.198 2.960 3.090 3.148 3.023 3.094 2.965 3.189     7.93
-------------------------------------------------------------------------------
(#) = Out of Range
```

Evaluate Continuing Calibration Report

```
Data File: I:\MS19\DATA\2013_03\05\03051332.D
Acq On    :  5 Mar 2013  22:14                         Operator: WA
Sample    : 500pg TO-15SIM CCV STD                     Inst    : MS19
Misc      : S25-02221305/S25-02071307 (3/8)
ALS Vial  : 15   Sample Multiplier: 1

Quant Time: Mar 06 06:07:52 2013
Quant Method : J:\MS19\METHODS\X19022213.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Mon Feb 25 07:18:53 2013
Response via : Initial Calibration
DataAcq Meth:TO15SIM2.M


Min. RRF      :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%      Max. Rel. Area : 200%

      Compound                               AvgRF    CCRF      %Dev Area% Dev(min)
-------------------------------------------------------------------------------
 1 I    Bromochloromethane (IS1)             1.000    1.000       0.0    98  -0.01
 2 T    Dichlorodifluoromethane (CF          2.293    1.892      17.5    83   0.03
 3 T    Chloromethane                        0.441    0.367      16.8    87   0.04
 4 T    Vinyl Chloride                       1.587    1.273      19.8    85   0.03
 5 T    Bromomethane                         0.888    0.738      16.9    82   0.02
 6 T    Chloroethane                         0.610    0.500      18.0    81   0.02
 7 T    Acetone                              0.479    0.429      10.4    85   0.00
 8 T    Trichlorofluoromethane               1.691    1.378      18.5    80   0.01
 9 T    1,1-Dichloroethene                   1.152    0.946      17.9    83   0.00
10 T    Methylene Chloride                   1.201    0.976      18.7    81   0.00
11 T    Trichlorotrifluoroethane             1.311    1.073      18.2    81   0.00
12 T    trans-1,2-Dichloroethene             1.386    1.060      23.5    81   0.00
13 T    1,1-Dichloroethane                   1.635    1.370      16.2    85   0.00
14 T    Methyl tert-Butyl Ether              2.836    2.369      16.5    85   0.01
15 T    cis-1,2-Dichloroethene               1.393    1.086      22.0    83   0.00
16 T    Chloroform                           1.821    1.487      18.3    82  -0.01
17 S    1,2-Dichloroethane-d4 (SS1)          0.977    0.970       0.7    96   0.00
18 T    1,2-Dichloroethane                   1.268    0.995      21.5    82  -0.01
19 T    1,1,1-Trichloroethane                1.729    1.439      16.8    84   0.00
20 T    Benzene                              3.957    3.334      15.7    81   0.00
21 T    Carbon Tetrachloride                 1.360    1.155      15.1    82   0.00

22 I    1,4-Difluorobenzene (IS2)            1.000    1.000       0.0    95   0.00
23 T    1,2-Dichloropropane                  0.228    0.185      18.9    81   0.00
24 T    Bromodichloromethane                 0.319    0.262      17.9    82   0.00
25 T    Trichloroethene                      0.416    0.309      25.7    79   0.00
26 T    1,4-Dioxane                          0.222    0.171      23.0    81   0.00
27 T    cis-1,3-Dichloropropene              0.367    0.301      18.0    84   0.00
28 T    trans-1,3-Dichloropropene            0.301    0.251      16.6    87   0.00
29 T    1,1,2-Trichloroethane                0.223    0.180      19.3    81   0.00
30 S    Toluene-d8 (SS2)                     0.938    0.933       0.5    96   0.00
31 T    Toluene                              1.159    0.953      17.8    82   0.00
32 T    1,2-Dibromoethane                    0.327    0.255      22.0    82   0.00
33 T    Tetrachloroethene                    0.460    0.380      17.4    82   0.00

34 I    Chlorobenzene-d5 (IS3)               1.000    1.000       0.0    96   0.00
35 T    Chlorobenzene                        7.509    6.323      15.8    81   0.00
36 T    Ethylbenzene                        10.836    9.177      15.3    81   0.00
37 T    m,p-Xylene                           8.485    7.437      12.4    82   0.00
38 T    o-Xylene                             9.314    8.015      13.9    85   0.00
```

RH 3/6/13

```
                 Evaluate Continuing Calibration Report

 Data File: I:\MS19\DATA\2013_03\05\03051332.D
 Acq On    :  5 Mar 2013  22:14                        Operator: WA
 Sample    : 500pg TO-15SIM CCV STD                    Inst     : MS19
 Misc      : S25-02221305/S25-02071307 (3/8)
 ALS Vial  : 15   Sample Multiplier: 1

 Quant Time: Mar 06 06:07:52 2013
 Quant Method : J:\MS19\METHODS\X19022213.M
 Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
 QLast Update : Mon Feb 25 07:18:53 2013
 Response via : Initial Calibration
 DataAcq Meth:TO15SIM2.M


 Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
 Max. RRF Dev :  30%     Max. Rel. Area : 200%

       Compound                          AvgRF   CCRF      %Dev Area% Dev(min)
 ------------------------------------------------------------------------
39 T   1,1,2,2-Tetrachloroethane         3.638   3.451      5.1   88   0.00
40 S   Bromofluorobenzene (SS3)          4.712   5.114     -8.5  100   0.00
41 T   1,3-Dichlorobenzene               7.007   5.988     14.5   81   0.00
42 T   1,4-Dichlorobenzene               7.206   5.999     16.7   80   0.00
43 T   1,2-Dichlorobenzene               6.701   5.758     14.1   80   0.00
44 T   1,2,4-Trichlorobenzene            5.054   4.144     18.0   84   0.00
45 T   Naphthalene                      14.424  11.361     21.2   83   0.00
46 T   Hexachlorobutadiene               3.189   2.755     13.6   85   0.00
-------------------------------------------------------------------------

   (#) = Out of Range                 SPCC's out = 0  CCC's out = 0
```

```
                  Evaluate Continuing Calibration Report

Data File: I:\MS19\DATA\2013_03\06\03061302.D
Acq On    :  6 Mar 2013  18:13                     Operator: WA
Sample    : 500pg TO-15SIM CCV STD                 Inst    : MS19
Misc      : S25-02221305/S25-02251303 (3/26)
ALS Vial  : 15   Sample Multiplier: 1

Quant Time: Mar 07 06:20:06 2013
Quant Method : J:\MS19\METHODS\X19022213.M
Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Mon Feb 25 07:18:53 2013
Response via : Initial Calibration
DataAcq Meth:TO15SIM2.M


Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
Max. RRF Dev :  30%     Max. Rel. Area : 200%

      Compound                           AvgRF   CCRF      %Dev Area% Dev(min)
-------------------------------------------------------------------------------
 1 I  Bromochloromethane (IS1)           1.000   1.000      0.0  106  -0.01
 2 T  Dichlorodifluoromethane (CF        2.293   2.131      7.1  101   0.03
 3 T  Chloromethane                      0.441   0.436      1.1  112   0.03
 4 T  Vinyl Chloride                     1.587   1.488      6.2  108   0.03
 5 T  Bromomethane                       0.888   0.835      6.0  101   0.02
 6 T  Chloroethane                       0.610   0.588      3.6  103   0.02
 7 T  Acetone                            0.479   0.480     -0.2  103   0.00
 8 T  Trichlorofluoromethane             1.691   1.548      8.5   98   0.01
 9 T  1,1-Dichloroethene                 1.152   1.114      3.3  106   0.00
10 T  Methylene Chloride                 1.201   1.159      3.5  104   0.00
11 T  Trichlorotrifluoroethane           1.311   1.188      9.4   98   0.00
12 T  trans-1,2-Dichloroethene           1.386   1.245     10.2  104   0.00
13 T  1,1-Dichloroethane                 1.635   1.633      0.1  110   0.00
14 T  Methyl tert-Butyl Ether            2.836   2.845     -0.3  111   0.01
15 T  cis-1,2-Dichloroethene             1.393   1.263      9.3  105   0.00
16 T  Chloroform                         1.821   1.722      5.4  103  -0.01
17 S  1,2-Dichloroethane-d4 (SS1)        0.977   1.017     -4.1  109   0.00
18 T  1,2-Dichloroethane                 1.268   1.162      8.4  104  -0.01
19 T  1,1,1-Trichloroethane              1.729   1.649      4.6  105   0.00
20 T  Benzene                            3.957   3.891      1.7  103   0.00
21 T  Carbon Tetrachloride               1.360   1.347      1.0  104   0.00

22 I  1,4-Difluorobenzene (IS2)          1.000   1.000      0.0  107   0.00
23 T  1,2-Dichloropropane                0.228   0.217      4.8  107   0.00
24 T  Bromodichloromethane               0.319   0.299      6.3  105   0.00
25 T  Trichloroethene                    0.416   0.351     15.6  100   0.00
26 T  1,4-Dioxane                        0.222   0.199     10.4  106   0.00
27 T  cis-1,3-Dichloropropene            0.367   0.351      4.4  110   0.00
28 T  trans-1,3-Dichloropropene          0.301   0.287      4.7  112   0.00
29 T  1,1,2-Trichloroethane              0.223   0.204      8.5  103   0.00
30 S  Toluene-d8 (SS2)                   0.938   0.943     -0.5  109   0.00
31 T  Toluene                            1.159   1.084      6.5  104   0.00
32 T  1,2-Dibromoethane                  0.327   0.280     14.4  101   0.00
33 T  Tetrachloroethene                  0.460   0.410     10.9   99   0.00

34 I  Chlorobenzene-d5 (IS3)             1.000   1.000      0.0  111   0.00
35 T  Chlorobenzene                      7.509   6.773      9.8  101   0.00
36 T  Ethylbenzene                      10.836  10.071      7.1  104   0.00
37 T  m,p-Xylene                         8.485   8.135      4.1  104   0.00
38 T  o-Xylene                           9.314   8.691      6.7  107   0.00
```

3/7/13

```
                    Evaluate Continuing Calibration Report

  Data File: I:\MS19\DATA\2013_03\06\03061302.D
  Acq On    :  6 Mar 2013  18:13                          Operator: WA
  Sample    : 500pg TO-15SIM CCV STD                      Inst    : MS19
  Misc      : S25-02221305/S25-02251303 (3/26)
  ALS Vial  : 15   Sample Multiplier: 1

  Quant Time: Mar 07 06:20:06 2013
  Quant Method : J:\MS19\METHODS\X19022213.M
  Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
  QLast Update : Mon Feb 25 07:18:53 2013
  Response via : Initial Calibration
  DataAcq Meth:TO15SIM2.M


  Min. RRF     :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
  Max. RRF Dev :  30%     Max. Rel. Area : 200%

         Compound                            AvgRF    CCRF      %Dev Area% Dev(min)
 --------------------------------------------------------------------------
 39 T    1,1,2,2-Tetrachloroethane           3.638    3.592       1.3  106    0.00
 40 S    Bromofluorobenzene (SS3)            4.712    4.695       0.4  107    0.00
 41 T    1,3-Dichlorobenzene                 7.007    6.258      10.7   99    0.00
 42 T    1,4-Dichlorobenzene                 7.206    6.305      12.5   98    0.00
 43 T    1,2-Dichlorobenzene                 6.701    6.009      10.3   98    0.00
 44 T    1,2,4-Trichlorobenzene              5.054    4.401      12.9  104    0.00
 45 T    Naphthalene                        14.424   13.219       8.4  113    0.00
 46 T    Hexachlorobutadiene                 3.189    2.760      13.5   99    0.00
 --------------------------------------------------------------------------

    (#) = Out of Range                    SPCC's out = 0  CCC's out = 0
```

Radon Analysis (EPA Method GS: Grab Sample/Scintillation Cell counting)

For GSI Environmental

Client Project Number: ESTCPVI Study - Tyndall AFB 3585/3669

Samples Collected by: T. McHugh/L. Beckley
Sample Dates: 02/21/13
Sample containers: Tedlar bags w/ nylon fittings
Site: Tyndall AFB
Assumed Site Pressure **1.00** atm
based on an elevation of 15 ft
Analysts: Doug Hammond
Phone: 310-490-7896
Time Zone adjustment: add to decay time
email: dhammond@usc.edu
3 hours
Collect (EST)
Run (PST)

	Summary	Collection		Analysis					Lab Duplicates		
		Date	time	Date	time	Vol run	Conc.	±1 sig	mean	±1ssd	Notes
			(EST)		(PST)	(cc)	pCi/L	pCi/L	pCi/L	pCi/L	
Received 02/25/13											
1	156-AA-1	2/21/13	16:05	2/25/13	13:52	120	0.03	0.06			
2	156-IA-4	2/21/13	16:05	2/25/13	13:57	120	0.00	0.07	0.02	0.02	*
	lab dupe	2/21/13	16:05	2/25/13	14:00	120	0.03	0.07			
3	156-IA-4-BL	2/22/13	8:04	2/25/13	14:03	120	0.07	0.05			

Uncertainty given in pCi/liter is based on counting statistics for low activity samples. For high activity samples uncertainty is ±5%.
The Lower Limit of Detection for Rn (95% confidence level as recommended by EPA 402-R-95-012, Oct. 97) is 0.14 pCi/liter.
Results are reported based on standardization with NIST-traceable radon sources.
These results are for application of naturally-occurring radon as a tracer of soil vapor intrusion, but are not intended for evaluation of radon hazards.
Results corrected to in situ pressure as noted above
Note Details:
*This analysis had an observed dpm of -0.002, less than cell background but within counting uncertainty of zero. Result is below the detection limit and reported as observed dpm of 0.0001.

Raw Data, Calculation factors, and Analytical Details

		Collection		Analysis													count	
	Sample ID	Date	Time	Date	Time	Count in	He	Air/He	Vol run	Press	obs	sig	Decay T	Decay	Concentration		stats	
			(EST)		(PST)	cell/ch	eff	eff	(cc)	factor	dpm	dpm	(hours)	factor	dpm/liter	pCi/liter	pCi/liter	Notes
																	±1 sig	
Received 02/25/13																		
1	156-AA-1	2/21/13	16:05	2/25/13	13:52	83/33	0.806	0.95	120	1.00	0.003	0.006	96.8	2.077	0.07	0.03	0.06	
2	156-IA-4	2/21/13	16:05	2/25/13	13:57	82/32	0.743	0.95	120	1.00	0.000	0.006	96.9	2.079	0.00	0.00	0.07	
	lab dupe	2/21/13	16:05	2/25/13	14:00	84/11	0.785	0.95	120	1.00	0.003	0.007	96.9	2.079	0.07	0.03	0.07	
3	156-IA-4-BL	2/22/13	8:04	2/25/13	14:03	81/31	0.818	0.95	120	1.00	0.008	0.006	81.0	1.844	0.16	0.07	0.05	

Decay correctiions based on Rn decay constant of 0.1813 per day
Radon Conc = {(0.4504)(1000)(obs dpm)(decay factor)(Press factor)}/{(cc used)(He eff)(Air/He)}
Conversion from dpm based on 0.4504 pCi/dpm
(in pCi/liter)
Blanks are negligible.

Definitions:

Cell/ch:	Counting cell and channel used	sig dpm	uncertainty (± 1 sig) in dpm based on counting statistics
He eff:	Cell and counter efficiency using helium matrix	Decay T:	time elapsed from sampling to analysis
Air/He:	Correction for matrix counting gas density	Decay factor:	Correction factor for decay from collection to analysis
Sample vol:	Volume analyzed (cc)	dpm/liter:	Radon concentration in disintigrations per minute per liter of sample
Press factor:	Correction to in situ pressure based on collection altitude	piC/liter:	Radon concentration in picoCuries per liter
obs dpm:	observed radon activity (disintigrations per minute) when analyzed	count stats:	uncertainty in observed radon based on counting statistics

Columbia Analytical Services HSC / Radon

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page _______ of ________

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No.

CAS Contact:

Company Name & Address (Reporting Information)
GSI Environmental
2211 Norfolk Ste 1000
Houston TX 77098

Project Name: ESTCP VI Study - Tyndall AFB

Project Number: 3585/3669

Project Manager: T McHugh / L Beckley

P.O. # / Billing Information

Phone: 713-367-4775

Fax

Email Address for Result Reporting: lmbeckley@gsi-net.com

Sampler (Print & Sign): TEM

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method: Radon	Analysis Method: Rec'd	Comments e.g. Actual Preservative or specific instructions
156-AA-1		2/21/13	16:05	—	—	—	—	500 mL	✓	✓	1L Tedlar
156-IA-4		2/21/13	16:05	—	—	—	—	500 ml	✓	✓	1L Tedlar (NP)
156-IA-4-BL		2/22/13	8:04	—	—	—	—	700 mL	✓	✓	1L Tedlar

Report Tier Levels - please select
Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries) _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Data Validation Package) 10% Surcharge _____

EDD required [✓ Yes] / No
Type: ______________

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date: 2/22/13	Time: 11:00am	Received by: (Signature) Douglas E. Hammond	Date: 2/25/13	Time: 1300
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank
Temperature ____ °C

COC AIR REV 3.11

OU #677 and 677a
ER-201025, Tndall AFB

analyses completed:
C CSIA -- tubes 3/14/2013
C CSIA -- water 3/15/2013
Cl CSIA -- tubes 3/20/2013
Cl CSIA -- water 3/06/2013

Sample ID	**average TCE δ13C**	**average TCE δ37Cl**
156-SS-3	-9.6	6.3
219-SS-3	-1.9	6.3
219-IA-3 P1	-29.0	-3.5
219-IA-3 P2	-28.8	-3.2
MW-8	13.8	10.1
MW-20S	-18.4	4.7

Note: For Sample ID MW-8, the actual well sampled was MW-5.

Run #	Sample ID	Tube #	Split X	TCE δ13C	notes
9350	156-SS-3	C16_M17855	splitless	-9.8	
9352	156-SS-3	C16_M16576	1:1	-9.4	
9354	219-SS-3	C16_M17784	1:3		peak too small
9355	219-SS-3	C16_M17784 (via M17789)	splitless	-1.6	
9363	219-SS-3	C16_M17751	splitless	-2.2	
9357	219-IA-3 P1	C16_M17686	1:25		peak too large
9359	219-IA-3 P1	C16_M17787 (via M17860)	1:80	-28.7	
9362	219-IA-3 P1	C16_M17787 (via M17718)	1:80	-29.3	
9358	219-IA-3 P2	C16_M17822	1:25		peak too large
9361	219-IA-3 P2	C16_M17688 (via M17856)	1:80	-28.8	

Sample ID	average TCE δ13C
156-SS-3	-9.6
219-SS-3	-1.9
219-IA-3 P1	-29.0
219-IA-3 P2	-28.8
MW-8	13.8
MW-20S	-18.4

Run #	Sample ID	Water volume (mL)	Split X	TCE δ13C
9365	MW-8	25	splitless	13.8
9366	MW-20S	8	splitless	-18.3
9367	MW-20S	4	splitless	-18.4

Standards

Run #	Sample ID	Tube #	Split X	TCE δ13C
9348	TCE stand. 100 ng	C16_J03738	splitless	-30.5
9349	TCE stand. 100 ng	C16_M17859	splitless	-30.0
9351	TCE stand. 100 ng	C16_M17825	splitless	-30.3
9353	TCE stand. 100 ng	C16_J03664	splitless	-30.2
9356	TCE stand. 100 ng	C16_J03729	splitless	-30.0
9360	TCE stand. 100 ng	C16_M16543	splitless	-29.6
9364	TCE stand. 100 ng	aqueous by PT	splitless	-30.2
9370	TCE stand. 100 ng	aqueous by PT	splitless	-30.0

average	-30.1
stdev	0.3
off-line δ13C of the stand.	-30.8
correction (x)	-0.7

Run #	Sample ID	Tube #	Split X	TCE δ37Cl
3298	156-SS-3	C16-M17818 (via C16_M17758)	1:1	6.1
3302	156-SS-3	C16-M17818 (via C16_M17859)	splitless	6.4
3293	219-SS-3	C16_M17717	splitless	6.3
3289	219-1A-3 Pump 1	C16_M17787 (via C16_M16587)	1:13	-3.5
3305	219-1A-3 Pump 1	C16_M17787 (via C16_M17857)	1:15	-3.5
3291	219-1A-3 Pump 2	C16_M17688 (via C16_M17786)	1:14	-2.9
3292	219-1A-3 Pump 2	C16_M17688 (via C16_J03132)	1:14	-2.9
3306	219-1A-3 Pump 2	C16_M17688 (via C16_M17723)	1:15	-3.7

Sample ID	average TCE δ37Cl
156-SS-3	6.3
219-SS-3	6.3
219-IA-3 P1	-3.5
219-IA-3 P2	-3.2
MW-8	10.1
MW-20S	4.7

Run #	Sample ID	Water volume (mL)	Split X	TCE δ37Cl
3274	MW8	26	splitless	10.0
3281	MW8	25	splitless	10.2
3283	MW8	25	splitless	10.1
3275	MW20S	3	splitless	4.5
3282	MW20S	3	splitless	4.8

Standards

Run #	Sample ID	Tube #	Split X	TCE δ37Cl
3286	TCE stand 70 ng	C16_J05145	splitless	3.1
3287	TCE stand 70 ng	C16_M17690	splitless	3.4
3288	TCE stand 70 ng	C16_M16587	splitless	3.4
3290	TCE stand 70 ng	C16_K08451	splitless	3.2
3294	TCE stand 70 ng	C16_M17783	splitless	3.2
3295	TCE stand 70 ng	C16_K08458	splitless	3.4
3296	TCE stand 70 ng	C16_K08449	splitless	3.0
3301	TCE stand 70 ng	C16_M17750	splitless	3.5
3303	TCE stand 70 ng	C16_J03150	splitless	3.4
3304	TCE stand 70 ng	C16_M17683	splitless	3.2
3268	TCE stand 70 ng	aqueous by PT	splitless	3.1
3269	TCE stand 70 ng	aqueous by PT	splitless	3.3
3270	TCE stand 70 ng	aqueous by PT	splitless	3.5
3272	TCE stand 70 ng	aqueous by PT	splitless	3.3
3277	TCE stand 70 ng	aqueous by PT	splitless	3.5
3278	TCE stand 70 ng	aqueous by PT	splitless	3.1
3279	TCE stand 70 ng	aqueous by PT	splitless	3.1
3280	TCE stand 70 ng	aqueous by PT	splitless	3.4
3284	TCE stand 70 ng	aqueous by PT	splitless	3.4
3285	TCE stand 70 ng	aqueous by PT	splitless	3.3

average 3.3
stdev 0.2

off-line δ37Cl of the stand. 3.3
correction (x) 0.0

OU #677 and 677a
ER-201025, Tndall AFB

analyses completed:
C CSIA -- tubes 3/14/2013
C CSIA -- water 3/15/2013
Cl CSIA -- tubes 3/20/2013
Cl CSIA -- water 3/06/2013
reanalyzed Cl CSIA -- 5/23/2013

Sample ID	**average TCE δ13C**	**average TCE δ37Cl**
156-SS-3	-9.6	6.3
219-SS-3	-1.9	6.3
219-IA-3 P1	-29.0	-3.5
219-IA-3 P2	-28.8	-3.2
MW-8	13.8	10.1
MW-20S	-18.4	4.7

Run #	Sample ID	Tube #	Split X	TCE δ13C	notes
9350	156-SS-3	C16_M17855	splitless	-9.8	
9352	156-SS-3	C16_M16576	1:1	-9.4	
9354	219-SS-3	C16_M17784	1:3		peak too small
9355	219-SS-3	C16_M17784 (via M17789)	splitless	-1.6	
9363	219-SS-3	C16_M17751	splitless	-2.2	
9357	219-IA-3 P1	C16_M17686	1:25		peak too large
9359	219-IA-3 P1	C16_M17787 (via M17860)	1:80	-28.7	
9362	219-IA-3 P1	C16_M17787 (via M17718)	1:80	-29.3	
9358	219-IA-3 P2	C16_M17822	1:25		peak too large
9361	219-IA-3 P2	C16_M17688 (via M17856)	1:80	-28.8	

Sample ID	average TCE δ13C
156-SS-3	-9.6
219-SS-3	-1.9
219-IA-3 P1	-29.0
219-IA-3 P2	-28.8
MW-8	13.8
MW-20S	-18.4

Run #	Sample ID	Water volume (mL)	Split X	TCE δ13C
9365	MW-8	25	splitless	13.8
9366	MW-20S	8	splitless	-18.3
9367	MW-20S	4	splitless	-18.4

Standards

Run #	Sample ID	Tube #	Split X	TCE δ13C
9348	TCE stand. 100 ng	C16_J03738	splitless	-30.5
9349	TCE stand. 100 ng	C16_M17859	splitless	-30.0
9351	TCE stand. 100 ng	C16_M17825	splitless	-30.3
9353	TCE stand. 100 ng	C16_J03664	splitless	-30.2
9356	TCE stand. 100 ng	C16_J03729	splitless	-30.0
9360	TCE stand. 100 ng	C16_M16543	splitless	-29.6
9364	TCE stand. 100 ng	aqueous by PT	splitless	-30.2
9370	TCE stand. 100 ng	aqueous by PT	splitless	-30.0

average	-30.1
stdev	0.3
off-line δ13C of the stand.	-30.8
correction (x)	-0.7

Run #	Sample ID	Tube #	Split X	TCE δ37Cl	remarks
3298	156-SS-3	C16-M17818 (via C16_M17758)	1:1	6.1	
3302	156-SS-3	C16-M17818 (via C16_M17859)	splitless	6.4	
3583	156-SS-3	C16_M17853	1:2	6.3	analyzed May-22-2013
3592	156-SS-3 (split of #3583)	C16_M17853	1:1	6.2	analyzed May-23-2013
3293	219-SS-3	C16_M17717	splitless	6.3	
3289	219-1A-3 Pump 1	C16_M17787 (via C16_M16587)	1:13	-3.5	
3305	219-1A-3 Pump 1	C16_M17787 (via C16_M17857)	1:15	-3.5	
3585	219-1A-3 Pump 1 (split of #3305)	C16_M17787 (via C16_M17855)	1:9	-3.3	analyzed May-22-2013
3291	219-1A-3 Pump 2	C16_M17688 (via C16_M17786)	1:14	-2.9	
3292	219-1A-3 Pump 2	C16_M17688 (via C16_J03132)	1:14	-2.9	
3306	219-1A-3 Pump 2	C16_M17688 (via C16_M17723)	1:15	-3.7	
3586	219-1A-3 Pump 2 (split of #3306)	C16_M17688 (via C16_M17856)	1:9	-3.3	analyzed May-22-2013

Sample ID	average TCE δ37Cl	averages with May 2013
156-SS-3	6.3	6.3
219-SS-3	6.3	6.3
219-IA-3 P1	-3.5	-3.4
219-IA-3 P2	-3.2	-3.2
MW-8	10.1	10.1
MW-20S	4.7	4.7

Run #	Sample ID	Water volume (mL)	Split X	TCE δ37Cl
3274	MW8	26	splitless	10.0
3281	MW8	25	splitless	10.2
3283	MW8	25	splitless	10.1
3275	MW20S	3	splitless	4.5
3282	MW20S	3	splitless	4.8

Standards

Run #	Sample ID	Tube #	Split X	TCE δ37Cl
3286	TCE stand 70 ng	C16_J05145	splitless	3.1
3287	TCE stand 70 ng	C16_M17690	splitless	3.4
3288	TCE stand 70 ng	C16_M16587	splitless	3.4
3290	TCE stand 70 ng	C16_K08451	splitless	3.2
3294	TCE stand 70 ng	C16_M17783	splitless	3.2
3295	TCE stand 70 ng	C16_K08458	splitless	3.4
3296	TCE stand 70 ng	C16_K08449	splitless	3.0
3301	TCE stand 70 ng	C16_M17750	splitless	3.5
3303	TCE stand 70 ng	C16_J03150	splitless	3.4
3304	TCE stand 70 ng	C16_M17683	splitless	3.2
3268	TCE stand 70 ng	aqueous by PT	splitless	3.1
3269	TCE stand 70 ng	aqueous by PT	splitless	3.3
3270	TCE stand 70 ng	aqueous by PT	splitless	3.5
3272	TCE stand 70 ng	aqueous by PT	splitless	3.3
3277	TCE stand 70 ng	aqueous by PT	splitless	3.5
3278	TCE stand 70 ng	aqueous by PT	splitless	3.1
3279	TCE stand 70 ng	aqueous by PT	splitless	3.1
3280	TCE stand 70 ng	aqueous by PT	splitless	3.4
3284	TCE stand 70 ng	aqueous by PT	splitless	3.4
3285	TCE stand 70 ng	aqueous by PT	splitless	3.3
			average	3.3
			stdev	0.2
			off-line δ37Cl of the stand.	3.3
			correction (x)	0.0

Former Raritan Arsenal Site, New Jersey

Columbia Analytical Services INC
Now part of the ALS Group
2655 Park Center Drive, Suite A, Simi Valley, CA 93065 | 805.526.7161 | www.caslab.com

LABORATORY REPORT

April 24, 2013

Lila Beckley
GSI Environmental Inc.
2211 Norfolk, Suite 1000
Houston, TX 77098

RE: ESTCP VI Study - Raritan / 3585/3669

Dear Lila:

Your report number P1301371 has been amended for the samples submitted to our laboratory on April 2, 2013. The results have been reported down to the Method Detection Limit (MDL) per client request. The revised pages have been indicated by the “Revised Page” footer located at the bottom right of the page.

All analyses were performed according to our laboratory’s NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Sue Anderson
By Sue Anderson at 11:09 am, Apr 24, 2013

Sue Anderson
Project Manager

Client: GSI Environmental Inc.
Project: ESTCP VI Study - Raritan / 3585/3669

Service Request No: P1301371

CASE NARRATIVE

The samples were received intact under chain of custody on April 2, 2013 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Volatile Organic Compound Analysis

The samples were analyzed in SIM mode for selected volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

Samples 209-SG-09 (P1301371-008) and 209-IA-09 (P1301371-009) required dilution due to the presence of elevated levels of Methylene Chloride, a non-target analyte. The reporting limits have been adjusted to reflect the dilutions.

The responses for the #3 internal standard in sample CP4-IA-5-NP (P1301371-013) and DUP-1 (P1301371-014) were outside control criteria because of suspected matrix interference. The samples were diluted in an attempt to eliminate the effects of the matrix interference. The results have been reported from the dilutions; therefore, the associated method reporting limits have been elevated accordingly.

The Summa canisters were cleaned, prior to sampling, down to the method reporting limit (MRL) reported for this project. Please note, projects which require reporting below the MRL could have results between the MRL and method detection limit (MDL) that are biased high.

Columbia Analytical Services, Inc. dba ALS Environmental – Simi Valley

Certifications, Accreditations, and Registrations

Agency	Web Site	Number
AIHA	http://www.aihaaccreditedlabs.org	101661
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0694
DoD ELAP	http://www.pjlabs.com/search-accredited-labs	L11-203
Florida DOH (NELAP)	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E871020
Maine DHHS	http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/labcert.htm	2012039
Minnesota DOH (NELAP)	http://www.health.state.mn.us/accreditation	494864
New Jersey DEP (NELAP)	http://www.nj.gov/dep/oqa/	CA009
New York DOH (NELAP)	http://www.wadsworth.org/labcert/elap/elap.html	11221
Oregon PHD (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	CA200007
Pennsylvania DEP	http://www.depweb.state.pa.us/labs	68-03307 (Registration)
Texas CEQ (NELAP)	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704413-12-3
Utah DOH (NELAP)	http://www.health.utah.gov/lab/labimp/certification/index.html	CA015272012-2
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C946

Analyses were performed according to our laboratory's NELAP and DoD-ELAP approved quality assurance program. A complete listing of specific NELAP and DoD-ELAP certified analytes can be found in the certifications section at www.caslab.com, www.alsglobal.com, or at the accreditation body's website.

Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact the laboratory for information corresponding to a particular certification.

DETAIL SUMMARY REPORT

Client: GSI Environmental Inc.
Service Request: P1301371
Project ID: ESTCP VI Study - Raritan / 3585/3669

Date Received: 4/2/2013
Time Received: 09:20

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-15 - VOC SIM
CP4-AA-1	P1301371-001	Air	3/26/2013	16:42	AS00366	-3.23	3.73	X
CP4-IA-1	P1301371-002	Air	3/26/2013	16:44	AC01464	-4.22	3.72	X
CP4-IA-2	P1301371-003	Air	3/26/2013	16:45	AC01662	-1.75	3.69	X
CP4-IA-3	P1301371-004	Air	3/26/2013	16:30	AS00452	-0.10	3.81	X
CP4-SG-6	P1301371-005	Air	3/26/2013	15:00	AS00364	-1.37	3.58	X
CP4-SG-3	P1301371-006	Air	3/26/2013	09:00	AC01810	-1.27	3.62	X
209-SG-06	P1301371-007	Air	3/27/2013	10:50	AC01785	-2.01	3.61	X
209-SG-09	P1301371-008	Air	3/27/2013	10:00	AS00370	-1.85	3.63	X
209-IA-09	P1301371-009	Air	3/27/2013	16:09	AS00288	-3.92	3.69	X
209-IA-10	P1301371-010	Air	3/27/2013	16:08	AC01788	-3.91	3.77	X
209-AA-1	P1301371-011	Air	3/27/2013	16:10	AC00791	-3.42	3.76	X
CP4-IA-5-BL	P1301371-012	Air	3/28/2013	08:45	AC01855	0.55	3.60	X
CP4-IA-5-NP	P1301371-013	Air	3/28/2013	11:05	AC00389	0.11	3.76	X
DUP-1	P1301371-014	Air	3/28/2013	00:00	AC01263	0.44	3.58	X

Columbia Analytical Services™

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

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Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) [✓ 10 Day-Standard]

CAS Project No. P1301371

CAS Contact: Sue Anderson

Company Name & Address (Reporting Information): GSI Environmental
2211 Norfolk Suite 1000
Houston TX 77098

Project Name: ESTCP VI Study - Raritan

Project Number: 3585/3669

Project Manager: Lila Beckley

P.O. # / Billing Information:

Phone: 713 367 4775

Fax:

Email Address for Result Reporting: lmbeckley@gsi-net.com

Sampler (Print & Sign): TEM / LMB

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method TO15 SIM (see quote)		Comments e.g. Actual Preservative or specific instructions
CP4-AA-1	①-394	3/26/13	0930-1642	AS00366	FCA00151	-29.2	-9.5	6L	✓		
CP4-IA-1	②-4.24	3/26/13	0924-1644	AC01464	00040	-29.3	-10				
CP4-IA-2	③-1.78	3/26/13	0930-1645	AC01662	00714	-29.3	-5				
CP4-IA-3	④-0.19	3/26/13	1630	AS00452	—	-29.3	-1				
CP4-SG-6	⑤-1.38	3/26/13	1500	AS00364	—	-29.3	-4.5				
CP4-SG-3	⑥-1.33	3/26/13	0900	AC01810	—	-29.3	-4				
209-SG-06	⑦-2.08	3/27/13	1050	AC01785	—	-29.3	-6				
209-SG-09	⑧-1.46	3/27/13	1000	AS00370	—	-29.3	-5				
209-IA-09	⑨-395	3/27/13	1609	AS00288	FCA00686	-29.2	-9.5				
209-IA-10	⑩-3.45	3/27/13	1608	AC01788	FCA00553	-29.2	-9.6				
209-AA-1	⑪-342	3/27/13	1610	AC00791	FCA00109	-29.3	-8.5				
CP4-IA-5-BL	⑫+0.60	3/28/13	0845	AC01855	—	-29.2	0				
CP4-IA-5-NP	⑬+0.09	3/28/13	1105	AC00389	—	-29.2	0				
Dup-1	⑭+043	3/28/13		AC01263	—	-29.1	0	↓	↓		

-14.54
-14.54-2
-14.52-2
-13.1

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ✓
Tier IV (Data Validation Package) 10% Surcharge ____

Note: 14 spls
6 cans returned unused (1 w/ bad vac)

EDD required [✓ Yes] / No
Type: µg/m3

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	3/28/13	1700		4/2/13	0920

Cooler / Blank Temperature ____ °C

Sample Acceptance Check Form

Client: GSI Environmental Inc.
Work order: P1301371
Project: ESTCP VI Study - Raritan / 3585/3669
Sample(s) received on: 4/2/13
Date opened: 4/2/13
by: MZAMORA

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	**No**	**N/A**
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by ALS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? ____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? ____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1301371-001.01	6.0 L Silonite Can					
P1301371-002.01	6.0 L Ambient Can					
P1301371-003.01	6.0 L Ambient Can					
P1301371-004.01	6.0 L Silonite Can					
P1301371-005.01	6.0 L Silonite Can					
P1301371-006.01	6.0 L Ambient Can					
P1301371-007.01	6.0 L Ambient Can					
P1301371-008.01	6.0 L Silonite Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

Sample Acceptance Check Form

Client: GSI Environmental Inc. Work order: P1301371

Project: ESTCP VI Study - Raritan / 3585/3669

Sample(s) received on: 4/2/13 Date opened: 4/2/13 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1301371-009.01	6.0 L Silonite Can					
P1301371-010.01	6.0 L Ambient Can					
P1301371-011.01	6.0 L Ambient Can					
P1301371-012.01	6.0 L Ambient Can					
P1301371-013.01	6.0 L Ambient Can					
P1301371-014.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-AA-1** CAS Project ID: P1301371
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669** CAS Sample ID: P1301371-001

Test Code: EPA TO-15 SIM Date Collected: 3/26/13
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Date Received: 4/2/13
Analyst: Wida Ang Date Analyzed: 4/6/13
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AS00366
Initial Pressure (psig): -3.23 Final Pressure (psig): 3.73

Canister Dilution Factor: 1.61

CAS #	**Compound**	**Result** µg/m³	MRL µg/m³	MDL µg/m³	**Result** ppbV	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.040	0.0040	ND	0.016	0.0016	
75-35-4	1,1-Dichloroethene	ND	0.040	0.0050	ND	0.010	0.0013	
156-60-5	trans-1,2-Dichloroethene	ND	0.040	0.018	ND	0.010	0.0045	
156-59-2	cis-1,2-Dichloroethene	ND	0.040	0.016	ND	0.010	0.0040	
79-01-6	Trichloroethene	**0.057**	0.040	0.0093	**0.011**	0.0075	0.0017	
127-18-4	Tetrachloroethene	**0.096**	0.040	0.0045	**0.014**	0.0059	0.00067	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-IA-1**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-002

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01464

Date Collected: 3/26/13
Date Received: 4/2/13
Date Analyzed: 4/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.22 Final Pressure (psig): 3.72

Canister Dilution Factor: 1.76

CAS #	Compound	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.044	0.0044	ND	0.017	0.0017	
75-35-4	1,1-Dichloroethene	ND	0.044	0.0055	ND	0.011	0.0014	
156-60-5	trans-1,2-Dichloroethene	ND	0.044	0.019	ND	0.011	0.0049	
156-59-2	cis-1,2-Dichloroethene	ND	0.044	0.017	ND	0.011	0.0044	
79-01-6	Trichloroethene	**1.3**	0.044	0.010	**0.25**	0.0082	0.0019	
127-18-4	Tetrachloroethene	**0.30**	0.044	0.0049	**0.045**	0.0065	0.00073	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-IA-2**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-003

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01662

Date Collected: 3/26/13
Date Received: 4/2/13
Date Analyzed: 4/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -1.75 Final Pressure (psig): 3.69

Canister Dilution Factor: 1.42

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.036	0.0036	ND	0.014	0.0014	
75-35-4	1,1-Dichloroethene	ND	0.036	0.0044	ND	0.0090	0.0011	
156-60-5	trans-1,2-Dichloroethene	**0.018**	0.036	0.016	**0.0045**	0.0090	0.0039	**J**
156-59-2	cis-1,2-Dichloroethene	ND	0.036	0.014	ND	0.0090	0.0035	
79-01-6	Trichloroethene	**2.1**	0.036	0.0082	**0.39**	0.0066	0.0015	
127-18-4	Tetrachloroethene	**0.27**	0.036	0.0040	**0.040**	0.0052	0.00059	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-IA-3**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-004

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00452

Date Collected: 3/26/13
Date Received: 4/2/13
Date Analyzed: 4/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -0.10 Final Pressure (psig): 3.81

Canister Dilution Factor: 1.27

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.032	0.0032	ND	0.012	0.0012	
75-35-4	1,1-Dichloroethene	ND	0.032	0.0039	ND	0.0080	0.00099	
156-60-5	trans-1,2-Dichloroethene	ND	0.032	0.014	ND	0.0080	0.0035	
156-59-2	cis-1,2-Dichloroethene	ND	0.032	0.012	ND	0.0080	0.0031	
79-01-6	Trichloroethene	**2.4**	0.032	0.0074	**0.44**	0.0059	0.0014	
127-18-4	Tetrachloroethene	**0.16**	0.032	0.0036	**0.024**	0.0047	0.00052	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS
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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-SG-6** CAS Project ID: P1301371
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669** CAS Sample ID: P1301371-005

Test Code: EPA TO-15 SIM Date Collected: 3/26/13
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Date Received: 4/2/13
Analyst: Wida Ang Date Analyzed: 4/6/13
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AS00364
Initial Pressure (psig): -1.37 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.37

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	MDL µg/m³	**Result** **ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.034	0.0034	ND	0.013	0.0013	
75-35-4	1,1-Dichloroethene	ND	0.034	0.0042	ND	0.0086	0.0011	
156-60-5	trans-1,2-Dichloroethene	**0.023**	0.034	0.015	**0.0058**	0.0086	0.0038	**J**
156-59-2	cis-1,2-Dichloroethene	**0.014**	0.034	0.013	**0.0034**	0.0086	0.0034	**J**
79-01-6	Trichloroethene	**15**	0.034	0.0079	**2.9**	0.0064	0.0015	
127-18-4	Tetrachloroethene	**7.3**	0.034	0.0038	**1.1**	0.0051	0.00057	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-SG-3**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-006

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01810

Date Collected: 3/26/13
Date Received: 4/2/13
Date Analyzed: 4/6/13 & 4/8/13
Volume(s) Analyzed: 1.00 Liter(s)
0.10 Liter(s)

Initial Pressure (psig): -1.27 Final Pressure (psig): 3.62

Canister Dilution Factor: 1.36

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.034	0.0034	ND	0.013	0.0013	
75-35-4	1,1-Dichloroethene	ND	0.034	0.0042	ND	0.0086	0.0011	
156-60-5	trans-1,2-Dichloroethene	**0.30**	0.034	0.015	**0.076**	0.0086	0.0038	
156-59-2	cis-1,2-Dichloroethene	**1.1**	0.034	0.013	**0.28**	0.0086	0.0034	
79-01-6	Trichloroethene	**93**	0.34	0.079	**17**	0.063	0.015	**D**
127-18-4	Tetrachloroethene	**12**	0.034	0.0038	**1.7**	0.0050	0.00056	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **209-SG-06**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-007

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01785

Date Collected: 3/27/13
Date Received: 4/2/13
Date Analyzed: 4/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.01 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.44

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.036	0.0036	ND	0.014	0.0014	
75-35-4	1,1-Dichloroethene	**0.028**	0.036	0.0045	**0.0072**	0.0091	0.0011	**J**
156-60-5	trans-1,2-Dichloroethene	ND	0.036	0.016	ND	0.0091	0.0040	
156-59-2	cis-1,2-Dichloroethene	ND	0.036	0.014	ND	0.0091	0.0036	
79-01-6	Trichloroethene	**0.55**	0.036	0.0084	**0.10**	0.0067	0.0016	
127-18-4	Tetrachloroethene	**13**	0.036	0.0040	**1.9**	0.0053	0.00059	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

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RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**209-SG-09**	CAS Project ID:	P1301371
Client Project ID:	**ESTCP VI Study - Raritan / 3585/3669**	CAS Sample ID:	P1301371-008
Test Code:	EPA TO-15 SIM	Date Collected:	3/27/13
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19	Date Received:	4/2/13
Analyst:	Wida Ang	Date Analyzed:	4/6/13
Sample Type:	6.0 L Summa Canister	Volume(s) Analyzed:	0.20 Liter(s)
Test Notes:			
Container ID:	AS00370		

Initial Pressure (psig): -1.85 Final Pressure (psig): 3.63

Canister Dilution Factor: 1.43

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	MDL µg/m³	**Result** **ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.18	0.018	ND	0.070	0.0070	
75-35-4	1,1-Dichloroethene	**0.050**	0.18	0.022	**0.013**	0.045	0.0056	**J**
156-60-5	trans-1,2-Dichloroethene	ND	0.18	0.079	ND	0.045	0.020	
156-59-2	cis-1,2-Dichloroethene	ND	0.18	0.070	ND	0.045	0.018	
79-01-6	Trichloroethene	**8.1**	0.18	0.041	**1.5**	0.033	0.0077	
127-18-4	Tetrachloroethene	**6.4**	0.18	0.020	**0.95**	0.026	0.0030	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **209-IA-09**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-009

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AS00288

Date Collected: 3/27/13
Date Received: 4/2/13
Date Analyzed: 4/6/13
Volume(s) Analyzed: 0.20 Liter(s)

Initial Pressure (psig): -3.92 Final Pressure (psig): 3.69

Canister Dilution Factor: 1.71

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.21	0.021	ND	0.084	0.0084	
75-35-4	1,1-Dichloroethene	**0.063**	0.21	0.027	**0.016**	0.054	0.0067	**J**
156-60-5	trans-1,2-Dichloroethene	ND	0.21	0.094	ND	0.054	0.024	
156-59-2	cis-1,2-Dichloroethene	ND	0.21	0.084	ND	0.054	0.021	
79-01-6	Trichloroethene	ND	0.21	0.050	ND	0.040	0.0092	
127-18-4	Tetrachloroethene	**0.073**	0.21	0.024	**0.011**	0.032	0.0035	**J**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**

Client Sample ID: **209-IA-10**

Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371

CAS Sample ID: P1301371-010

Test Code: EPA TO-15 SIM

Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19

Analyst: Wida Ang

Sample Type: 6.0 L Summa Canister

Test Notes:

Container ID: AC01788

Date Collected: 3/27/13

Date Received: 4/2/13

Date Analyzed: 4/6/13

Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.91 Final Pressure (psig): 3.77

Canister Dilution Factor: 1.71

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	MDL µg/m³	**Result** **ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.043	0.0043	ND	0.017	0.0017	
75-35-4	1,1-Dichloroethene	ND	0.043	0.0053	ND	0.011	0.0013	
156-60-5	trans-1,2-Dichloroethene	ND	0.043	0.019	ND	0.011	0.0047	
156-59-2	cis-1,2-Dichloroethene	ND	0.043	0.017	ND	0.011	0.0042	
79-01-6	Trichloroethene	**0.064**	0.043	0.0099	**0.012**	0.0080	0.0018	
127-18-4	Tetrachloroethene	**0.058**	0.043	0.0048	**0.0086**	0.0063	0.00071	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

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Client:	**GSI Environmental Inc.**		
Client Sample ID:	**209-AA-1**	CAS Project ID:	P1301371
Client Project ID:	**ESTCP VI Study - Raritan / 3585/3669**	CAS Sample ID:	P1301371-011
Test Code:	EPA TO-15 SIM	Date Collected:	3/27/13
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19	Date Received:	4/2/13
Analyst:	Wida Ang	Date Analyzed:	4/6/13
Sample Type:	6.0 L Summa Canister	Volume(s) Analyzed:	1.00 Liter(s)
Test Notes:			
Container ID:	AC00791		

Initial Pressure (psig): -3.42 Final Pressure (psig): 3.76

Canister Dilution Factor: 1.64

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.041	0.0041	ND	0.016	0.0016	
75-35-4	1,1-Dichloroethene	ND	0.041	0.0051	ND	0.010	0.0013	
156-60-5	trans-1,2-Dichloroethene	ND	0.041	0.018	ND	0.010	0.0046	
156-59-2	cis-1,2-Dichloroethene	ND	0.041	0.016	ND	0.010	0.0041	
79-01-6	Trichloroethene	**0.017**	0.041	0.0095	**0.0032**	0.0076	0.0018	**J**
127-18-4	Tetrachloroethene	**0.042**	0.041	0.0046	**0.0062**	0.0060	0.00068	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-IA-5-BL**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-012

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01855

Date Collected: 3/28/13
Date Received: 4/2/13
Date Analyzed: 4/8/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): 0.55 Final Pressure (psig): 3.60

Canister Dilution Factor: 1.20

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
75-01-4	Vinyl Chloride	ND	0.030	0.0030	ND	0.012	0.0012	
75-35-4	1,1-Dichloroethene	ND	0.030	0.0037	ND	0.0076	0.00094	
156-60-5	trans-1,2-Dichloroethene	**0.041**	0.030	0.013	**0.010**	0.0076	0.0033	
156-59-2	cis-1,2-Dichloroethene	ND	0.030	0.012	ND	0.0076	0.0030	
79-01-6	Trichloroethene	**0.43**	0.030	0.0070	**0.080**	0.0056	0.0013	
127-18-4	Tetrachloroethene	**0.066**	0.030	0.0034	**0.0098**	0.0044	0.00050	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-IA-5-NP**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-013

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC00389

Date Collected: 3/28/13
Date Received: 4/2/13
Date Analyzed: 4/8/13
Volume(s) Analyzed: 0.20 Liter(s)

Initial Pressure (psig): 0.11 Final Pressure (psig): 3.76

Canister Dilution Factor: 1.25

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	MDL µg/m³	**Result** **ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.16	0.016	ND	0.061	0.0061	
75-35-4	1,1-Dichloroethene	ND	0.16	0.019	ND	0.039	0.0049	
156-60-5	trans-1,2-Dichloroethene	ND	0.16	0.069	ND	0.039	0.017	
156-59-2	cis-1,2-Dichloroethene	ND	0.16	0.061	ND	0.039	0.015	
79-01-6	Trichloroethene	**0.32**	0.16	0.036	**0.060**	0.029	0.0067	
127-18-4	Tetrachloroethene	**0.097**	0.16	0.018	**0.014**	0.023	0.0026	**J**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **DUP-1**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-014

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01263

Date Collected: 3/28/13
Date Received: 4/2/13
Date Analyzed: 4/8/13
Volume(s) Analyzed: 0.20 Liter(s)

Initial Pressure (psig): 0.44 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.21

CAS #	**Compound**	**Result** **µg/m³**	MRL µg/m³	MDL µg/m³	**Result** **ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.15	0.015	ND	0.059	0.0059	
75-35-4	1,1-Dichloroethene	ND	0.15	0.019	ND	0.038	0.0047	
156-60-5	trans-1,2-Dichloroethene	**0.25**	0.15	0.067	**0.064**	0.038	0.017	
156-59-2	cis-1,2-Dichloroethene	ND	0.15	0.059	ND	0.038	0.015	
79-01-6	Trichloroethene	**0.33**	0.15	0.035	**0.062**	0.028	0.0065	
127-18-4	Tetrachloroethene	**0.17**	0.15	0.017	**0.025**	0.022	0.0025	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P130406-MB

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 4/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.025	0.0025	ND	0.0098	0.00098	
75-35-4	1,1-Dichloroethene	ND	0.025	0.0031	ND	0.0063	0.00078	
156-60-5	trans-1,2-Dichloroethene	ND	0.025	0.011	ND	0.0063	0.0028	
156-59-2	cis-1,2-Dichloroethene	ND	0.025	0.0098	ND	0.0063	0.0025	
79-01-6	Trichloroethene	ND	0.025	0.0058	ND	0.0047	0.0011	
127-18-4	Tetrachloroethene	ND	0.025	0.0028	ND	0.0037	0.00041	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P130408-MB

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 4/8/13
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	**Compound**	**Result** µg/m^3	MRL µg/m^3	MDL µg/m^3	**Result ppbV**	MRL ppbV	MDL ppbV	**Data Qualifier**
75-01-4	Vinyl Chloride	ND	0.025	0.0025	ND	0.0098	0.00098	
75-35-4	1,1-Dichloroethene	ND	0.025	0.0031	ND	0.0063	0.00078	
156-60-5	trans-1,2-Dichloroethene	ND	0.025	0.011	ND	0.0063	0.0028	
156-59-2	cis-1,2-Dichloroethene	ND	0.025	0.0098	ND	0.0063	0.0025	
79-01-6	Trichloroethene	ND	0.025	0.0058	ND	0.0047	0.0011	
127-18-4	Tetrachloroethene	ND	0.025	0.0028	ND	0.0037	0.00041	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**
CAS Project ID: P1301371

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 3/26 - 3/28/13
Date(s) Received: 4/2/13
Date(s) Analyzed: 4/6 - 4/8/13

Client Sample ID	**CAS Sample ID**	**1,2-Dichloroethane-d4 % Recovered**	**Toluene-d8 % Recovered**	**Bromofluorobenzene % Recovered**	Acceptance Limits	**Data Qualifier**
Method Blank	P130406-MB	**91**	**104**	**92**	70-130	
Method Blank	P130408-MB	**88**	**103**	**95**	70-130	
Lab Control Sample	P130406-LCS	**94**	**103**	**93**	70-130	
Lab Control Sample	P130408-LCS	**91**	**103**	**95**	70-130	
CP4-AA-1	P1301371-001	**91**	**105**	**89**	70-130	
CP4-IA-1	P1301371-002	**91**	**104**	**86**	70-130	
CP4-IA-1	P1301371-002DUP	**90**	**104**	**87**	70-130	
CP4-IA-2	P1301371-003	**90**	**105**	**82**	70-130	
CP4-IA-3	P1301371-004	**90**	**104**	**82**	70-130	
CP4-SG-6	P1301371-005	**90**	**105**	**88**	70-130	
CP4-SG-3	P1301371-006	**89**	**106**	**80**	70-130	
209-SG-06	P1301371-007	**91**	**102**	**88**	70-130	
209-SG-09	P1301371-008	**91**	**106**	**90**	70-130	
209-IA-09	P1301371-009	**91**	**104**	**92**	70-130	
209-IA-10	P1301371-010	**90**	**103**	**90**	70-130	
209-AA-1	P1301371-011	**90**	**103**	**92**	70-130	
CP4-IA-5-BL	P1301371-012	**88**	**102**	**77**	70-130	
CP4-IA-5-NP	P1301371-013	**90**	**104**	**77**	70-130	
DUP-1	P1301371-014	**89**	**105**	**75**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

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Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P130406-LCS

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 4/06/13
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
75-01-4	Vinyl Chloride	4.00	**4.15**	**104**	56-117	
75-35-4	1,1-Dichloroethene	4.36	**3.88**	**89**	62-113	
156-60-5	trans-1,2-Dichloroethene	4.04	**3.54**	**88**	61-111	
156-59-2	cis-1,2-Dichloroethene	4.28	**3.73**	**87**	63-112	
79-01-6	Trichloroethene	3.96	**3.09**	**78**	58-113	
127-18-4	Tetrachloroethene	3.80	**2.84**	**75**	60-111	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

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Client: **GSI Environmental Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P130408-LCS

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 4/08/13
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	**Compound**	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	CAS Acceptance Limits	**Data Qualifier**
75-01-4	Vinyl Chloride	4.00	**3.95**	**99**	56-117	
75-35-4	1,1-Dichloroethene	4.36	**3.88**	**89**	62-113	
156-60-5	trans-1,2-Dichloroethene	4.04	**3.55**	**88**	61-111	
156-59-2	cis-1,2-Dichloroethene	4.28	**3.81**	**89**	63-112	
79-01-6	Trichloroethene	3.96	**3.19**	**81**	58-113	
127-18-4	Tetrachloroethene	3.80	**2.93**	**77**	60-111	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY DUPLICATE SUMMARY RESULTS

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Client: **GSI Environmental Inc.**
Client Sample ID: **CP4-IA-1**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**

CAS Project ID: P1301371
CAS Sample ID: P1301371-002DUP

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01464

Date Collected: 3/26/13
Date Received: 4/2/13
Date Analyzed: 4/6/13
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.22 Final Pressure (psig): 3.72

Canister Dilution Factor: 1.76

CAS #	**Compound**	Sample Result		**Duplicate Sample Result**		Average	**% RPD**	RPD	**Data**
		µg/m³	ppbV	**µg/m³**	ppbV	µg/m³		Limit	**Qualifier**
75-01-4	Vinyl Chloride	ND	ND	ND	ND	-	**-**	25	
75-35-4	1,1-Dichloroethene	ND	ND	ND	ND	-	**-**	25	
156-60-5	trans-1,2-Dichloroethene	ND	ND	ND	ND	-	**-**	25	
156-59-2	cis-1,2-Dichloroethene	ND	ND	ND	ND	-	**-**	25	
79-01-6	Trichloroethene	1.35	0.251	1.36	0.253	1.355	**0.7**	25	
127-18-4	Tetrachloroethene	0.302	0.0446	0.302	0.0446	0.302	**0**	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**
CAS Project ID: P1301371

Method Blank Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Lab File ID: 04061303.D
Analyst: Wida Ang
Date Analyzed: 4/06/13
Sample Type: 6.0 L Summa Canister(s)
Time Analyzed: 02:34
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P130406-LCS	04061304.D	03:07
CP4-AA-1	P1301371-001	04061315.D	13:48
CP4-IA-1	P1301371-002	04061316.D	14:21
CP4-IA-1 (Lab Duplicate)	P1301371-002DUP	04061317.D	14:54
CP4-IA-2	P1301371-003	04061318.D	15:26
CP4-IA-3	P1301371-004	04061319.D	15:59
CP4-SG-6	P1301371-005	04061320.D	16:32
CP4-SG-3	P1301371-006	04061321.D	17:05
209-SG-06	P1301371-007	04061322.D	17:37
209-SG-09	P1301371-008	04061323.D	18:10
209-IA-09	P1301371-009	04061324.D	18:43
209-IA-10	P1301371-010	04061325.D	19:15
209-AA-1	P1301371-011	04061326.D	19:48

RESULTS OF ANALYSIS

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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669**
CAS Project ID: P1301371

Method Blank Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19
Lab File ID: 04081303.D
Analyst: Wida Ang
Date Analyzed: 4/08/13
Sample Type: 6.0 L Summa Canister(s)
Time Analyzed: 08:39
Test Notes:

Client Sample ID	CAS Sample ID	Lab File ID	Time Analyzed
Lab Control Sample	P130408-LCS	04081304.D	09:12
CP4-SG-3 (Dilution)	P1301371-006	04081306.D	10:31
CP4-IA-5-BL	P1301371-012	04081312.D	14:12
CP4-IA-5-NP	P1301371-013	04081317.D	17:09
DUP-1	P1301371-014	04081318.D	17:41

RESULTS OF ANALYSIS
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Client: **GSI Environmental Inc.**
Client Project ID: **ESTCP VI Study - Raritan / 3585/3669** CAS Project ID: P1301371

Internal Standard Area and RT Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Lab File ID: 04061302.D
Analyst: Wida Ang Date Analyzed: 4/6/13
Sample Type: 6.0 L Summa Canister(s) Time Analyzed: 02:01
Test Notes:

		IS1 (BCM)				**IS2 (DFB)**				**IS3 (CBZ)**			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	50217		11.66		220840		13.41		30322		17.09	
	Upper Limit	70304		11.99		309176		13.74		42451		17.42	
	Lower Limit	30130		11.33		132504		13.08		18193		16.76	
	Client Sample ID												
01	Method Blank	49826		11.66		214849		13.41		30678		17.09	
02	Lab Control Sample	49938		11.66		219672		13.41		30468		17.09	
03	CP4-AA-1	50552		11.66		226086		13.41		31534		17.09	
04	CP4-IA-1	50432		11.66		223569		13.40		33583		17.09	
05	CP4-IA-1 (Lab Duplicate)	50409		11.66		222053		13.40		32807		17.09	
06	CP4-IA-2	50028		11.66		221254		13.41		34539		17.09	
07	CP4-IA-3	50867		11.66		225392		13.41		34757		17.09	
08	CP4-SG-6	50559		11.66		223155		13.41		32601		17.09	
09	CP4-SG-3	50604		11.66		223687		13.41		35978		17.09	
10	209-SG-06	50840		11.66		230789		13.41		33313		17.09	
11	209-SG-09	50984		11.66		222513		13.41		31646		17.09	
12	209-IA-09	50518		11.66		220404		13.41		30064		17.09	
13	209-IA-10	49238		11.66		220213		13.41		30839		17.09	
14	209-AA-1	49248		11.66		218196		13.40		29491		17.09	
15													
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits. See case narrative.

RESULTS OF ANALYSIS

Page 1 of 1

Client: **GSI Environmental Inc.**

Client Project ID: **ESTCP VI Study - Raritan / 3585/3669** CAS Project ID: P1301371

Internal Standard Area and RT Summary

Test Code: EPA TO-15 SIM
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/7890A/MS19 Lab File ID: 04081302.D
Analyst: Wida Ang Date Analyzed: 4/8/13
Sample Type: 6.0 L Summa Canister(s) Time Analyzed: 08:06
Test Notes:

		IS1 (BCM)				IS2 (DFB)				IS3 (CBZ)			
		AREA	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**	**AREA**	**#**	**RT**	**#**
	24 Hour Standard	50663		11.66		220706		13.41		29173		17.09	
	Upper Limit	70928		11.99		308988		13.74		40842		17.42	
	Lower Limit	30398		11.33		132424		13.08		17504		16.76	
	Client Sample ID												
01	Method Blank	49936		11.66		217389		13.41		28648		17.09	
02	Lab Control Sample	51082		11.66		222836		13.41		29396		17.09	
03	CP4-SG-3 (Dilution)	51745		11.66		219682		13.41		31358		17.09	
04	CP4-IA-5-BL	53900		11.66		235852		13.41		37656		17.09	
05	CP4-IA-5-NP	51790		11.66		226392		13.41		37454		17.09	
06	DUP-1	49347		11.65		215068		13.40		36550		17.09	
07													
08													
09													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = 140% of internal standard area
AREA LOWER LIMIT = 60% of internal standard area
RT UPPER LIMIT = 0.33 minutes of internal standard RT
RT LOWER LIMIT = 0.33 minutes of internal standard RT

# Column used to flag values outside QC limits with an I.
I = Internal standard not within the specified limits. See case narrative.

```
                          Response Factor Report MS19

Method Path : I:\MS19\METHODS\
Method File : X19032813.M
Title       : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
Last Update  : Thu Mar 28 14:08:39 2013
Response Via : Initial Calibration

Calibration Files
10   =03281302.D  20   =03281303.D  50   =03281304.D  100 =03281305.D  500 =03281306.D  1000=03281307.D
2500=03281308.D  9999=03281309.D  20K =03281310.D

      Compound           10     20     50    100    500   1000   2500   9999   20K   Avg        %RSD
-----------------------------------------------------------------------------------------------------

  1) I   Bromochloromethane... ----------------ISTD---------------------
  2) T   Dichlorodifluo... 3.095 2.831 2.652 2.598 2.581 2.480 2.350 2.276 2.228 2.566    10.77
  3) T   Chloromethane           0.578 0.478 0.433 0.437 0.414 0.358 0.420 0.442 0.445    14.29
  4) T   Vinyl Chloride    1.727 1.625 1.507 1.474 1.448 1.416 1.363 1.355 1.399 1.479     8.41
  5) T   Bromomethane            1.165 0.924 0.806 0.827 0.779 0.735 0.815 0.819 0.859    15.69
  6) T   Chloroethane      0.776 0.719 0.611 0.590 0.585 0.560 0.543 0.588 0.591 0.618    12.47
  7) T   Acetone                                   0.497 0.464 0.437 0.444 0.444 0.457     5.32
  8) T   Trichlorofluor... 2.336 2.155 1.978 1.947 1.937 1.857 1.807 1.842 1.800 1.962     9.09
  9) T   1,1-Dichloroet... 1.355 1.179 1.109 1.068 1.096 1.057 1.037 1.103 1.112 1.124     8.50
 10) T   Methylene Chlo...             1.653 1.397 1.217 1.152 1.100 1.103 1.094 1.245    16.81
 11) T   Trichlorotrifl... 1.574 1.432 1.359 1.287 1.240 1.171 1.140 1.111 1.156 1.275    12.17
 12) T   trans-1,2-Dich... 1.551 1.408 1.291 1.239 1.251 1.209 1.177 1.222 1.229 1.286     9.28
 13) T   1,1-Dichloroet... 2.232 1.977 1.777 1.707 1.776 1.671 1.615 1.740 1.706 1.800    10.60
 14) T   Methyl tert-Bu... 3.186 2.899 2.697 2.678 2.731 2.760 2.860 2.950 3.079 2.871     6.15
 15) T   cis-1,2-Dichlo... 1.557 1.371 1.287 1.252 1.279 1.230 1.204 1.258 1.238 1.297     8.35
 16) T   Chloroform        2.438 2.212 2.046 1.934 1.999 1.909 1.818 1.886 1.833 2.008    10.03
 17) S   1,2-Dichloroet... 1.294 1.283 1.287 1.249 1.255 1.249 1.207 1.195 1.187 1.245     3.25
 18) T   1,2-Dichloroet... 1.835 1.643 1.547 1.491 1.487 1.429 1.382 1.387 1.358 1.506    10.14
 19) T   1,1,1-Trichlor... 2.304 2.125 1.972 1.905 1.905 1.831 1.797 1.850 1.848 1.948     8.47
 20) T   Benzene                       4.709 4.324 4.145 3.975 3.874 3.890 3.825 4.106     7.76
 21) T   Carbon Tetrach... 1.628 1.582 1.520 1.493 1.549 1.515 1.504 1.570 1.582 1.549     2.88

 22) I   1,4-Difluorobenzen... ----------------ISTD---------------------
 23) T   1,2-Dichloropr... 0.282 0.267 0.246 0.240 0.233 0.223 0.218 0.229 0.226 0.241     8.88
 24) T   Bromodichlorom... 0.398 0.395 0.361 0.353 0.352 0.339 0.336 0.357 0.354 0.361     6.14
 25) T   Trichloroethene   0.482 0.444 0.388 0.366 0.362 0.342 0.329 0.341 0.333 0.376    14.16
 26) T   1,4-Dioxane       0.243 0.217 0.199 0.201 0.203 0.199 0.202 0.217 0.217 0.211     6.90
 27) T   cis-1,3-Dichlo... 0.364 0.355 0.340 0.346 0.364 0.367 0.379 0.411 0.411 0.371     6.88
 28) T   trans-1,3-Dich... 0.273 0.284 0.278 0.295 0.306 0.314 0.333 0.371 0.379 0.315    12.31
 29) T   1,1,2-Trichlor... 0.272 0.251 0.232 0.229 0.223 0.212 0.208 0.217 0.216 0.229     9.00
 30) S   Toluene-d8 (SS2)  0.980 1.001 0.984 0.989 0.962 0.952 0.954 0.956 0.964 0.971     1.83
 31) T   Toluene                 1.381 1.192 1.142 1.110 1.061 1.037 1.075 1.036 1.129    10.18
 32) T   1,2-Dibromoethane 0.341 0.323 0.299 0.299 0.299 0.291 0.290 0.309 0.309 0.307     5.34
 33) T   Tetrachloroethene 0.502 0.485 0.443 0.426 0.422 0.397 0.382 0.397 0.391 0.427     9.91

 34) I   Chlorobenzene-d5 (... ----------------ISTD---------------------
 35) T   Chlorobenzene     6.577 6.070 5.519 5.330 5.441 5.260 5.142 5.318 4.956 5.512     9.14
 36) T   Ethylbenzene      8.499 7.729 7.277 7.300 7.705 7.808 8.021 8.444 7.774 7.840     5.48
 37) T   m,p-Xylene        6.215 5.808 5.496 5.641 6.343 6.458 6.535 6.752 6.144 6.155     6.92
```

```
                         Response Factor Report MS19

 Method Path : I:\MS19\METHODS\
 Method File : X19032813.M
 Title      : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
38) T   o-Xylene          7.131 6.650 6.342 6.460 6.936 6.917 6.913 7.118 6.489 6.773     4.35
39) T   1,1,2,2-Tetrac... 2.830 2.807 2.856 2.979 3.134 3.081 3.162 3.255 3.029 3.015     5.28
40) S   Bromofluoroben... 3.827 3.840 3.782 3.877 3.997 4.026 4.051 3.906 3.717 3.891     2.94
41) T   1,3-Dichlorobe... 6.005 5.213 4.859 4.773 5.080 4.797 4.772 4.935 4.522 4.995     8.55
42) T   1,4-Dichlorobe... 6.869 5.667 5.053 4.914 5.054 4.888 4.876 4.966 4.614 5.211    13.10
43) T   1,2-Dichlorobe... 5.771 5.108 4.783 4.640 4.936 4.702 4.631 4.752 4.378 4.856     8.21
44) T   1,2,4-Trichlor... 4.941 3.975 3.519 3.338 3.542 3.453 3.457 3.718 3.444 3.710    13.45
45) T   Naphthalene       1.424 1.102 0.964 0.929 1.069 1.073 1.094 1.205 1.086 1.105 E1  13.02
46) T   Hexachlorobuta... 2.649 2.441 2.265 2.154 2.259 2.168 2.132 2.269 2.115 2.272     7.62
-------------------------------------------------------------------------------------------
(#) = Out of Range
```

```
                    Evaluate Continuing Calibration Report

 Data File: I:\MS19\DATA\2013_04\06\04061302.D
 Acq On     :  6 Apr 2013   2:01 am                    Operator: WA/KR
 Sample     : 500pg TO-15SIM CCV STD                   Inst    : MS19
 Misc       : S25-03191301/S25-03221308 (4/20)
 ALS Vial   : 15   Sample Multiplier: 1

 Quant Time: Apr 06 06:21:52 2013
 Quant Method : I:\MS19\METHODS\X19032813.M
 Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
 QLast Update : Thu Mar 28 14:08:39 2013
 Response via : Initial Calibration
 DataAcq Meth:TO15SIM2.M

 Min. RRF      :    0.000  Min. Rel. Area :   50%  Max. R.T. Dev  0.33min
 Max. RRF Dev :   30%      Max. Rel. Area : 200%

        Compound                               AvgRF   CCRF       %Dev Area% Dev(min)
 ----------------------------------------------------------------------------------
  1 I    Bromochloromethane (IS1)              1.000   1.000        0.0   96    0.00
  2 T    Dichlorodifluoromethane (CF           2.566   2.158       15.9   80    0.03
  3 T    Chloromethane                         0.445   0.486       -9.2  107    0.04
  4 T    Vinyl Chloride                        1.479   1.590       -7.5  105    0.03
  5 T    Bromomethane                          0.859   0.891       -3.7  103    0.02
  6 T    Chloroethane                          0.618   0.725      -17.3  119    0.02
  7 T    Acetone                               0.457   0.646      -41.4# 125    0.00
  8 T    Trichlorofluoromethane                1.962   1.707       13.0   85    0.01
  9 T    1,1-Dichloroethene                    1.124   1.075        4.4   94    0.00
 10 T    Methylene Chloride                    1.245   1.165        6.4   92    0.00
 11 T    Trichlorotrifluoroethane              1.275   1.064       16.5   82    0.00
 12 T    trans-1,2-Dichloroethene              1.286   1.205        6.3   92    0.00
 13 T    1,1-Dichloroethane                    1.800   1.765        1.9   95    0.00
 14 T    Methyl tert-Butyl Ether               2.871   2.849        0.8  100    0.02
 15 T    cis-1,2-Dichloroethene                1.297   1.226        5.5   92    0.00
 16 T    Chloroform                            2.008   1.764       12.2   85    0.00
 17 S    1,2-Dichloroethane-d4 (SS1)           1.245   1.169        6.1   89    0.00
 18 T    1,2-Dichloroethane                    1.506   1.239       17.7   80    0.00
 19 T    1,1,1-Trichloroethane                 1.948   1.617       17.0   81    0.00
 20 T    Benzene                               4.106   4.095        0.3   95    0.00
 21 T    Carbon Tetrachloride                  1.549   1.300       16.1   81    0.00

 22 I    1,4-Difluorobenzene (IS2)             1.000   1.000        0.0  101    0.00
 23 T    1,2-Dichloropropane                   0.241   0.232        3.7  100    0.00
 24 T    Bromodichloromethane                  0.361   0.295       18.3   85    0.00
 25 T    Trichloroethene                       0.376   0.310       17.6   87    0.00
 26 T    1,4-Dioxane                           0.211   0.205        2.8  102    0.01
 27 T    cis-1,3-Dichloropropene               0.371   0.345        7.0   96    0.00
 28 T    trans-1,3-Dichloropropene             0.315   0.283       10.2   93    0.00
 29 T    1,1,2-Trichloroethane                 0.229   0.203       11.4   92    0.00
 30 S    Toluene-d8 (SS2)                      0.971   0.997       -2.7  105    0.00
 31 T    Toluene                               1.129   1.046        7.4   95    0.00
 32 T    1,2-Dibromoethane                     0.307   0.265       13.7   90    0.00
 33 T    Tetrachloroethene                     0.427   0.341       20.1   82    0.00

 34 I    Chlorobenzene-d5 (IS3)                1.000   1.000        0.0   93    0.00
 35 T    Chlorobenzene                         5.512   5.217        5.4   89    0.00
 36 T    Ethylbenzene                          7.840   8.211       -4.7   99    0.00
 37 T    m,p-Xylene                            6.155   6.544       -6.3   96    0.00
 38 T    o-Xylene                              6.773   7.042       -4.0   94    0.00
 39 T    1,1,2,2-Tetrachloroethane             3.015   3.106       -3.0   92    0.00
 40 S    Bromofluorobenzene (SS3)              3.891   3.709        4.7   86    0.00
 41 T    1,3-Dichlorobenzene                   4.995   4.587        8.2   84    0.00
 42 T    1,4-Dichlorobenzene                   5.211   4.587       12.0   84    0.00
 43 T    1,2-Dichlorobenzene                   4.856   4.414        9.1   83    0.00
 44 T    1,2,4-Trichlorobenzene                3.710   3.080       17.0   81    0.00
 45 T    Naphthalene                          11.050  10.314        6.7   90    0.00
 46 T    Hexachlorobutadiene                   2.272   1.936       14.8   80    0.00
 ----------------------------------------------------------------------------------

    (#) = Out of Range                  SPCC's out = 0   CCC's out = 0
```

RA 4/6/13

```
                  Evaluate Continuing Calibration Report

  Data File: I:\MS19\DATA\2013_04\08\04081302.D
  Acq On     :  8 Apr 2013   8:06 am                  Operator: WA
  Sample     : 500pg TO-15SIM CCV STD                 Inst     : MS19
  Misc       : S25-03191301/S25-03221308 (4/20)
  ALS Vial   : 15   Sample Multiplier: 1

  Quant Time: Apr 08 08:39:40 2013
  Quant Method : I:\MS19\METHODS\X19032813.M
  Quant Title  : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
  QLast Update : Thu Mar 28 14:08:39 2013
  Response via : Initial Calibration
  DataAcq Meth:TO15SIM2.M


  Min. RRF      :   0.000  Min. Rel. Area :  50%  Max. R.T. Dev  0.33min
  Max. RRF Dev :  30%      Max. Rel. Area : 200%

       Compound                               AvgRF   CCRF      %Dev Area% Dev(min)
  --------------------------------------------------------------------------------

  1 I    Bromochloromethane (IS1)              1.000   1.000       0.0   97   0.00
  2 T    Dichlorodifluoromethane (CF           2.566   2.104      18.0   79   0.04
  3 T    Chloromethane                         0.445   0.473      -6.3  105   0.04
  4 T    Vinyl Chloride                        1.479   1.552      -4.9  104   0.03
  5 T    Bromomethane                          0.859   0.887      -3.3  104   0.03
  6 T    Chloroethane                          0.618   0.708     -14.6  117   0.03
  7 T    Acetone                               0.457   0.639     -39.8# 124   0.00
  8 T    Trichlorofluoromethane                1.962   1.684      14.2   84   0.01
  9 T    1,1-Dichloroethene                    1.124   1.067       5.1   94   0.00
 10 T    Methylene Chloride                    1.245   1.151       7.6   92   0.00
 11 T    Trichlorotrifluoroethane              1.275   1.086      14.8   85   0.00
 12 T    trans-1,2-Dichloroethene              1.286   1.202       6.5   93   0.00
 13 T    1,1-Dichloroethane                    1.800   1.697       5.7   92   0.00
 14 T    Methyl tert-Butyl Ether               2.871   2.903      -1.1  103   0.02
 15 T    cis-1,2-Dichloroethene                1.297   1.227       5.4   93   0.00
 16 T    Chloroform                            2.008   1.751      12.8   85   0.00
 17 S    1,2-Dichloroethane-d4 (SS1)           1.245   1.127       9.5   87   0.00
 18 T    1,2-Dichloroethane                    1.506   1.208      19.8   79   0.00
 19 T    1,1,1-Trichloroethane                 1.948   1.613      17.2   82   0.00
 20 T    Benzene                               4.106   4.108      -0.0   96   0.00
 21 T    Carbon Tetrachloride                  1.549   1.284      17.1   80   0.00

 22 I    1,4-Difluorobenzene (IS2)             1.000   1.000       0.0  101   0.00
 23 T    1,2-Dichloropropane                   0.241   0.232       3.7  101   0.00
 24 T    Bromodichloromethane                  0.361   0.297      17.7   85   0.00
 25 T    Trichloroethene                       0.376   0.314      16.5   88   0.00
 26 T    1,4-Dioxane                           0.211   0.205       2.8  102   0.01
 27 T    cis-1,3-Dichloropropene               0.371   0.352       5.1   98   0.00
 28 T    trans-1,3-Dichloropropene             0.315   0.288       8.6   95   0.00
 29 T    1,1,2-Trichloroethane                 0.229   0.204      10.9   92   0.00
 30 S    Toluene-d8 (SS2)                      0.971   0.992      -2.2  104   0.00
 31 T    Toluene                               1.129   1.058       6.3   96   0.00
 32 T    1,2-Dibromoethane                     0.307   0.269      12.4   91   0.00
 33 T    Tetrachloroethene                     0.427   0.352      17.6   84   0.00

 34 I    Chlorobenzene-d5 (IS3)                1.000   1.000       0.0   89   0.00
 35 T    Chlorobenzene                         5.512   5.508       0.1   90   0.00
 36 T    Ethylbenzene                          7.840   8.638     -10.2  100   0.00
 37 T    m,p-Xylene                            6.155   6.871     -11.6   97   0.00
 38 T    o-Xylene                              6.773   7.384      -9.0   95   0.00
 39 T    1,1,2,2-Tetrachloroethane             3.015   3.231      -7.2   92   0.00
 40 S    Bromofluorobenzene (SS3)              3.891   3.706       4.8   83   0.00
 41 T    1,3-Dichlorobenzene                   4.995   4.741       5.1   83   0.00
 42 T    1,4-Dichlorobenzene                   5.211   4.777       8.3   84   0.00
 43 T    1,2-Dichlorobenzene                   4.856   4.606       5.1   83   0.00
 44 T    1,2,4-Trichlorobenzene                3.710   3.239      12.7   82   0.00
 45 T    Naphthalene                          11.050  10.656       3.6   89   0.00
 46 T    Hexachlorobutadiene                   2.272   2.050       9.8   81   0.00
 --------------------------------------------------------------------------------

    (#) = Out of Range                  SPCC's out = 0  CCC's out = 0

X19032813.M Mon Apr 08 12:46:01 2013                                     Page: 1
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4/8/13

Radon Analysis (EPA Method GS: Grab Sample/Scintillation Cell counting)

For GSI

Client Project Number: 3585/3669

Samples Collected by: Lila Beckley
Site: ESTCP VI Study, Raritan NJ

Sample Dates: 3/28/13
Sample containers: Tedlar bags
Assumed Site Pressure 1.00 atm
based on an elevation of 125 ft
Time Zone adjustment: add to decay time
3 hours
Collect (EDT)
Run (PDT)

Analysts: Doug Hammond
Phone: 310-490-7896
email: dhammond@usc.edu

	Summary	Collection		Analysis					Lab Duplicates		
		Date	time (EDT)	Date	time (PDT)	Vol run (cc)	Conc. pCi/L	±1 sig pCi/L	mean pCi/L	±1ssd pCi/L	Notes
Received 3/29/13											
1	CP4-AA-BL	3/28/13	8:50	3/29/13	13:10	120	0.03	0.02	0.08	0.07	
	lab dupe	3/28/13	8:50	3/29/13	13:15	60	0.13	0.04			
2	CP4-IA-5-BL	3/28/13	8:45	3/29/13	13:19	120	0.23	0.02			
3	CP4-IA-5-NP	3/28/13	11:05	3/29/13	13:24	65	0.11	0.03			
4	DUP-1	3/28/13	11:05	3/29/13	13:30	120	0.15	0.02			

Uncertainty given in pCi/liter is based on counting statistics for low activity samples. For high activity samples uncertainty is ±5%.
The Lower Limit of Detection for Rn (95% confidence level as recommended by EPA 402-R-95-012, Oct. 97) is 0.14 pCi/liter.
Results are reported based on standardization with NIST-traceable radon sources.
These results are for application of naturally-occurring radon as a tracer of soil vapor intrusion, but are not intended for evaluation of radon hazards.

Results corrected to in situ pressure as noted above

Raw Data, Calculation factors, and Analytical Details

	Sample ID	Collection Date	Time (EDT)	Analysis Date	Time (PDT)	Count in cell/ch	He eff	Air/He eff	Vol run (cc)	Press factor	obs dpm	sig dpm	Decay T (hours)	Decay factor	Concentration dpm/liter	pCi/liter	count stats pCi/liter ±1 sig	Notes
Received 3/29/13																		
1	CP4-AA-BL	3/28/13	8:50	3/29/13	13:10	82/32	0.743	0.95	120	1.00	0.01	0.00	31.3	1.267	0.07	0.03	0.02	
	lab dupe	3/28/13	8:50	3/29/13	13:15	76/22	0.912	0.98	60	1.00	0.01	0.00	31.4	1.268	0.28	0.13	0.04	
2	CP4-IA-5-BL	3/28/13	8:45	3/29/13	13:19	81/31	0.818	0.95	120	1.00	0.04	0.00	31.6	1.269	0.50	0.23	0.02	
3	CP4-IA-5-NP	3/28/13	11:05	3/29/13	13:24	84/11	0.785	0.98	65	1.00	0.01	0.00	29.3	1.248	0.25	0.11	0.03	
4	DUP-1	3/28/13	11:05	3/29/13	13:30	83/11	0.806	0.95	120	1.00	0.03	0.00	29.4	1.249	0.34	0.15	0.02	

Decay correctiions based on Rn decay constant of 0.1813 per day
Conversion from dpm based on 0.4504 pCi/dpm
Blanks are negligible.

Radon Conc = {(0.4504)(1000)(obs dpm)(decay factor)(Press factor)}/{(cc used)(He eff)(Air/He)}
(in pCi/liter)

Definitions:

Cell/ch:	Counting cell and channel used	sig dpm	uncertainty (± 1 sig) in dpm based on counting statistics
He eff:	Cell and counter efficiency using helium matrix	Decay T:	time elapsed from sampling to analysis
Air/He:	Correction for matrix counting gas density	Decay factor:	Correction factor for decay from collection to analysis
Sample vol:	Volume analyzed (cc)	dpm/liter:	Radon concentration in disintigrations per minute per liter of sample
Press factor:	Correction to in situ pressure based on collection altitude	piC/liter:	Radon concentration in picoCuries per liter
obs dpm:	observed radon activity (disintigrations per minute) when analyzed	count stats:	uncertainty in observed radon based on counting statistics

Columbia Analytical Services INC

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Radon

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No.

CAS Contact:

Company Name & Address (Reporting Information)
GSI Environmental
2211 Norfolk
Houston TX 77098

Project Name: ESTCP VI Study - Raritan, NJ

Project Number: 3585/3669

Project Manager: Lila Beckley

P.O. # / Billing Information

Phone: 713 367 4775

Fax

Email Address for Result Reporting: lmbeckley@gsi-net.com

Sampler (Print & Sign): TEM

Analysis Method

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Radon	Rn Rec'd	Comments e.g. Actual Preservative or specific instructions
CP4-AA-BL		3/28/13	0850					1L	✓	✓	750mL in 1L
CP4-IA-5BL		3/28/13	0845							✓	Tedlar
CP4-IA-5NP		3/28/13	1105							✓	Low Volume?
DUP-1		3/28/13	1105							✓	

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required Yes / No
Type: ____

Project Requirements (MRLs, QAPP)

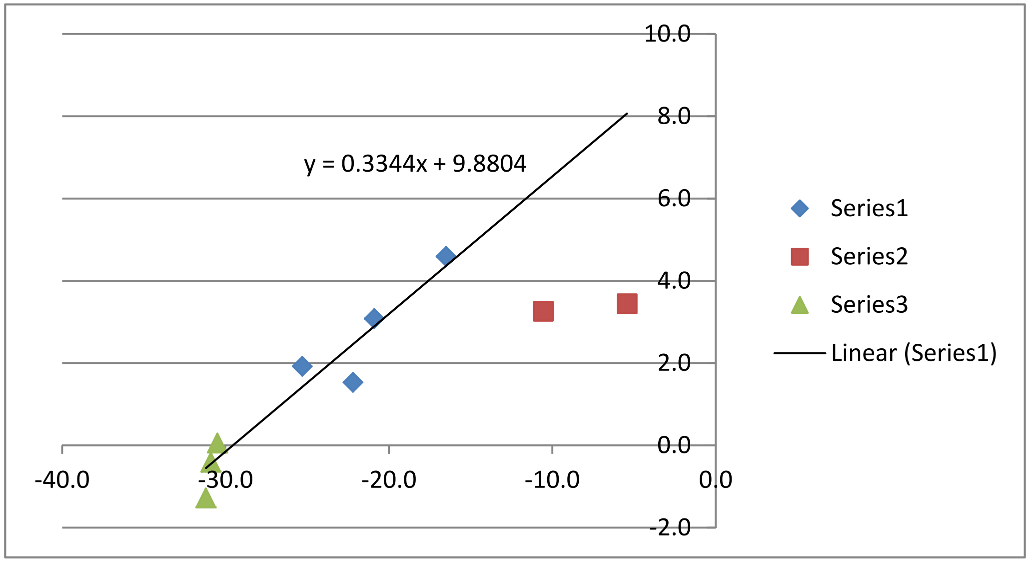
Relinquished by: (Signature) Beckley
Date: 3/28/13 Time: 1330
Received by: (Signature) Douglas E.
Date: 3/29/13 Time: 1300

Relinquished by: (Signature)
Date: Time:
Received by: (Signature)
Date: Time:

Cooler / Blank Temperature ____ °C

Received by GSI, 3 May 2013
Results of FRAS samples:

SAMPLE ID	**C**	**Cl**		
209-SG-09	-10.6		3.3	
CP4-IA-3	-31.2			-1.3
CP4-IA-4	-30.9			-0.4
CP4-IA-4B	-30.5			0.1
CP4-SG-6	-5.4		3.4	
MW-136	-22.2	1.5		
MW-139	-16.5	4.6		
MW-156	-25.3	1.9		
MW-CP-IV-1	-20.9	3.1		



Received by GSI, 3 May 2013
Results of FRAS samples:

Notes

correction [X] accounts for the method bias, based on the external standard runs, see QAQC data

"corrected δ=δ+X" should be used to compare data from the present sampling event with those from past or future sampling event

date analyzed

RUN #	SAMPLE ID	AIRTUBE #	TCE del VPDB
9452	209-SG-09	C16_M17715	-10.7
9476	209-SG-09	C16_J03132	-10.4
9446	CP4-IA-3	C16_M16576	-31.1
9456	CP4-IA-3	C16_M17718	-31.3
9447	CP4-IA-4	C16_M17824	-30.9
9448	CP4-IA-4B	C16_M17859	-30.5
9449	CP4-SG-6	C16_M17758	-5.7
9461	CP4-SG-6	C16_M17824	-5.8
9474	CP4-SG-6	C16_M17758	-5.3
9475	CP4-SG-6	C16_J05145	-4.9
9444	TCE standard	C16_K08421	-30.0
9445	TCE standard	C16_J03696	-30.0
9450	TCE standard	C16_M16542	-30.1
9451	TCE standard	C16_M17687	-30.1
9454	TCE standard	C16_M17787	-30.3
9473	TCE standard	C16_M17715	-30.0
9477	TCE standard	C16_J07064	-29.7
9478	TCE standard	C16_M17821	-30.2

AVERAGES

SAMPLE ID	TCE del VPDB	stdev
209-SG-09	-10.6	0.2
CP4-IA-3	-31.2	0.1
CP4-IA-4	-30.9	
CP4-IA-4B	-30.5	
CP4-SG-6	-5.4	0.4
MW-136	-22.2	
MW-139	-16.5	0.4
MW-156	-25.3	0.0
MW-CP-IV-1	-20.9	

RUN #	SAMPLE ID	volume (ul)	TCE del VPDB
9467	MW-136	12000	-22.2
9465	MW-139	3000	-16.8
9470	MW-139	3000	-16.2
9469	MW-156	450	-25.3
9471	MW-156	450	-25.3
9468	MW-CP-IV-1	25000	-20.9
9462	TCE standard	3	-29.9
9463	TCE standard	3	-30.1
9466	TCE standard	3	-30.3
9472	TCE standard	3	-30.1

Received by GSI, 3 May 2013
Results of FRAS samples:

Notes

correction [X] accounts for the method bias, based on the external standard runs, see QAQC data
"corrected δ=δ+X" should be used to compare data from the present sampling event with those from past or future sampling events
date analyzed

RUN #	SAMPLE ID	AIRTUBE	TCE del SMOC
3389	209-SG-09	C16_M17789	3.3
3385	CP4-IA-3	C16_M17784	-1.6
3394	CP4-IA-3	C16_M17825	-0.9
3387	CP4-IA-4	C16_J03738	-0.4
3386	CP4-IA-4B	C16_M17817	-0.2
3395	CP4-IA-4B	C16_M17687	0.3
3382	CP4-SG-6	C16_M17820	3.4

AVERAGES

SAMPLE ID	TCE del SMOC	stdev
209-SG-09	3.3	
CP4-IA-3	-1.3	0.5
CP4-IA-4	-0.4	
CP4-IA-4B	0.1	0.4
CP4-SG-6	3.4	
MW-136	1.5	0.2
MW-139	4.6	0.1
MW-156	1.9	0.1
MW-CP-IV-1	3.1	

RUN #	SAMPLE ID	AIRTUBE	TCE del SMOC
3379	TCE standard	C16_K08421	2.7
3380	TCE standard	C16_M17787	3.2
3381	TCE standard	C16_J03146	3.2
3384	TCE standard	C16_M17857	3.2
3388	TCE standard	C16_M17722	3.4
3390	TCE standard	C16_J06979	3.3
3391	TCE standard	C16_M17758	3.6
3392	TCE standard	C16_J03116	3.6
3393	TCE standard	C16_K08440	3.5
		average	3.3
		stdev	0.2
		off-line δ37Cl of the stand.	3.3
		correction (x)	0.0

RUN #	SAMPLE ID	volume (ul)	TCE del SMOC
3361	MW-136	5000	1.7
3366	MW-136	4250	1.4
3360	MW-139	1850	4.6
3365	MW-139	1900	4.6
3353	MW-156	180	1.8
3359	MW-156	240	2.0
3362	MW-CP-IV-1	20500	3.1

RUN #	SAMPLE ID	TCE del SMOC
3350	TCE standard	3.6
3354	TCE standard	3.2
3355	TCE standard	3.0
3363	TCE standard	3.0
3364	TCE standard	3.9
3367	TCE standard	3.2
average		3.3
stdev		0.3
off-line δ37Cl of the stand.		3.3
correction (x)		0.0

Supplemental CSIA Results

RUN #	SAMPLE ID	TUBE #	date analyzed	bzn (ng)	tce (ng)	pce (ng)
3244	BLANK CLEANED TUBE			0.4	0.0	0.0
3245	BLANK CLEANED TUBE			0.3	0.0	0.0
3246	BLANK CLEANED TUBE			0.3	0.0	0.0
3247	BLANK CLEANED TUBE			0.4	0.0	0.0
3252	613 TRIP BLANK	C16_K08449	Jan-10-2013	0.2	0.0	0.0
3257	613 TRIP BLANK	C16_K08458	Jan-11-2013	0.2	0.0	0.0
3251	631 TRIP BLANK	C16_J03703	Jan-10-2013	0.4	0.1	0.0
3255	631 TRIP BLANK	C16_K08451	Jan-11-2013	1.2	0.2	0.2
3256	631 TRIP BLANK	C16_J03115	Jan-11-2013	0.4	0.0	0.0
3309	677 TRIP BLANK	C16_M16542	Mar-22-2013	0.3	0.0	0.0
3311	677 TRIP BLANK	C16_M17854	Mar-22-2013	0.2	0.0	0.0
3398	687 TRIP BLANK	C16_K08451	Apr-15-2013	0.1	0.1	0.0
3401	687 TRIP BLANK	C16_M17860	Apr-15-2013	0.4	1.3	0.1
3402	687 TRIP BLANK	C16_M16587	Apr-15-2013	0.2	0.2	0.0

OU #712
ER-201025, city gas samples

analyses completed:
C CSIA -- 5/23/2013

Run #	Sample ID	volume (ml)	Split X	benzene δ13C
9577	Houston Natural Gas	2	1 : 9	-22.3
9578	Houston Natural Gas	2	1 : 4	-22.2
9580	Houston Natural Gas	2	1 : 3	-22.2
9583	Austin Natural Gas	2	splitless	-22.2
9584	Austin Natural Gas	2	splitless	-21.8

Sample ID	benzene δ13C	stdev
Houston Natural Gas	-22.2	0.1
Austin Natural Gas	-22.0	0.3

Run #	Sample ID	Split X	benzene δ13C
9575	BZ standard	splitless	-28.1
9576	BZ standard	splitless	-28.0
9581	BZ standard	splitless	-28.1
9582	BZ standard	splitless	-27.9

average	-28.025
stdev	0.1
off-line δ13C of the stand.	-28.1
correction (x)	-0.1

OU project #712a
Cleint: GSI, Project ER-201025
Two samples in Summa canisters
Analyzed August 21-22, 2013

Run #	**Sample ID**	**δ2H**
7868	Austin Nat. Gas; 25 ML	-84
7870	Houston Nat. Gas; 20 ML	-80
7871	Houston Nat. Gas; 6 ML	-75
7865	standard	-79
7866	standard	-78
7867	standard	-68
7869	standard	-70
7873	standard	-78
	average	-75
	stdev	5
	off-line δ of the standard	-75

Appendix E: Recommended Protocol

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs

CSIA PROTOCOL FOR VAPOR INTRUSION INVESTIGATIONS

Use of Compound-Specific Stable Isotope Analysis to Distinguish Between Vapor Intrusion and Indoor Sources of VOCs

ESTCP Project ER-201025

Version 1
June 2013

Lila Beckley and Thomas McHugh,
GSI Environmental Inc.

Tomasz Kuder and R. Paul Philp,
School Geology and Geophysics, University of Oklahoma

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TABLES

FIGURES

LIST OF ACRONYMS

‰	Per mil (parts per thousand)
1,1-DCE	1,1-Dichloroethene
1,1,1-TCA	1,1,1-Trichloroethane
1,2-DCA (EDC)	1,2-Dichloroethane (Ethylene Dichloride)
AFB	Air Force Base
bgs	Below ground surface
cis-1,2-DCE	cis-1,2-Dichloroethene
COC	Constituent of concern
CSIA	Compound-Specific Stable Isotope Analysis
DoD	U.S. Department of Defense
δ	Delta, an Isotope Ratio Measure
ft	Feet, foot
GC/MS	Gas Chromatograph/Mass Spectrometer
K	thousand
MTBE	Methyl tert butyl ether
N/A	Not applicable
PCE	Tetrachloroethene
SMOC	Standard Mean Ocean Chloride
TAGA	Trace Atmospheric Gas Analyzer
TCE	Trichloroethene
USEPA	U.S. Environmental Protection Agency
V-PDB	Vienna - Pee Dee Belemnite
V-SMOW	Vienna – Standard Mean Ocean Water
VI	Vapor Intrusion
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

Compound-specific stable isotope analysis (CSIA) can be used as a building-specific vapor intrusion investigation tool to augment data from other investigation methods. The primary utility is to provide an independent line of evidence to distinguish between vapor intrusion and indoor sources of VOCs.

This CSIA protocol is not a standalone investigation approach. It involves collection of subsurface source (i.e., groundwater) and indoor air samples. Concentrations of target VOCs from these media must be known or estimated to develop CSIA sampling parameters (e.g., sample collection time).

This document i) describes the applicability of CSIA for vapor intrusion investigations (Section 2.0), ii) provides a step-by-step procedure for sample collection (Section 3.0), and iii) includes guidelines for data interpretation (Section 4.0). Additional background information on this investigation approach is available in the ESTCP Project ER-201025 Final Report (GSI, 2013a).

2.0 APPLICABILITY

2.1 Technology Background

Many elements, such as carbon, occur as different isotope species, differing in their number of neutrons present in the nucleus. For example, ^{12}C, with 6 neutrons, is the most abundant form of carbon. ^{13}C, with 7 neutrons, makes up a small fraction (~1%) of the carbon in the environment. Isotopic ratios (^{13}C/^{12}C) of a specific compound (e.g., TCE) can vary as a result of differences in their source material or compound synthesis or due to transformation in the environment (USEPA, 2008). Differences in the isotopic ratio measured in organic contaminants present in environmental samples can be used to i) distinguish between different sources of the contaminants and ii) understand biodegradation and other transformation processes occurring in the environment.

CSIA measures the carbon, chlorine, and/or hydrogen isotope ratios for individual chemicals. The results, however, are not reported as direct ratios of the isotopes. In order to ensure inter-laboratory comparability and accuracy, the ratios are expressed relative to an international standard (typically V-PDB for carbon, SMOC for chlorine, and V-SMOW for hydrogen). Measured values are compared to the standard and reported as δ^{13}C, δ^{37}Cl, and δ^{2}H. Results are typically reported in parts per thousand (“per mil” [‰]).

As discussed in Section 3.4, groundwater samples are collected in standard VOA vials. Vapor samples are collected on sorbent tubes (Section 3.5) or in Summa canisters. In an evaluation of commercially-available sorbents, Carboxen 1016 was found to perform best under different sampling conditions (GSI, 2012). The validated sampling conditions are summarized in Table 1.

Table 1: Sampling Conditions for Fractionation-Free Performance with Carboxen 1016

Parameter	Validated Range
Target VOCs/isotopes	benzene (C, H), TCE (C, Cl), PCE (C, Cl)
Sample Volume	≤100 L[1]
Sample Collection Rate	≤100 mL/min
Relative Humidity (at 23°C)	10 % - 90 %
Target VOC mass: benzene	30 to 900 ng[2]
Target VOC mass: TCE, PCE	100 to 2250 ng
Non-target VOC mass	0 to 800 ug
Sample Holding Time (at 4˚C)[3]	Up to 4 weeks[3]
Sample Holding Time (at -10˚C)[3]	Up to 24 weeks[3]

[1] Laboratory study showed an absence of fractionation for sample volumes up to 200L. However, a 100L sample volume limit is recommended as a conservative measure to ensure an absence of fractionation; [2] A higher minimum sample mass of 1000 ng is required to measure the hydrogen isotope ratio for benzene. Performance for up to 5000 ng was validated; [3] Storage of samples at room temperature is not recommended. Refrigerated tubes can be stored for at least 4 weeks prior to analysis (Klisch et al., 2012). It is recommended that tubes be frozen for holding time longer than 4 weeks, and analyzed within 6 months of collection (see GSI, 2013).

The methodology for determination of isotope ratios in VOCs present in air/vapor involves i) recovery and preconcentration of the target volatiles from air/vapor by sample processing by standard methods such as those described in USEPA Methods TO-15 or TO-17 (USEPA 1999a; USEPA 1999b); and ii) analysis of the collected samples for their isotope ratios, using CSIA adapted from the protocols used for analysis of the same VOCs present in groundwater samples (USEPA, 2008).

2.2 Application to Vapor Intrusion

Various processes can change the isotope ratios of a compound (so-called isotope fractionation). Molecular bonds containing the lighter isotopes are broken at slightly faster rates than those containing the heavier isotopes. As a result, the isotopic ratio for a compound can change over time as the compound is biodegraded in the subsurface. The parent compound (e.g., TCE) becomes relatively enriched in heavy isotopes (i.e., less negative $\delta^{13}C$ and $\delta^{37}Cl$ values), while transformation products (e.g., cis-1,2-DCE) end up with less of the heavy isotopes (i.e., more negative $\delta^{13}C$ and $\delta^{37}Cl$ values). While physical processes such as evaporation and sorption can also cause fractionation at contaminated sites, these processes are often too subtle to have a measurable effect on isotope ratios, except for hydrogen.

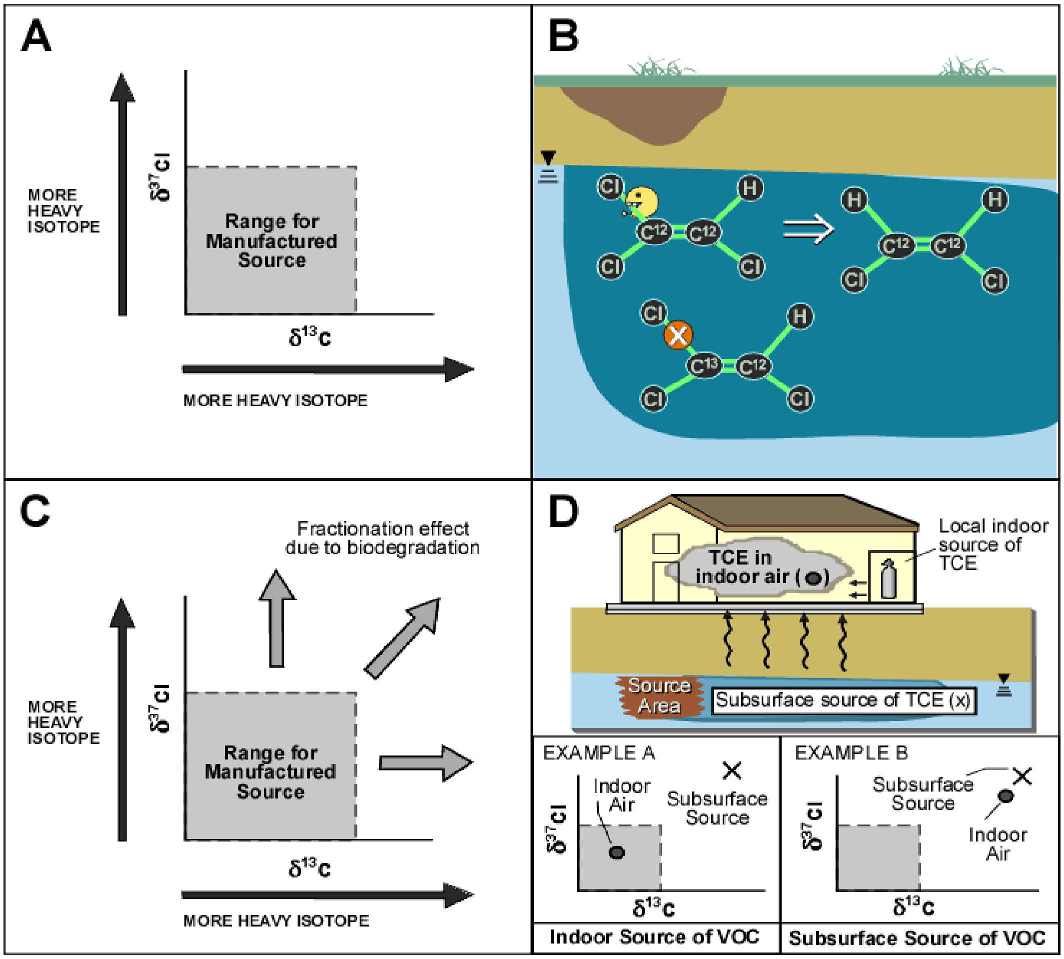
The CSIA approach involves i) determination of stable isotope ratios of the target VOCs present in the air ($^{13}C/^{12}C$, $^{37}Cl/^{35}Cl$ for PCE and TCE; $^{13}C/^{12}C$ and $^{2}H/^{1}H$ in the case of benzene) and ii) use of those ratios to differentiate between VOCs sourced from the subsurface (true vapor intrusion) and those sourced from miscellaneous household products. The conceptual basis for application of CSIA to vapor intrusion follows:

1. Isotope ratios for VOCs originating from different manufactured sources have isotope ratios within a defined range (Figure 1, Panel A). This range is small compared to the range of isotope ratios created by isotope fractionation effects that occur in the subsurface.
2. VOCs originating from subsurface sources commonly undergo biodegradation in groundwater and later in the unsaturated soil prior to entering indoor air. Individual

molecules that contain the lighter isotopes are often preferentially biodegraded, resulting in enrichment of the heavier isotope species in the undegraded residue (Figure 1, Panel B). This enrichment process is known as isotope fractionation.

3. The consequence of isotope fractionation is that isotope composition of VOCs originating from the subsurface is often clearly different than that of pristine (undegraded) manufactured products acting as indoor sources of the same VOCs (Figure 1, Panel C).
4. This difference allows the successful differentiation between VOCs from indoor sources and those from true vapor intrusion sources (Figure 1, Panel D).

Figure 1: Conceptual Basis for Application of CSIA to Vapor Intrusion



Interpretation of the origin of VOCs in indoor air based on CSIA results is relatively straightforward in comparison to traditional vapor intrusion investigation methods. The isotope ratios from VOCs in indoor air are directly compared to those from the subsurface source (groundwater) and those measured in a variety of available consumer products. Isotope ratios dissimilar from the subsurface source but similar to the values characteristic of, for example, TCE present in household products is a strong indication that the latter are responsible for the indoor air contamination (see Figure 1, Panel D, Example A). On the other hand, the isotope ratios of TCE in indoor air can be similar to the subsurface sources and different from indoor sources, confirming the impact of vapor intrusion (Figure 1, Panel D, Example B).

2.3 Building-Specific Applicability

Building-specific investigations of vapor intrusion are typically required when VOCs have been detected above applicable screening concentrations within 30 to 100 feet of the buildings and the results of subsurface testing (i.e., groundwater or soil gas) indicate a potential vapor intrusion concern (USEPA, 2002; ITRC, 2007).

When a building-specific investigation is required, the CSIA investigation procedure is broadly applicable to a wide variety of building types and COCs. The investigation procedure will be most commonly applied in conjunction with other investigation methods. Specific considerations for the selection of this investigation procedure are discussed below.

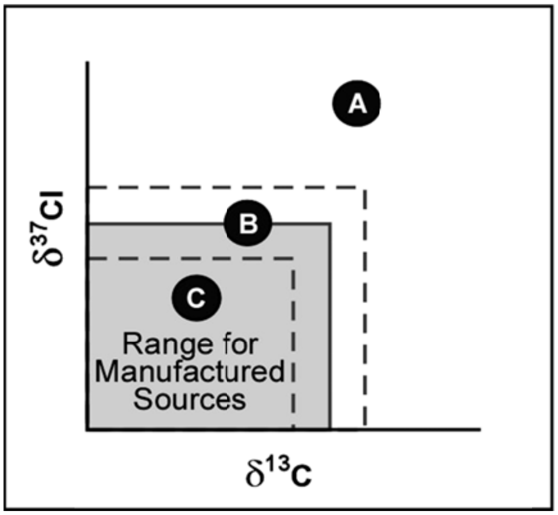
2.3.1 Isotope Fingerprint of Subsurface Source

The CSIA procedure relies on differences in the isotope signature between the subsurface VOC source and potential indoor VOC sources in order to determine the origin of VOCs detected in indoor air. As a result, the method is most likely to provide clear results if the isotope fingerprint for the subsurface source is outside the range for potential indoor sources (see Figure 2 “A”). The method may also yield useful supporting evidence if the isotope ratios for the subsurface source are close to the heavy end of the indoor source range (see Figure 2 “B”). In this situation, an indoor air sample with isotope ratios that closely match the subsurface source would provide supporting evidence of vapor intrusion, but this result, alone, would not be definitive because of the potential contribution from indoor sources.

Biodegradation of VOCs in the subsurface commonly results in an isotope fractionation effect. Therefore, sites with evidence of biodegradation (e.g., detection of daughter products) are more likely to have subsurface sources with isotope signatures that are distinct from potential indoor sources. 50% biodegradation of TCE should commonly be sufficient for the subsurface source to be distinct from the range of indoor sources. However, for benzene, up to 90% biodegradation could be required and for PCE, more than 90% biodegradation could be required at some sites (GSI, 2012).

The isotope signature of the subsurface source should be measured <u>before large scale application of the CSIA procedure</u> at a site. Based on the results of initial isotope fingerprinting, the applicability of CSIA at the site for the evaluation of vapor intrusion should be determined as illustrated in Figure 2. The isotope signature of the subsurface source can be measured prior to the collection of any indoor air samples or in conjunction with the initial sampling of one or two buildings.

Figure 2: Site-Specific Applicability of CSIA for Vapor Intrusion Based on Isotope Ratios of Subsurface Source



Note: A) Isotope ratios for subsurface source are outside range for potential indoor sources, CSIA likely to provide strong evidence; B) Isotope ratios for subsurface source are near heavy end of range for potential indoor sources, CSIA may provide supporting evidence; C) Isotope ratios for subsurface source are within the range for potential indoor sources, CSIA unlikely to distinguish between indoor and subsurface sources.

2.3.2 Building-Specific Considerations

The application of CSIA to vapor intrusion requires the collection of at least one indoor air sample and at least one subsurface (i.e., groundwater) sample. As discussed in Section 3, the subsurface sample should be collected near the target building. Site-specific factors should also be considered when selecting sample locations. For example, collection of the indoor air sample can take up to 24 hours, depending on the concentration of the target VOC in indoor air. The CSIA procedure is applicable to any type of building provided that access can be obtained for placement and retrieval of the sample pumps.

2.3.3 Vapor Intrusion COCs

Accurate measurement of carbon or chlorine isotope ratios requires approximately 100 ng of the target chlorinated VOC. For a target petroleum VOC (i.e., benzene), the accurate measurement of carbon isotope ratios requires approximately 50 ng; accurate measurement of the hydrogen isotope ratio requires approximately 1000 ng. The required sample volume is equal to the required mass divided by the concentration in the source medium. For sample volumes of greater than 3L, use of an adsorbent tube and sample pump (per USEPA method TO-17) is the most practical sample collection method. The adsorbent tube sampling method has been validated for PCE, TCE, and benzene (Kuder et al., 2012). For other target VOCs, additional laboratory validation would be required to ensure that the sample collection method does not introduce a confounding fractionation effect. Recommended laboratory validation analyses are provided in Kuder et al., 2012.

2.4 Use of CSIA with Other Investigation Approaches

The CSIA procedure will most commonly be used in conjunction with other investigation methods such as conventional Summa canister sampling or on-site GC/MS analysis (GSI, 2013b). The CSIA procedure may be used i) as a supplemental tool during an **initial investigation** at buildings without prior vapor intrusion testing (provided that, at a minimum, screening-quality data are available to estimate target VOC concentrations) or ii) at buildings where preliminary testing of indoor air has identified VOC concentrations near or above regulatory screening values, and there is some **uncertainty concerning the source of the VOCs**.

3.0 INVESTIGATION PROTOCOL FOR APPLICATION OF CSIA TO VAPOR INTRUSION

3.1 PRE-SAMPLING ACTIVITIES

CSIA will most commonly be conducted as part of a larger vapor intrusion sampling program. As a result, the pre-sampling activities discussed here focus only on the additional planning steps required for the collection of samples for CSIA. Basic activities such as obtaining building access are not covered.

Pre-sampling, preparatory activities include:

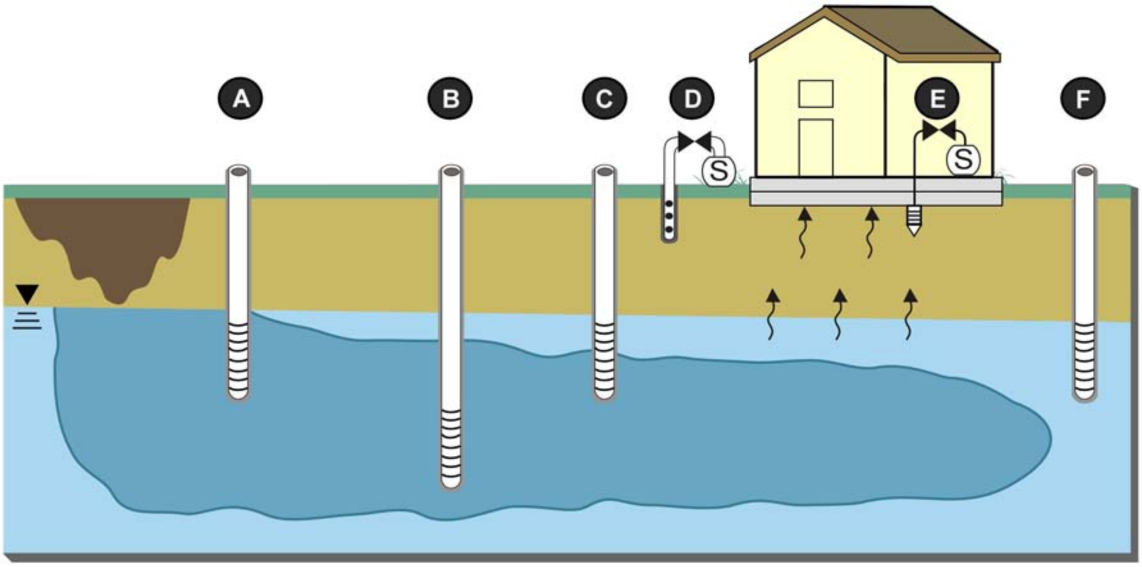
1. **Identify Specific Structures for Sampling**: Select specific structures to be included in the CSIA program. If prior sampling results are available, this would include buildings with VOCs in indoor air near or above screening levels for which the source is uncertain. If no prior sampling results are available, then this may include all buildings with VI concerns or only the highest priority buildings.
2. **Determine Target VOCs**: Identify the VOCs for CSIA. The target VOCs should be the one to two vapor intrusion COCs of greatest concern based on consideration of subsurface concentrations, indoor air screening concentrations, and potential for indoor sources. The sorbent sample collection method has been validated for PCE, TCE, and benzene. Additional validation would be required for application of this sample collection method to other VOCs.
3. **Estimate Target VOC Concentrations**: The collection of indoor air samples for CSIA requires an estimate of the concentration of the target VOC at the sample point in order to determine the proper sample volume. VOC concentrations may be estimated based on results from previous sampling events. Uncertainty is accounted for by collecting additional sample mass (see Section 3.5.2 and 3.5.5). Groundwater concentrations must be estimated as well. Use of historic data is typically sufficient for this purpose.
4. **Necessary Equipment**: The collection of low concentration vapor samples for CSIA requires use of sorbent tubes and pumps as described in USEPA Method TO-17 (USEPA, 1999b). Higher concentration samples can be collected using a Summa canister (see Section 5.5). If water samples will be collected to characterize the subsurface source, then appropriate equipment will be required.

3.2 SUBSURFACE SAMPLING LOCATIONS

Groundwater samples are recommended for characterization of isotope ratios in the subsurface source. Results obtained during demonstration of the protocol indicate that isotope ratios in soil gas are more variable and, in some cases, less representative of vapors potentially entering the building. When possible, the groundwater sample should be collected in close proximity to the building of concern. If monitoring wells are not available close to the building, upgradient (not downgradient) wells should be selected for sampling (see Figure 3).

Although soil gas samples are less useful than groundwater samples for comparison to indoor air, measurement of isotope ratios in soil gas may provide insights into biodegradation processes occurring in the vadose zone (McHugh et al., 2011a).

Figure 3: Advantages and Disadvantages of Sample Locations for Characterization of the Subsurface VOC Isotope Signature



Location	Advantages	Disadvantages
A) Upgradient Groundwater Well (Screened at water table)	• Water sample easier to collect than soil gas sample. • Easiest sample point if this is the closest existing well to target building.	• Does not account for any additional enrichment that occurs closer to building both within the saturated zone and within the vadose zone.
B) Deep Groundwater Well	• Not recommended	• High uncertainty. Isotope ratios may not be representative of VOCs at top of water table.
C) Groundwater Well Close to Target Building (Screened at water table)	• Water sample easier to collect than soil gas sample. • This water sample will be most representative of VOCs potentially entering building.	• Does not account for any additional enrichment that occurs within vadose zone.
D) Soil Gas Sample from Close to Building	• Not recommended for primary characterization of subsurface source.	• More difficult to collect than water sample.
E) Sub-slab Soil Gas Sample	• Not recommended for primary characterization of subsurface source.	• May contain VOCs originating from within building. • Sample collection can be a lengthy process, depending on concentration.
F) Downgradient Groundwater Well	• Not recommended	• May be more enriched in heavy isotopes than VOCs entering building. • Could yield false positive results.

Note: 1) Recommendation based on current understanding of spatial variability in vadose zone.

3.3 INDOOR AIR SAMPLING LOCATIONS

For most buildings, indoor air can be characterized through the collection and analysis of a single indoor air sample from the area of the building most likely to be impacted by vapor intrusion (e.g., the lowest level of multi-level building). For larger buildings where the air may not be well mixed (e.g., buildings with multiple air handling systems), one sample from each area may be warranted. If indoor sources are considered to be more likely within specific portions of the building (e.g., the garage), then an additional sample may be collected from this area.

3.4 COLLECTION OF WATER SAMPLES

Water samples for CSIA can be collected using the same sampling procedures used to collect samples to measure VOC concentrations (e.g., in accordance with USEPA, 1996 or ASTM, 2002 for low flow sample collection). Two 40 mL volatile organic analysis (VOA) vials should be collected for analysis of each specific isotope ratio. For example, the analysis of carbon and chlorine isotope of PCE and TCE would require a total of eight 40 mL VOA vials (2 vials x 2 sets of ratios (carbon and chlorine) x 2 compounds (PCE and TCE)). Samples for the analysis of carbon or hydrogen isotopes should be preserved using hydrochloric acid. Samples for the analysis of chlorine isotopes should be preserved using sulfuric acid. Samples should be refrigerated for shipping and stored at 4ºC prior to analysis.

3.5 COLLECTION OF VAPOR SAMPLES

Vapor samples for CSIA can be collected using Summa canisters or sorbent tubes. The appropriate sample method is determined based on the sample volume required.

3.5.1 Required Minimum Sample Volumes

The sample volume is determined by the minimum mass required for analysis and the sample concentration. The minimum mass required for analysis is provided in Table 2 (Kuder et al., 2012).

Table 2: Minimum Mass Required for a Single Isotope Analysis

Target VOC	Isotope	Minimum Mass Required for Analysis
PCE or TCE	Carbon	100 ng
PCE or TCE	Chlorine	100 ng
Benzene	Carbon	50 ng
Benzene	Hydrogen	1000 ng (1)

1) In most cases, it will be impractical to collect enough sample volume to measure the hydrogen isotope ratio in indoor air.

The minimum sample volume is calculated using Equation 1:

Equation 1:

$$\text{Sample Volume (L)} = \text{Minimum Mass (ng)} / \text{Sample Concentration (ug/m}^3\text{)} \times 1\ (\text{L} - \text{ug})/(\text{m}^3 - \text{ng})$$

Where:
Sample Volume = Minimum sample volume for CSIA (L)
Minimum Mass = Minimum sample mass for CSIA (ng, see Table 2)
Sample Concentration = Estimated or measured concentration of target VOC in sample (ug/m^3)
1 (L – ug)/(m^3 – ng) = Units conversion factor. 1 ug/m^3 = 1 ng/L

3.5.2 Estimation of Sample Point Concentrations

Because CSIA requires a minimum sample mass, the sample point concentration must be estimated to determine the required sample volume. The sample point concentration may be estimated based on on-site analysis conducted on the same day as the CSIA sampling, analysis conducted prior the CSIA sampling, or based on information other than a direct measurement of the target VOC concentration at the sample point. The uncertainty associated with the estimate will depend on the estimation method (see Table 3).

Table 3: Example Uncertainty Associated with Concentration Estimation Methods

Estimation Method	Example Uncertainty
On-site Concentration Measurement on the Day of CSIA Sample Collection	< 2x
Concentration Measurement on a Prior Day	2 – 4 x
Other Estimation Method	> 5 – 10 x

When calculating the minimum sample volume using Equation 1, the uncertainty in the estimated sample point concentration should be considered in order to ensure that adequate sample mass is collected.

3.5.3 Recommended Samplers for Vapor Samples

The recommended sampler is based on the minimum sample volume as shown in Table 4.

Table 4: Recommended Samplers for Vapor Samples for CSIA

Minimum Sample Volume	Recommended Sampler
≤250 mL	1L Summa
≤1.5 L	6L Summa
> 1.5 L	Sorbent Tube

A Summa canister larger than the minimum sample volume (i.e., a 6L Summa for a 1.5L minimum sample volume) is recommended because many laboratories cannot extract the full sample volume from the Summa canister. In addition, it is common practice to provide enough sample for at least two analyses. It is possible to use Summa canisters for somewhat higher minimum sample volumes by collecting two or more Summa canisters for each sample. Summa canisters are recommended for smaller sample volumes because they are easier to use than sorbent tubes. However, sorbent tubes may also be used for lower volume samples. For example, if sorbent tubes are being used at a site to collect samples requiring larger volumes, then the investigator may choose to also collect the lower volume samples using sorbent tubes (i.e., rather than using Summa canisters for some samples and sorbent tubes for others).

3.5.4 Collection of Samples Using Summa Canisters

When using a Summa canister to collect a vapor sample for CSIA, the sample can be collected as grab samples (i.e., without use of a flow controller). Otherwise, the sample collection should be conducted in accordance with typical guidance on the collection of Summa canister samples for measurement of VOC concentration (e.g., NDEP, 2001 or similar procedures available from analytical laboratory). Summa canister samples should be stored at room temperature prior to analysis.

3.5.5 Collection of Samples Using Sorbent Tubes

When using a sorbent tube to collect a vapor sample for CSIA, the sample should be collected in accordance with the procedures for the use of active sorbent samplers for measurement of VOC concentrations (e.g., USEPA, 1999b). A minimum of two sorbent tubes should be collected for each isotope analysis. However, as shown in Table 5, additional sorbent tubes are recommended for samples with higher uncertainty in the estimated sample concentration.

Table 5: Recommended Number of Sorbent Tubes for Each Isotope Analysis per Single COC and Single Isotope Ratio

Uncertainty in Estimated Concentration	Recommended Number of Sorbent Tubes
<2x	Two tubes each with a target mass of 2 times the minimum required mass.[2]
2 – 4 x	Two tubes each with a target mass of 2 times the minimum required mass AND two tubes each with a target mass of 4 times the minimum required mass.[3]
> 4 x	Three tubes each with a target mass of 3 times the minimum required mass AND two tubes each with a target mass of 10 times the minimum required mass.[4]

Note: 1) Table provides the recommended number of tubes for each isotope analysis for each target VOC (e.g., carbon isotopes in TCE). An equal number of additional tubes is required for each additional isotope or target VOC. 2) Example: If target VOC is TCE and target isotope is carbon, then collect two tubes, each having 200 ng of sample (i.e., 100 ng x 2). 3) Example: If target VOC is TCE and target isotope is carbon, then collect four tubes total: two tubes, each having 200 ng of sample, plus two tubes, each having 400 ng of sample. 4) Example: If target VOC is TCE and target isotope is carbon, then collect 5 tubes total: three tubes, each having 300 ng of sample, plus two tubes, each having 1000 ng of sample.

The recommendations provided in Table 5 are intended to provide the greatest likelihood that reliable CSIA results will be obtained from each sample. If the actual VOC mass collected on the sample tube is close to (i.e., within 50%) the target mass and no analytical difficulties are encountered, than an accurate result can be obtained from a single tube. The collection of additional tubes is recommended to account for variations in the actual sample mass and analytical difficulties that occasionally result in sample loss. The typical analytical costs (Section 3.7, Table 6) are per sample (i.e., the cost covers the analysis of one or more tubes, as needed to obtain an accurate result). However, the laboratory requires an estimated mass of target analyte on each sample tube. When the sample mass cannot be estimated within 4x, an additional fee may apply to cover the cost of additional testing required to determine the sample mass.

The maximum sample volume of the sorbent tubes is 100L (in order to ensure that sample collection does not introduce an isotope fractionation effect). As a result, for samples with low estimated concentrations of the target VOC (or with high mass requirements [e.g., hydrogen isotope from benzene]), it may not be possible to collect sample tubes with target masses greater than the minimum required sample mass. A sampling plan for sample points with low estimated concentrations of the target VOC should be developed in coordination with the laboratory (see Section 3.7).

Sorbent tube samples should be refrigerated during shipping and stored at 4ºC (or frozen) prior to analysis.

3.6 SAMPLE SHIPMENT AND ANALYSIS

Water and vapor samples should be stored and shipped in accordance with manufacturer and laboratory guidelines. Samples collected in sorbent tubes should be stored at 4ºC and shipped to the laboratory ([University of Oklahoma]; see contact information in Section 3.7). Water samples and gas samples collected in Summa canisters can be analyzed at the University of Oklahoma or at another qualified isotope laboratory.

3.7 ANALYTICAL LABORATORIES AND COST

Although a number of commercial laboratories provide isotope analysis for water sample or air samples, at present, the University of Oklahoma service laboratory is the only laboratory that can measure compound-specific isotope ratios of VOCs on adsorbent tube samples. Analytical costs are summarized in Table 6.

Table 6: Analytical Costs for CSIA

Analyte	Carbon	Chlorine	Hydrogen
Adsorbent Tube Samples			
PCE/TCE	$400/sample	$400/sample	$350/sample (TCE)
Benzene	$350/sample	N/A	$350/sample
Water Samples			
PCE/TCE	$350/sample	$400/sample	$350/sample (TCE)
Benzene	$350/sample	N/A	$350/sample

Note: Laboratory requires estimated mass or concentration of target analyte in sample. An additional fee may apply if this information is not provided.

Information on the University of Oklahoma service laboratory can be obtained from:

University of Oklahoma, Geology Department
100 E. Boyd St; Room A710
Norman OK 73019
Attn: Dr. Paul Philp

Email:
pphilp@ou.edu Dr. Paul Philp
tkuder@ou.edu Dr. Tomasz Kuder

Phone:
405-325-4469 (Dr. Paul Philp)
405-325-4453 (CSIA laboratory)
405-325-3253 (OU Geology Department, Front Desk)

4.0 DATA INTERPRETATION

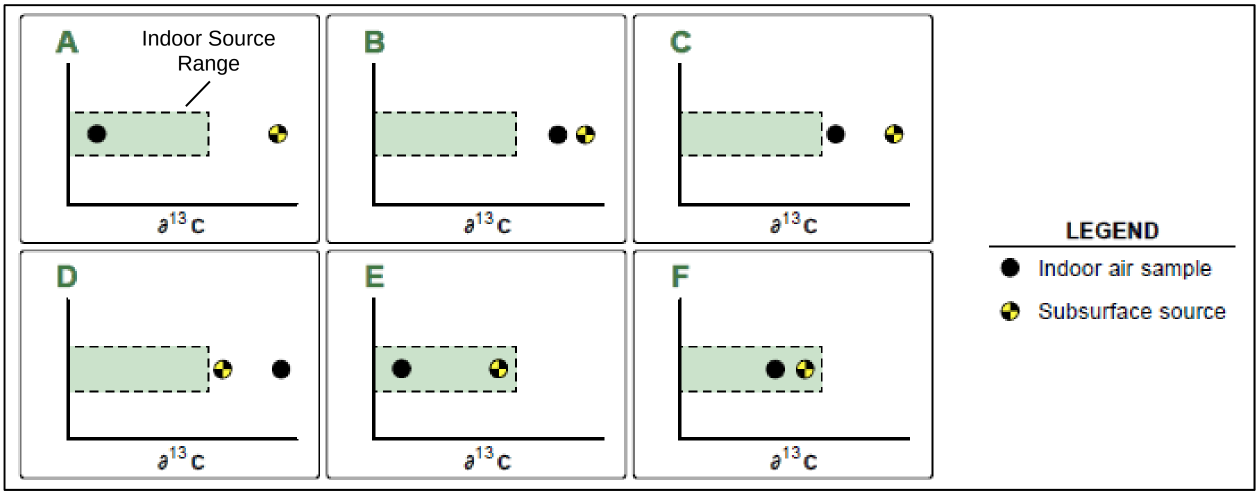
The measured isotope ratios for the subsurface samples and for indoor air can be used to determine the likely source of the target VOC in indoor air, based on i) the similarity of the subsurface and indoor air results, and ii) comparison to isotopic signatures of indoor sources (e.g., manufactured products). The range of likely isotope ratios for indoor sources (Table 7) was determined through literature reviews and laboratory analysis of common consumer products (McHugh et al., 2011b, GSI, 2012).

Table 7: Likely Range of Isotope Ratios for Indoor Sources of PCE, TCE, and Benzene

	Likely Range	
VOC	**Carbon Isotope Ratio (‰)**	**Chlorine Isotope Ratio (‰)**
PCE	-37.4 to -24.0	-4.4 to 1.0
TCE	-34.0 to -23.0	-3.2 to 4.7
VOC	**Carbon Isotope Ratio (‰)**	**Hydrogen Isotope Ratio (‰)**
Benzene	-31.5 to -23.5	-82 to -37

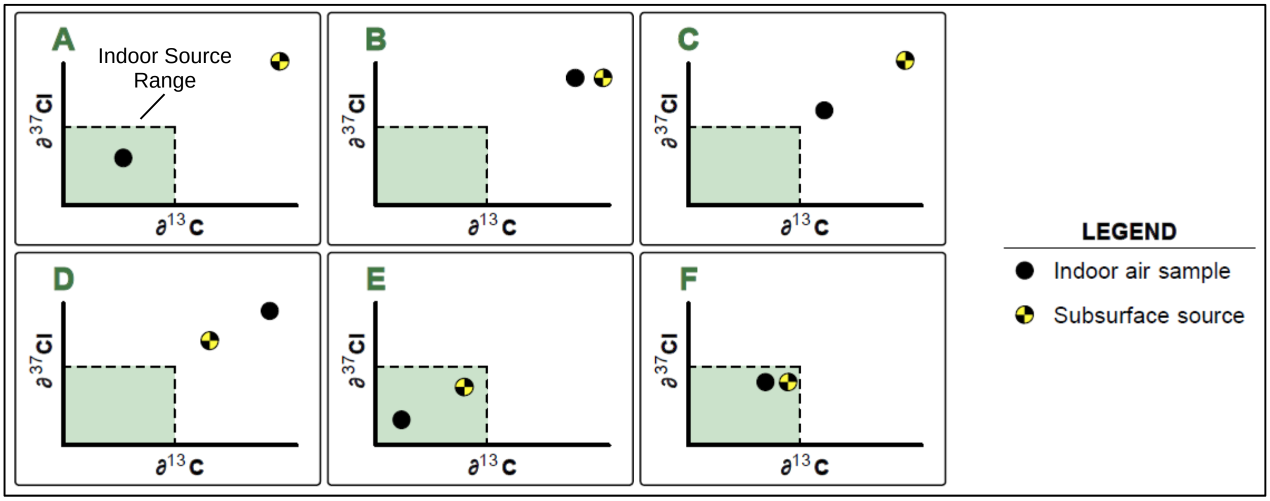
Potential results and interpretations based on a single isotope are illustrated in Figure 4.

Figure 4: Interpretation of CSIA Results for Single Isotope



If two isotope ratios are analyzed, the data interpretation is as follows (Figure 5):

Figure 5: Interpretation of CSIA Results for Two Isotopes



For both Figures 4 and 5, data interpretation is based on pattern-matching as follows:

A) Strong evidence that an indoor source is the primary source of VOCs in indoor air;
B) Strong evidence that the subsurface source is the primary source of VOCs in indoor air;
C) Evidence of mixed subsurface and indoor air sources;
D) Evidence that the subsurface source is the primary source of VOCs in indoor air, additional enrichment in the heavy isotopes is likely occurring between the subsurface measurement point and the target building;
E) Supporting evidence that an indoor source is the primary source of VOCs in indoor air; and
F) Supporting evidence that the subsurface source is the primary source of VOCs in indoor air. However, results are also potentially consistent with an indoor source, so the results should be interpreted within the context of other lines of evidence.

In addition, the strength of the overall conclusion should be weighted based on i) the number of samples used to characterize the indoor air and subsurface source (i.e., groundwater) and ii) the consistency of the results with other lines of evidence. Although one subsurface sample may be sufficient to characterize the isotope ratios for subsurface sources of VOCs, additional samples can strengthen the interpretation of the results by characterizing the variability in the subsurface source and thereby reducing the uncertainty concerning the apparent similarities or differences between the subsurface source and indoor air samples. Similarly, multiple indoor air samples can serve to characterize variability and reduce uncertainty.

In cases where the CSIA results identify an indoor source as the primary source of the VOC in indoor air, it is still possible that vapor intrusion may be a secondary source. In this situation, the indoor source may be found, removed, and the building retested to confirm that vapor intrusion is not a secondary source. Retesting, however, may not be needed if, for example i) the indoor air concentration is below or only slightly above the regulatory standard, ii) the indoor source cannot be removed without disrupting building operations, or iii) all parties involved are satisfied with the existing results.

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