DRAFT

Air Monitoring Work Plan
Frontier Fertilizer Superfund Site

Prepared for

United States Environmental Protection Agency

Region 9
75 Hawthorne Street
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December 2010

Submitted by:

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U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IX

Plan Title:	Air Monitoring Work Plan Frontier Fertilizer Superfund Site
Site Name:	Frontier Fertilizer NPL
Site Location:	3901 2nd St
City/State/Zip:	Davis, California 95618
Site EPA ID#:	CAD071530380
Anticipated Sampling Dates:	January 2011–June 2012
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Acronyms and Abbreviations

°C	degree(s) Celsius
µg/m^3	microgram(s) per cubic meter
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
COPC	chemical of potential concern
DBCP	1,2-dibromo-3-chloropropane
DCP	1,2-dichloropropane
DQO	data quality objective
DVE	dual-phase vacuum extraction
EDB	1,2-dibromoethane
EPA	U.S. Environmental Protection Agency
ERH	electrical resistive heating
GAC	granular activated carbon
HSP	health and safety plan
IDW	investigation-derived waste
ISTT	in situ thermal treatment
L	liter(s)
mL	milliliter(s)
MTBE	methyl tert-butyl ether
NPL	National Priorities List
OSHA	U.S. Occupational Safety and Health Administration
PEL	permissible exposure limit
PPE	personal protective equipment
ppmv	part(s) per million by volume
QA/QC	quality assurance/quality control

QAPP	quality assurance project plan
RA	remedial action
RAL	residential action level
RAMP	remedial action management plan
ROD	record of decision
RSCC	Regional Sample Control and Coordination
RSL	EPA Regional Screening Level
SAP	sampling and analysis plan
SGEW	soil gas extraction well
SGMW	soil gas monitoring well
SVE	soil-gas vacuum extraction
TCP	1,2,3-trichloropropane
UHP	ultra-high purity
VEU	vacuum extraction unit
VEW	vapor extraction well
VMP	vacuum monitoring point
VMW	vacuum monitoring well
VOC	volatile organic compound

SECTION 1

Introduction

This Air/Gas Monitoring Work Plan was prepared to coordinate and guide implementation of the quality assurance (QA) activities intended to monitor compliance with gas-phase emission control system performance limits during in-situ thermal treatment (ISTT). Gas-phase emission limits are established to be protective of offsite public health, including adjacent residential neighborhood. The ISTT element of the remedial action (RA) is designed to treat volatile chemicals of concern (COC) present in the Frontier Fertilizer Superfund Site (the Site) pesticide source zone by increasing the temperature of the source zone media, including soil and groundwater. The ISTT process increases the rate that the COCs degrade and the rate the COCs transition from a liquid to gas phase (volatilization). Volatilization results in a potential for exposure to COCs or related ISTT byproducts by inhalation; therefore, implementation of emission control measures are required. Emission controls include installation and operation of soil gas collection and treatment as part of the ISTT system.

This Air/Gas Monitoring Work Plan provides comprehensive guidance for ambient air monitoring during the planning and implementation of the ISTT portion of the RA. This work plan presents the data quality objectives (DQOs), methods and protocols, and QA requirements to be applied during the ISTT RA air/gas sampling and analysis program.

The Remedial Action Management Plan (RAMP) includes several documents to guide implementation of ISTT, including gas emission control system operation, maintenance activities, and performance monitoring. This Air/Gas Monitoring Work Plan, which is part of the RAMP, defines the activities intended to validate that RAMP activities are effective.

The RA at the Frontier Fertilizer National Priorities List (NPL) Site (Site) is being conducted by the U.S. Environmental Protection Agency (EPA), with support from CH2M HILL. Operation and maintenance of the ISTT is being performed by a specialty vendor.

1.1 Work Plan Structure

This work plan delineates planned air monitoring activities associated with the ISTT and is organized into the following sections:

- Section 1: Introduction
- Section 2: Background
- Section 3: Data Quality Objectives
- Section 4: Sampling Rationale
- Section 5: Request for Analyses
- Section 6: Field Methods and Procedures
- Section 7: Disposal of Investigation-derived Waste
- Section 8: Sample Documentation and Shipment
- Section 9: Quality Control

- Section 10: Data Validation and Usability
- Section 11: References
- Appendix A: Field Data Sheets
- Appendix B: Standard Operating Procedures
- Appendix C: Analytes, Reporting Limits, Precision Goals, and Accuracy Goals
- Appendix D: Example Tracking Reports/Chain-of-Custody

1.2 Project Roles and Responsibilities

Sampling, analysis, data collection and processing will be performed by a team experienced in collecting and processing of gas-phase samples and respective data. The key program personnel are listed in Table 1-1.

TABLE 1-1
Project Roles and Responsibilities
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Name	Role	Duties	Qualifications
Paul Seday	Project Manager	Provides project oversight. Makes the final decision on project plans. Ensures that technical, financial, and scheduling objectives are met.	Extensive knowledge of Site conditions, ISTT activities, and safety procedures.
Matt Marlatt	Task Manager and Site Safety Coordinator/ Field Team Leader	Coordinates field efforts. Provides and maintains sampling equipment and materials, and shipping and packing material. Develops and implements the project Health and Safety Plan (HSP). Assists in conducting Site briefings and performs all final safety checks. Implements the required field QA/QC measures. Ensures that the sampling team follows approved policies and field procedures.	Extensive knowledge of Site and safety procedures. Experienced in the collection, packaging, and shipping of ambient air samples.
Ben Thompson	Project Chemist/Technical Lead	Provides oversight for all technical chemistry issues relating to data quality, laboratory performance, and sampling. Provides oversight as needed related to technical issues.	Extensive experience in analytical and sampling methodology, specifically regarding ambient air samples.

TABLE 1-1
Project Roles and Responsibilities
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Name	Role	Duties	Qualifications
Artemis Antipas	Quality Assurance	Provides oversight for QA procedures, data and QC review.	Coordinates the technical planning through the DQO process. Oversees and helps develop the technical planning documents (QAPP/SAP) and oversees the data generation process from planning through the field to the lab and then to end users. Audits labs and field, oversees data validation and data management, and provides support as needed to data end users.
TBD	Database Manager	Loads data received from labs into database. Generates reports and data queries to support project needs.	
TBD	Field Technician(s)	Collects samples. Cleans and maintains equipment.	

SECTION 2

Background

2.1 Site Description

The Site is in an area zoned for light industrial/business park use in the eastern portion of the City of Davis, California (Figure 2-1). The Frontier Fertilizer Superfund Site occupies approximately 18 acres in the City of Davis, Yolo County, California. The Site includes a triangular-shaped 11.43-acre parcel at 3901 Second Street, Assessor's Parcel Number 071-412-031, owned by Pine Tree Properties and an adjacent 7-acre parcel, which is part of a 10.98-acre parcel, Assessor's Parcel Number 071-411-07, known as the "Remainder Parcel." The National Superfund Database Number (CERCLIS) is #CAD071530380. The geographic coordinates of the Site are 38° 33′ 9.5″ N latitude and 121° 42′ 7.0″ W longitude (Township 8 North, Range 2 East, Section 12, Mt. Diablo Baseline and Meridian, Davis, California, 7.5-minute quadrangle).

The Site and adjacent land is level, with few trees or structures taller than two stories. Approximately 600 feet north of the triangular parcel is residential housing. To the east and west are lots zoned for light industrial use, currently undergoing development. Commercial development of adjacent land to the northeast and northwest of the Site began in the summer of 2008. To the south are 2nd Street, primary east-west railroad tracks, and Interstate 80.

2.2 Operational History

The Site was first developed in the 1950s as an area to store agricultural equipment. The Barber and Rowland Company operated a pesticide and fertilizer distribution facility on the parcel from 1972 to 1982, and the Frontier Fertilizer Company continued operations from 1982 to 1987. Both companies handled chemicals on the western 4 acres of the parcel. Chemical-related operations consisted of storing, mixing, and loading pesticides and fertilizers into mobile tanks for farm application. Used tanks and containers were rinsed prior to reuse. It appears from the quantity of pesticides found that waste chemicals, mainly pesticides and fertilizer tank or container rinsate, were discharged into one or more disposal basins along the northern boundary of the 4 acres. Pesticide handling was discontinued during the 1980s when Yolo County discovered high levels of pesticides in an unlined disposal basin.

The first cleanup activities began at Frontier Fertilizer in 1983, and, in 1994, EPA took over management of the Frontier Fertilizer investigation after Frontier Fertilizer was added to the NPL. Since 1993, granular activated carbon (GAC) has been used to remove the following primary COCs from the extracted groundwater: 1,2-dibromo-3-chloropropane (DBCP); 1,2-dibromoethane (EDB); 1,2-dichloropropane (DCP); and 1,2,3-trichloropropane (TCP).

2.3 Site Remedy

A remedy was selected for the Site following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedy selection process. The remedy is a combination of technologies, with ISTT the principal component for treatment of soil in the pesticide source zone. Additional remedy details can be found in the Record of Decision (ROD) (EPA, 2006a).

Remedy design is scheduled to take place during 2008-2009 and the ISTT portion of the RA will continue through 2010 into 2012.

2.4 Conceptual ISTT Model

The ISTT system will treat contaminated soil by increasing the subsurface temperature to approximately 95 degrees Celsius (^{o}C) in the unsaturated zone and to the boiling point of water in the saturated zone using electrical energy. Electricity energy is applied to the ISTT volume via electrodes that conduct current through the soil. The resistance to current flow through the soil generates heat, resulting in the elevated temperature. Elevated temperatures increase the rate that the COCs degrade and increase the volatilization of COCs from the sorbed and liquid phases. Groundwater and soil gas extraction performed during ISTT will serve to contain mobilized COCs and treatment byproducts that are not degraded in situ and bring them above ground where they are subsequently treated.

Prior to heating, gas-phase emission controls will be installed and tested, including measurement of gas-phase COCs in the emission control system process stream and ambient air. Gas-phase emission control consists of applying a negative pressure to the unsaturated zone through a network of vapor extraction wells to collect soil gas. Extracted soil gas will be conveyed to and processed through GAC to remove contaminants. Once heating is initiated, the pressure will be checked in an array of vapor monitoring wells in and near the ISTT volume, and in conveyance pipes and treatment components to monitor effectiveness of the soil gas emission control system. The concentrations of COCs and byproducts in the collected gas will be measured to evaluate ISTT progress and gas-phase emission control system performance. Ambient air at the Site boundaries will be sampled and analyzed to supplement emission control system monitoring.

2.5 ISTT Safety Measures

Because of the ISTT process characteristics and Site COCs, significant effort is taken to plan for safe implementation of ISTT to protect Site workers and nearby residents. This subsection summarizes the various aspects of the ISTT process implemented to minimize risks presented by ISTT at the Site.

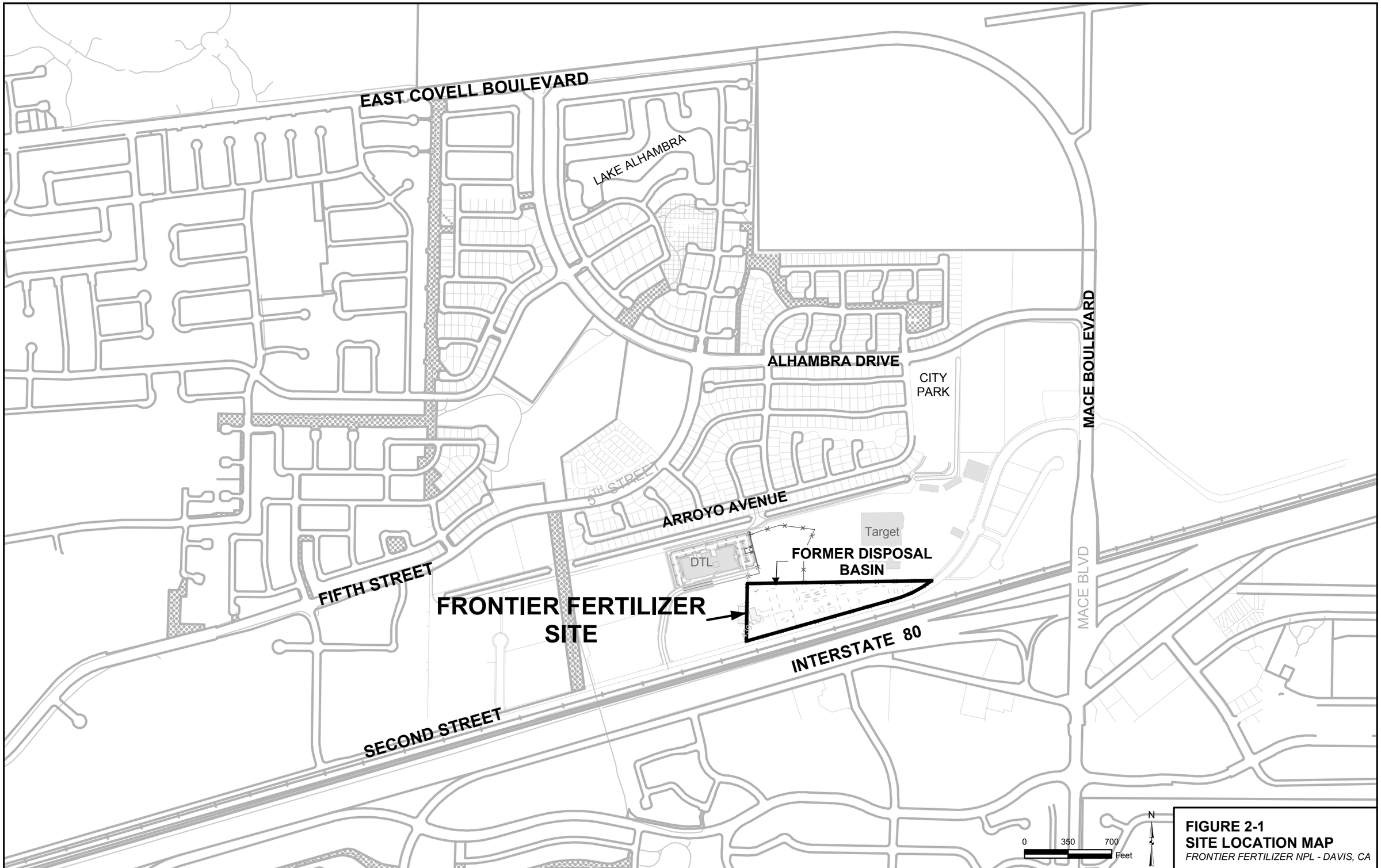

FIGURE 2-1
SITE LOCATION MAP
FRONTIER FERTILIZER NPL - DAVIS, CA

CH2MHILL

\\ZION\SACGIS\SACGIS\FRONTIER\MXD\FIGURE2-1_SITELOCATIONMAP.MXD SSCOPES 3/5/2009 12:08:42

2.5.1 Preparation

The site-specific RAMP is developed by personnel with specific qualifications for planning and implementation of in situ heating systems and with detailed knowledge of site-specific conditions. The RAMP is composed of documents that describe systems and procedures that will protect the community during implementation of in situ heating at the Site. Site-specific characteristics are loaded into a numerical model to develop electrical resistance heating (ERH) system design requirements, which includes minimization of risks and hazards to human health and the environment. Procedures for operating the systems, including monitoring their performance, are delineated in the RAMP documents.

2.5.2 Access Control

A 6-foot-high, 12-gauge chain link fence topped with three strands of barbed wire encircles the treatment area within the existing fenced Site. All manifold lines and electric cable running to the electrodes are completed above grade within the fenced area. Signs indicating dangers will be posted in conspicuous areas for safety concerns. Perimeter sentry motion detectors monitor the Site for unauthorized activity, and when such activity is detected, operations personnel will be immediately notified and security "dusk to dawn" flood lighting mounted on temporary poles will be activated. Security cameras are located at strategic locations at the Site. No unescorted person will be permitted to enter the fenced area unless they read and sign the HSP and have attended the ERH safety training program, which will be conducted onsite prior to startup of the system. Visitors who do not attend the safety training program are not allowed inside the fenced area without an escort. Under no circumstances may anyone other than Current Environmental Solutions (the subcontractor responsible for ISTT system operation) personnel enter the treatment area while the ISTT remedy is in operation.

2.5.3 ISTT System Controls

Numerous and redundant process control interlocks, including both physical and software programmable logic controllers, control energy application to the soil and aboveground process equipment. The sensors continuously monitor component performance and control associated ISTT components and/or notify operations and maintenance personnel of conditions that need attention. The controls include onsite and remote functionality to facilitate continuous monitoring of ISTT performance.

2.5.4 Gas-phase Emission Control

The gas phase, including vapor and steam, emission control includes containment, collection, treatment, and monitoring.

Containment and collection is accomplished by applying a vacuum, negative pressure, throughout the heated volume using the following components:

1. Soil-gas vacuum extraction (SVE) and dual-phase (soil gas and groundwater) vacuum extraction (DVE) wells are installed throughout the heated volume, co-located with each electrode, to apply the vacuum and extract soil gas.

2. The vacuum is applied via a piping manifold to the SVE and DVE wells with a vacuum extraction unit (VEU) consisting of a positive displacement blower. The VEU applies sufficient vacuum throughout the heated volume, gas conveyance plumbing, and treatment components. Maintaining continuous vacuum, maximizes containment and collection of gas-phase emissions, and any leaks in the process components result in fresh air entering the process.
3. A backup VEU is maintained to replace the primary VEU if electrical power service is disrupted or any other situation occurs that reduces effectiveness of the primary VEU.
4. In order to heat up to the ground surface, a cap consisting of a gravel layer overlain with a plastic liner is installed to contain contaminants driven upward by heat and steam. In the other treatment zones, the contamination is deeper, and heating does not start until 25 or 40 feet below ground surface. In these cases, lateral migration to electrodes is typically a much shorter and lesser path of resistance for the volatilized contaminants to take, so a cap is not deemed necessary. Approximately 5,000 square feet of Zones 1 and 2 contain shallow (less than 10 feet) soil contamination that will need to remain hotter to carry contaminants to the cap for collection. This area will be insulated above the gravel and plastic liner and covered with another liner to reduce heat losses in this area. The SVE wells will draw gases from the gravel layer.
5. Performance of the gas-phase emission containment and collection is monitored to effectively manage soil gas emitted from the heated soil. Vacuum levels at SVE and DVE well heads within and above the heated soil and at vacuum monitoring point (VMP) well heads located adjacent to the heated soil are monitored to evaluate and maintain containment and collection effectiveness. Visual inspection of emission containment and collection components and ambient air monitoring are also planned to check performance.

Treatment of collected soil gas includes passing it through gas/liquid separators, then through the condensing unit to cool it, then through GAC vessels. Treatment components and maintenance procedures are specified specially for the application. A 200 percent backup treatment capacity of GAC is online continuously (in series) to maximize treatment of gas-phase emissions.

Samples will be collected from treatment system influent, intermediate, and effluent streams and analyzed by a fixed-based laboratory for COCs and respective treatment byproducts to maintain treatment performance. Monitoring for gas-phase concentrations of total volatile organic hydrocarbons with a photoionization detector is part of the operations and monitoring activities.

SECTION 3

Data Quality Objectives

This section provides DQOs in qualitative and quantitative statements for establishing criteria for data quality and for developing data collection designs. The DQO process is a series of logical steps that facilitates planning for the resource-effective acquisition of environmental data. It is both flexible and iterative, and applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration level of a contaminant). The DQO process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the project. Use of the DQO process leads to efficient and effective expenditure of resources; consensus on the type, quality, and quantity of data needed to meet the project goal; and the full documentation of actions taken during the development of the project.

3.1 Monitoring Quality Objectives

The specific needs for data that will be collected during the RA were examined to ensure that the study characterization and monitoring objectives are optimally achieved. Specific DQOs were considered independently through the DQO process. DQOs are developed in accordance with the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006b).

The QA objective of this plan is to produce data of known and appropriate quality for the needs identified in previous sections. The EPA Region 9 Web site includes EPA Region 9 quality control acceptance criteria, for selected laboratory analytical methods (EPA, 2008). Data quality is assessed by evaluating the qualitative and quantitative data quality indicators: precision, accuracy, representativeness, comparability, and completeness. These data quality indicators are known collectively as the PARCC parameters. The PARCC parameters are defined as follows:

- **Precision** is quantitative measure of the data spread, when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference; a quantitative definition is given in Section 10.3. The level of effort for laboratory precision measurements will be a minimum of 1 sample duplicate per analytical batch and for combined field/laboratory precision, 1 field duplicate sample for every 10 samples.

- **Accuracy** is a quantitative assessment of the closeness of the measured value to the true value. For samples, accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A quantitative definition of average recovery accuracy is given in Section 10.3. Accuracy assessment in terms of laboratory control sample results will be carried out with each analytical batch.

  Representativeness is a measure of how closely the results reflect the actual concentration or distribution of the chemical compounds in the matrix samples. Sampling plan design, sampling techniques, and sample-handing protocols (for

example, for storage, preservation, and transportation) have been developed, and are discussed in subsequent sections of this document. The proposed documentation will establish that protocols have been followed and sample identification and integrity ensured.

- **Comparability** is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using defined procedures and the use of consistent methods and consistent units. Actual detection limits will depend on the sample matrix and will be reported as defined for the specific samples.
- **Completeness** is a measure of the amount of valid data obtained from the analytical measurement system and the complete implementation of defined field procedures. The quantitative definition of completeness is given in Section 10.3. The target completeness objective for chemical measurement data will be 90 percent based on the number of usable results to the total number of results. The project completeness will also be 90 percent but will be based on the total number of usable results for all parameters to the total number of results planned. The actual completeness may vary depending on the intrinsic nature of the samples. The completeness of the data will be assessed formally during final data review and report preparation; however, failure to collect planned data will be monitored throughout the project and corrective actions taken to maintain project completeness as appropriate and practical.
- **Sensitivity** is a measure of certainty with which the presence of a chemical may be identified in a given analytical system. For the chemical tests, sensitivity is established at the 95 percent confidence level by conducting a method detection limit (MDL) study in accordance with 40CFR, Part 136, Appendix B. For chemical tests, the laboratory will report all results below the reporting limit but above the MDL. Results below the reporting limit will be flagged as estimated, J, to indicate the increase in uncertainty as the limit of detection is approached.

The applicable QC procedures, quantitative detection limits, and level of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical methods. Appendix E presents the target analytes, reporting limits, precision goals, and accuracy goals for VOC sampling of water and vapor samples.

3.2 Data Management

Data will be managed in accordance with the Data Management Plan, Appendix A of the Frontier Fertilizer Sample and Analysis Plan (CH2M HILL, 2009).

In addition, data will be made available to FFSOG members by FTP site.

3.3 Data Quality Objective

3.3.1 Step 1 – Problem Statement

Problem:

During remediation activities, there exists the possibility that chemicals (COCs or COPCs) could be released to ambient air. If all containment and control measures were rendered useless and the entire volume were heated at the same time, a "worst-case" scenario could occur. [Note: This is not expected, and numerous safeguards are in place to prevent releases. Nonetheless, EPA plans for a "worst-case" in order to have a plan of action in place to prepare for the unexpected.]

Planning Team Members: Stan Smucker, Bonnie Arthur, Artemis Antipas, Matt Marlatt, Paul Seday

Limitations on Available Resources:

Region 9 laboratory is limited in the number of samples they can process per week (limited to 10/wk).

PE samples may not be readily available (at frequency requested by Oversight Group).

Relevant Deadlines:

Must be ready to collect samples when ISTT system operates.

3.3.2 Step 2 – Decision Statements

Key Questions/Decisions:

Are ambient air concentrations above or below RALs?

Possible Outcomes:

1) **Ambient air concentrations are below or equal to the RALs**.
    a. Continue as planned.
2) **Ambient air concentrations are above the RALs**
    a. At onsite locations.
        i. Evaluate the offsite location concentrations.
    b. At offsite (northern and southern fence line) locations.
        i. Initiate corrective action (Step 5).

3.3.3 Step 3 – Inputs to the Decision

What information is needed to answer question?

- Analytical results for ambient air (from 24-hour ambient air samples) for the Contaminants of Concern (COC) and the Contaminants of Potential Concern (COPC)

- Residential Action Levels
- Wind speed (mph) and direction (16-compass points)
- ISTT System Operations and Monitoring data

Where will the data come from?

- Sample analysis results will come from an offsite laboratory.
- Wind speed (mph) and direction (16-compass points) will come from an onsite weather station.
- ISTT data will come from ISTT operator subcontractor.

What is the action level?

The risk-based concentrations for volatile organic compounds (VOCs) in ambient air are the Residential Action Levels (RALs), which are the Agency for Toxic Substances and Disease Registry (ATSDR) minimum risk levels for short-term exposure, or where ATSDR levels are unavailable, the EPA regional screening levels (RSLs) for chemical contaminants at Superfund sites. The RALs are considered by EPA to be protective for residential exposure. The RALs for COCs (those contaminants that pose the most risk and are the focus of the site remediation) and chemicals of potential concern (COPCs) (those contaminants that are of secondary concern due to their frequency of detection or are potential ISTT byproducts) are listed in Table 3-1.

Are there methods that will meet the needs?

Yes, there are analytical methods that can detect analytes below the RALs. Table 3-1 compares the RALs with conservative TO-15 SIM analytical reporting limits and indicates that the achievable reporting limits for the COCs are lower than the risk-based concentrations. Based on this, ambient air monitoring by itself will be sufficient to determine if the risk-based concentrations are being achieved for all COCs and COPCs.

In order to maintain timely reporting from the laboratory, TO-15 SIM samples will be analyzed at the standard dilution levels, which will quantitatively return results for analytes that are in the range of about one to ten times the laboratory reporting limit. If a COC in Table 3-1 is determined to be outside this quantitative level, the sample will be rerun at a higher dilution to determine the quantitative result. Any COPC that approaches or exceeds its respective RAL during any phase of the treatment process will be brought to the attention of the sample team for further evaluation and follow-up activities.

TABLE 3-1
Ambient Air Analytical Methods, Reporting Limits, and Action Levels
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Chemical	Analytical Method	RALs (µg/m^3)	EPA Region 9 Lab RL (µg/m^3)[a]	RL < RAL
COCs				
DBCP	TO-15 SIM	1.9[c]	0.5[b]	Yes
EDB	TO-15 SIM	0.41[d]	0.38	Yes
DCP	TO-15 SIM	32[c]	0.23	Yes
TCP	TO-15 SIM	1.8[c]	0.3[b]	Yes
COPCs				
Bromoethene (vinyl bromide)	TO-15 SIM	7.6[d]	0.22[b]	Yes
1,2-Dichloroethane	TO-15 SIM	9.4[d]	0.2	Yes
Tetrachloroethene	TO-15 SIM	41[d]	0.34	Yes
Carbon tetrachloride	TO-15 SIM	16[d]	0.31	Yes
Chlorobenzene	TO-15 SIM	52[d]	0.23	Yes
m&p-Xylene	TO-15 SIM	730[d]	0.43	Yes
o-Xylene	TO-15 SIM	730[d]	0.22	Yes
1,1-Dichloroethane	TO-15 SIM	150[d]	0.2	Yes
Toluene	TO-15 SIM	5,200[d]	0.19	Yes
Methyl tert-butyl ether (MTBE)	TO-15 SIM	940[d]	0.18	Yes
Benzene	TO-15 SIM	31[d]	0.16	Yes
Vinyl chloride	TO-15 SIM	16[d]	0.13	Yes
1,3-Dichloropropane	TO-15 SIM	24[d,e]	0.2[b]	Yes
2,3-Dichloropropene	TO-15 SIM	21[d,e]	0.2[b]	Yes

[a]Reporting limits are based on 6-liter (L) SUMMA® canisters and take initial laboratory canister dilution factors into account. The table presents the best achievable reporting limits from the EPA Region 9 Laboratory.

[b]Method development needed to verify these reporting limits.

[c]Source: Minimal Risk Levels for short-term exposures (ATSDR, 2008).

[d]Source: RSLs for contaminants at Superfund sites. The lower of the cancer value (x 100) or non-cancer value is used to set the action level (EPA, 2008).

[e]Surrogate chemical used when no toxicity value available. 1,2-Dichloropropane substituted for 1,3-dichloropropane and 1,3-dichloropropene substituted for 2,3-dichloropropene.

Notes:
µg/m^3 = microgram(s) per cubic meter
RL = reporting limit

3.3.4 Step 4 – Study Boundaries

Spatial:

Breathing zones within and up to the site fence, See Figure 4-1 at the end of Section 4.

Temporal:

Decisions will apply until the next sample event and through cessation of the ISTT system operation.

Potential Obstacles:

Bad Weather may limit the availability to take samples.

3.3.5 Step 5 – Decision Rules

Specify the parameter that characterizes the population of interest:

Individual and monthly average ambient air sample results will characterize the population of interest.

Develop a decision rule:

If the individual results for ambient air concentrations are at or below the RALs then sampling and operations will proceed as planned.

If a concentration in ambient air at any of the onsite sample locations is detected above the RAL, then the following will be performed:

- The laboratory results will be confirmed. This may include such actions as checking the result against a duplicate sample (if one exists), reviewing PE results (if any exist), reviewing laboratory calibration data, and determining if more quantitative results are available.
- The ISTT system monitoring data will be reviewed.
- Evaluation of background data.
- Review of offsite sample analysis results and evaluation of sample locations for appropriateness.

If a concentration in ambient air at any of the offsite sample locations is detected above the RAL, then the following will be performed:

- Same steps as onsite detections above RALs; however, to speed decision making regarding laboratory confirmation, the duplicate samples at least initially will be collected from the fence line (offsite) location to the north.
- Reduce or stop application of energy to the subsurface (reduce contaminant mobilization) and initiate another sample round.
- As appropriate, the EPA will get input from stakeholders, bring out the mobile HAPSITE, and/or increase the sample locations and/or frequencies.

3.3.6 Step 6 – Tolerable Limits on Decision Rules

As sampling design will be per professional judgment rather than statistical, the data quality performance parameters will be analytical precision, accuracy, reproducibility, representativeness. These parameters are described in Section 3.1 and the tolerance limits/ acceptance criteria are described in Appendix C.

3.3.7 Step 7 – Optimization of the Sampling Design

For clarity, the sampling design, which includes the rationale and planned sampling, is presented in Section 4.

SECTION 4

Sampling Rationale

This section describes the rationale behind all ambient air sampling at Frontier Fertilizer. Monitoring during the ISTT project will be performed in five phases:

- Baseline—prior to installation.
- Commissioning—after installation, during emission control system startup testing, but before heating begins.
- Startup—while the soil temperature is increased from ambient to the desired temperature.
- Steady State—after startup while the ISTT temperature is maintained at the desired temperature.
- Shutdown—after ISTT heating and soil gas collection is discontinued.

4.1 Ambient Air

Ambient air sampling is scheduled during the five phases (baseline, commissioning, startup, steady state, and shutdown) of the ISTT project as summarized in Table 4-1. The primary purpose of ambient air sampling is to monitor ambient air VOC concentrations within the Site to monitor the area adjacent to ISTT activities and at the fence line for significant releases.

4.1.1 Sample Locations

Historical meteorological data including wind speed and direction were reviewed to determine appropriate monitoring locations. The predominant wind direction is the south-southeast direction (blowing from). The second most predominant wind direction is from the north and north-northwest (blowing from). To obtain sample data along the predominant wind directions three sample locations were identified (AA-01, AA-02, and AA-03): one to the south-southeast and two to the north-northeast of the ISTT volume. Two additional sample locations (AA-04 and AA-05) were added slightly north of the ISTT volume to account for wind fluctuations and add additional sample locations between the ISTT activities and the adjacent residential neighborhood.

Onsite ambient air stations AA-02, -04, and -05 are installed about 50 ft to the north of the ISTT volume. Their proximity to the ISTT volume will allow them to collect samples prior to dilution that will occur as air travels outward from the activity.

Offsite ambient air stations AA-01and AA-03 will be sampled regularly at first, but as ISTT progresses the number of samples collected per week also increases. To maintain a number of samples that the laboratory can handle efficiently and quickly, AA-01 is dropped from the

sample routing during periods of high sampling; however, depending on results, the actual location that is dropped may be modified.

4.1.2 Sampling Frequencies during the ISTT Stages

Due to power limitations, the ISTT system will heat three contiguous volumes in three sequential stages. The first stage, like all stages, will go from ambient temperatures to about 100 ºC. The predicted rate at which VOC mass is removed is greatest during 70 to 100 ºC. To coincide with the period of greatest mass removal, sampling during 60 to 100 ºC is increased to twice per week during Stage 1. Sampling frequency is increased at 60 ºC, 10 degrees early, as an extra safety factor.

While Stage 1 is heating, Stage 2 will begin heating. After Stages 1 and 2 are treated, treatment of stage 3 will begin. For overlapping stages, whichever Stage has a higher planned sample frequency will dominate the frequency. Planned sample frequencies are in Table 4-1.

4.1.3 Weather Monitoring Data

There is an onsite weather monitoring station to the east of the ISTT volume mounted 2 meters off the ground. The station is a Davis Instruments Vantage Pro2 that is capable of monitoring Wind speed (mph) and direction (16-compass points). The information is logged and downloaded to computer regularly.

Weather data from the nearby meteorological station at the University of California, Davis (California Air Resources Board # 57577) will be used as a backup to the onsite weather station to confirm onsite wind speed and direction during sample events.

An effort will be made to collect ambient air samples during worst-case ambient air conditions. Worst-case ambient conditions are expected to occur during periods of stagnant air, low wind speeds to the north, and/or or an atmospheric inversion. The National Weather Service 7-day forecast (http://www.nws.noaa.gov/) will be used to plan that samples are collected when worst-case conditions are anticipated.

TABLE 4-1
ISTT Ambient Air Sample Summary
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Phase	Location	Frequency	Duration[a]	Samples per Event	Total Samples	Analyte and Analytical Method
Baseline	Three ambient air locations around the Site (AA-01, -02, -03) and a duplicate sample at a random location (which is not included in total samples quantity)	Three events, staggered by approximately 12 days	Approximately 36 days, to evaluate weekend, weekday, and weather condition variations	3	9	VOCs by TO-15 SIM
Commissioning	Five ambient air locations around the Site(AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event after installation is completed and before heating begins	1 day during system commissioning	5	5	VOCs by TO-15 SIM
ISTT Stage 1 Startup (from ambient temperature to 60 °C)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event per week; if results are detected above the RAL frequency will increase to two events per week until two weeks of sampling indicate detections below RALs	Approximately 28 days (4 weeks)	5	20	VOCs by TO-15 SIM
ISTT Stage 1 Startup (from 60 °C to steady state temperature)	Four ambient air locations around the Site (AA-02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	Two event per week; if results are detected above the RAL frequency will increase to three events per week until two weeks of sampling indicate detections below RALs	Approximately 49 days (7 weeks)	4	56	VOCs by TO-15 SIM

TABLE 4-1
ISTT Ambient Air Sample Summary
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Phase	Location	Frequency	Duration[a]	Samples per Event	Total Samples	Analyte and Analytical Method
ISTT Stage 1 Steady State (soil at constant temperature)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event every other week; if results are detected above the RAL frequency will increase to two events per week until two weeks of sampling indicate detections below RALs	Approximately 126 days for steady state operation (18 weeks)	5	45	VOCs by TO-15 SIM
ISTT Stage 2 Startup (from ambient temperature to 100 °C)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event per week; if results are detected above the RAL frequency will increase to two events per week until two weeks of sampling indicate detections below RALs	Approximately 77 days (11 weeks)	5	55	VOCs by TO-15 SIM
ISTT Stage 2 Steady State (soil at constant temperature)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event every other week; if results are detected above the RAL frequency will increase to two events per week until two weeks of sampling indicate detections below RALs	Approximately 126 days for steady state operation (18 weeks)	5	45	VOCs by TO-15 SIM
ISTT Stage 3 Startup (from ambient temperature to 100 °C)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event per week; if results are detected above the RAL frequency will increase to two events per week until two weeks of sampling indicate detections below RALs	Approximately 77 days (11 weeks)	5	55	VOCs by TO-15 SIM

TABLE 4-1
ISTT Ambient Air Sample Summary
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Phase	Location	Frequency	Duration[a]	Samples per Event	Total Samples	Analyte and Analytical Method
ISTT Stage 3 Steady State (soil at constant temperature)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event every other week; if results are detected above the RAL frequency will increase to two events per week until two weeks of sampling indicate detections below RALs	Approximately 126 days for steady state operation (18 weeks)	5	45	VOCs by TO-15 SIM
Shutdown (post–soil gas extraction)	Five ambient air locations around the Site (AA-01, -02, -03, -04, -05) and a duplicate sample at a random location (which is not included in total samples quantity)	One event two days after soil gas extraction is ceased and treated soil is still at elevated temperatures. Detections above the RALs will restart the soil gas extraction	One day	5	5	VOCs by TO-15 SIM
				Total, excluding QA/QC samples:	**340**	
				Total, including QA/QC samples:	**412**	

[a]Durations and number of samples are subject to change.

[b]The need for ambient air sampling following ISTT system shutdown will be reconsidered based on the results obtained during ISTT operation.

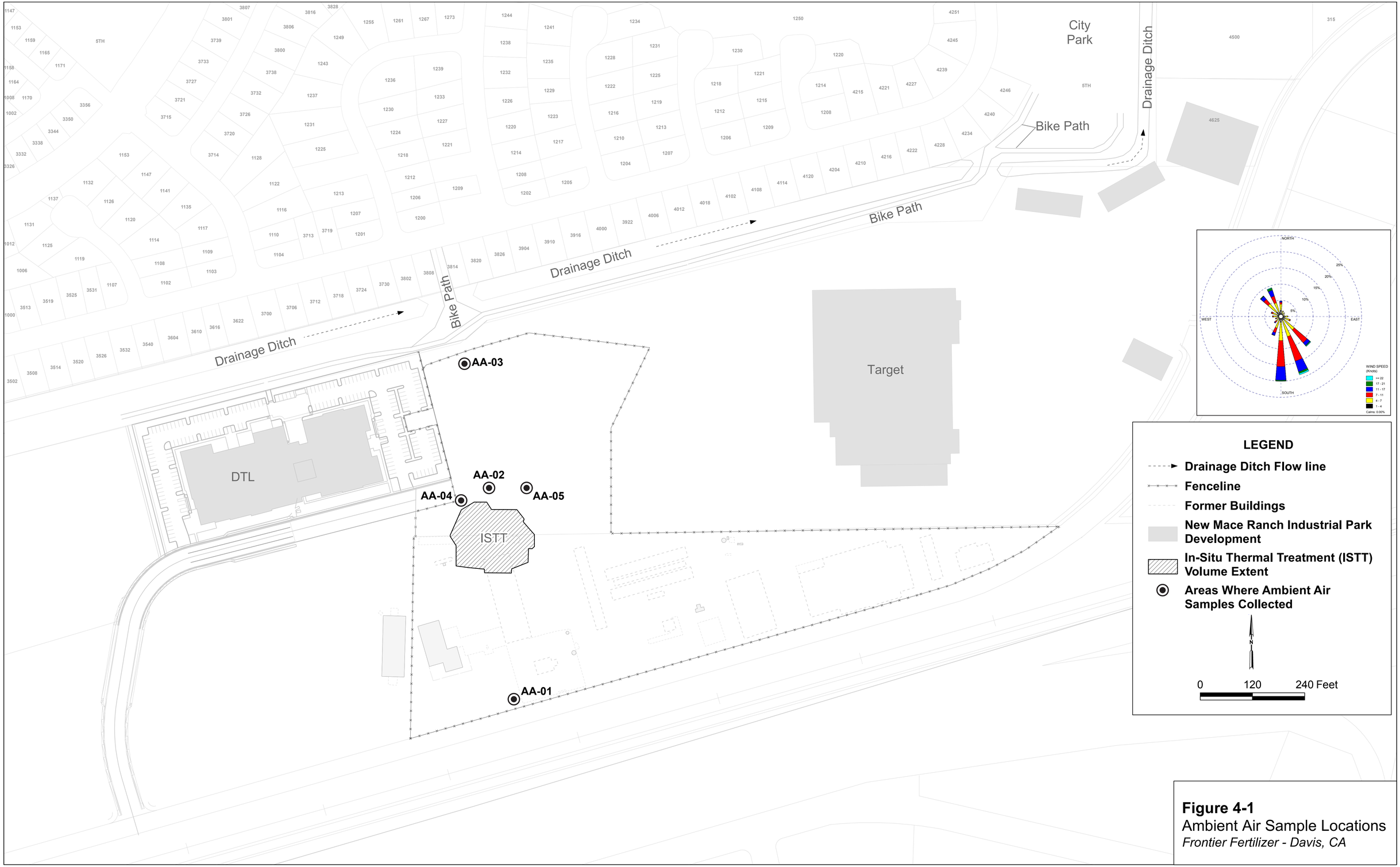

Figure 4-1
Ambient Air Sample Locations
Frontier Fertilizer - Davis, CA

SAC \\ZION\SACGIS\PROJ\FRONTIERFERTILIZER\PRELIMINARY_MONITORING_POINT_TECHNICAL_MEMORANDUM\MAPFILES\AIRGAS_MONITORINGPLAN.MXD SSCOPES 6/16/2009 10:58:35

ES062009045AC Figure_4-1_2010.ai 09.07.2010 tdaus

CH2MHILL

SECTION 5

Request for Analyses

5.1 Analyses Narrative

Table 5-1 presents the analyses that will be requested for the Site. Additional analysis details are provided in the following sections.

TABLE 5-1
Air/Gas Analyses
Air/Gas Monitoring Work Plan, Frontier Fertilizer Superfund Site, Davis, California

Analytes	Analytical Method	Analytical Turnaround Times*	Containers	Preservation	Holding Times
VOCs	EPA TO-15 SIM	2 to 21 days	1 × 6000-millilter (mL) SUMMA® canister	None	30 days

*Quicker turnaround times may be requested based on field monitoring as described in the RAMP. Short turnaround time (2 to 7 days) will be requested on air monitoring during the Commissioning and ISTT Startup phases.

5.2 Analytical Laboratory

All analytical services will be requested through EPA Region 9 Quality Assurance Office (R9RSCC@epa.gov) via the Regional Sample Control and Coordination (RSCC) Form. A minimum supply of six additional contingency sample containers and flow controllers will be requested from the laboratory and kept onsite.

The RSCC will review the form and determine what laboratory services will be assigned. The RSCC will provide a case number for the sample analysis. CH2M HILL may be directed to subcontract laboratory services for methods that cannot be performed by EPA Region 9 Laboratory.

The sample results are e-mailed electronically to the CH2M HILL Project Manager and the CH2M HILL Task Manager. The results are imported into the project database when received by the Database Manager.

5.2.1 Analytical Laboratory Services

The primary resource for analytical laboratory services is the EPA Region 9 Laboratory. CH2M HILL's Applied Sciences Laboratory (ASL) in Corvallis, Oregon will be contracted for use as a backup laboratory in case the EPA Region 9 Laboratory is unable to supply the needed containers or provide the analysis in within the time required. ASL is a National Environmental Laboratory Accreditation Conference (NELAC) accredited laboratory and is capable of meeting or exceeding the RALs presented in Table 3-1.

For more information on ASL, go to:
http://www.ch2m.com/corporate/services/assets/ASL.pdf

SECTION 6

Field Methods and Procedures

This section describes field procedures for the collection of ambient and process gas samples. Health and safety procedures, requirements, field documentation forms, and emergency contacts are discussed in the Frontier Fertilizer HSP (CH2M HILL, 2010).

6.1 General Field Methods

The following procedures apply to any gas samples collected at the Site:

- Any equipment that comes in direct contact with gas being sampled will be used for only that sample or sample location. For example, regulators and sample tubing will only be used for one sample before it is returned for cleaning or is disposed.
- SUMMA® canisters will be procured from the laboratory with documentation stating that they have been individually cleaned and certified.

6.2 Ambient Air Sampling

The ambient air sampling SOP is included in Appendix B. Some general guidelines for ambient air samples include:

- Ambient air sample canisters will be located in unobstructed areas in the breathing zone (approximately 1 to 2 meters above ground level) whenever possible.
- The vertical distance between the canister inlet and any obstacle will be at least two times the height difference between the obstacle and the inlet.
- Unrestricted airflow should occur within an arc of at least 270 degrees. The predominant and second most predominant wind directions will be included in this arc.
- Samples will be collected in 6-L SUMMA® canisters equipped with flow controllers that allow the can to fill in 24 hours. The flow controller and SUMMA canister are pictured in Figure 6-1.
- Coverings will be constructed to shade the SUMMA® canisters at monitoring stations where there is the potential for exposure to direct sunlight. An ambient air station, with summa canister and solar shield is pictured in Figure 6-2.

FIGURE 6-1
Flow Controller (left) and SUMMA Canister (right)

FIGURE 6-2
Summa canister installed in the field with solar shield

SECTION 7

Disposal of Investigation-derived Waste

In the process of collecting ambient air and process gas measurements and samples, the field team will generate different types of potentially contaminated investigation-derived waste (IDW) that include the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment

Used PPE and disposable equipment will be bagged and placed in a municipal refuse dumpster. These wastes are not hazardous and can be sent to a municipal landfill. Before discarding PPE and disposable equipment, field staff will render inoperable any equipment that may potentially be reused.

SECTION 8

Sample Documentation and Shipment

8.1 Field Data Sheets

Field data sheets will document sampling specific information such as weather conditions. An example of a field data sheet is provided in Appendix A. The information contained in the field data sheets includes:

- Sample location
- Sampler name
- Sample ID
- Sample start and stop date and time
- QA/QC type
- Sample analysis method
- Pre- and post-sampling canister vacuum readings
- Any deviations from sampling plans, Site-specific HSP, or QAPP procedures

8.2 Tracking, Labeling, Packaging, and Shipment

Sample tracking, labeling, packaging, and shipping will be conducted in accordance with the Frontier Fertilizer SAP (CH2M HILL, 2008a).

8.3 Chain-of-custody Records and QA/QC Summary Forms

Traffic Reports or CoC Records (TR/CoCs) are used to document sample collection and shipment to offsite laboratories (sample TR/CoCs are provided in Appendix D). All sample shipments will be accompanied by a TR/CoC record. One TR/CoC form will be printed from the project database that will be sent with the samples for each laboratory and each shipment (that is, each shipping day).

The CoC record will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of CH2M HILL. The field team leader will sign the CoC record. The field team leader will sign the "relinquished by" box and note date, time, and air bill number.

In addition to maintaining the custodial integrity of the samples, the TR/CoC will include the following information:

- Date and time of sample collection
- Type of sample (for example, matrix)
- Type of analysis to be performed

- Type of preservation used
- Shipping arrangements (i.e., Federal Express air bill number, …)

Corrections on sample paperwork will be made by placing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below, or after the mistake.

8.4 Labeling, Packaging, and Shipment

8.4.1 Sample Designation

All samples collected at the Frontier Fertilizer site will be identified by a unique sample ID and will be used for all samples collected from the specified location during the event, regardless of analysis method or analytical laboratory.

The sample ID designation will adhere to the following guidelines:

1) The first string of letters will be the Location ID (as identified in the sample database). For example, at ambient air location AA-01, this designation will be AA01.

2) The next four characters will identify the sample type (one character) and the event (three characters).

   a) The leading character will be added to designate quality control sample type: A (normal or primary sample), B (field duplicate), C (equipment blank), D (field blank) and E (laboratory QC sample such as matrix spike/matrix spike duplicate [MS/MSD]). Other QC samples that are not directly tied to the sample location will be indicated by sample type location ID and a two digit number that is sequentially increased as necessary through the event:

Quality Control Sample	Location IDs
Source Blank	SB01, SB02
Trip Blank	TB01, TB02

   b) The event code is a sequentially assigned three digit number preceded by "ces"

Combined, the sample ID should look as follows:

[*Location ID*]-[*QA Type*][*Event Code*]

For example 1, a sample collected form AA-01 groundwater sample from X-8B taken during event 007 will be identified as AA01-A007, if the sample is a duplicate AA01-B007, and if the sample is a laboratory QC sample AA01-E007.

8.4.2 Labels

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable, and unique numbers. The sample labels will include the following information:

- Sample ID

- Location
- Date and time of collection
- Sampler's initials
- Analytical method
- Summa can pressure at the end of sample collection.
- Method of preservation
- Assigned Case Number for the sample event

The labels will be printed on Avery white shipping labels, affixed to a tag that is wire-tied to the summa can.

8.4.3 Packaging and Shipment

All sample containers will be returned in their original shipping boxes , typically cardboard boxes with custom cut foam packing. The samples will be shipped with the appropriate TR/CoC enclosed in a large plastic bag. Each box will be securely taped shut with nylon strapping tape, and custody seals will be affixed to the top and bottom seams.

8.4.4 Laboratory Notification

EPA Region 9 Laboratory

EPA Region 9 Laboratory Sample Receiving will be notified by phone ([510] 412-2377) daily of the sample shipment schedule and will be provided with the following information:

- Site name
- Case number
- Laboratory name
- Shipping date
- Carrier
- Airbill/tracking number
- Number of coolers
- Number of samples
- Sample concentration
- Matrix
- Analyses
- Is the sampling event complete with this shipment or is it to continue?
- Any additional comments that may be relevant to the analyses or transportation of the samples
- Sampler mobile phone number, if available

Shipments made on Friday must be called into the sampling receiving by 12:00 p.m. Friday. For Friday shipments to EPA Region 9 Laboratory, the box "hold Saturday at FedEx Location" must be checked on the airbill. The FedEx office in Emeryville will be used as the shipping address (1600 63rd Street, Emeryville, CA 94608).

SECTION 9

Quality Control

The Frontier Fertilizer SAP (CH2M HILL, 2008a) identifies QC samples and procedures, data validation and usability, and data management for the Site. Because field duplicate collecting in the SAP is focused on groundwater and soil sample collection, the procedure is described below.

9.1 Field Duplicates

Duplicate samples are collected simultaneously and co-located with the primary samples. For vapor samples, field duplicates will be collected using a sampling tee to ensure the duplicate and primary samples are collected under identical conditions. Field duplicates will be labeled in a manner that is blind to the laboratory. A duplicate sample is treated independently of its counterpart in order to assess laboratory performance through comparison of the results. At a minimum, one field duplicate will be collected for every 10 normal samples. Duplicate samples will be packaged and sealed in the same manner as all other samples.

9.2 Performance Evaluation Samples

EPA will provide performance evaluation (PE) samples consisting of an air sample spiked with known concentrations of COCs approximately on a quarterly basis in order to evaluate the accuracy of the lab analysis. The EPA will contract PE samples directly with an outside vendor. The outside vendor is sent SUMMA canisters. The vendor will prepared the PE sample gravimetrically from liquids and then the final gas mix is verified against NIST gas standards for agreement. The PE samples are returned to CH2M HILL, where they are then sent to the laboratory for analysis.

9.3 Sampling Equipment Certification

Sampling Canisters

Six-liter passivated stainless steel canisters shall be used for sampling and analysis. Prior to shipment, these canisters shall be cleaned and individually certified by method TO-15 below half the reporting limits. The laboratory shall provide all sample equipment, shipping containers, and packing material necessary to properly collect and ship the samples to the laboratory.

Flow Controllers

Flow controllers will be certified clean by demonstration, documentation, and reporting of no target constituents above half the reporting limits for the target analytes. Flow controllers will also be shown to have a stable flow rate to fill a 6-liter canister over 24 hours (3.5 to 3.75 cc/min) for the ambient samples.

9.4 Analytical Batch

A laboratory QC batch is defined as a method blank, LCS, a sample duplicate, and 20 or fewer environmental samples of similar matrix that are analyzed together. For gas chromatography/mass spectrometry volatile analyses, a method blank, LCS, and laboratory duplicate must be analyzed in each 24-hour tune period. The number of environmental samples allowed in the laboratory QC batch is defined by the remaining time in the method-prescribed 24-hour tune period divided by the analytical run time. Each preparation or analytical batch will be identified in a way that enables environmental samples to be associated with the appropriate laboratory QC samples.

9.5 Method Blank

Blanks are used to monitor each preparation or analytical batch for interference and/or contamination from glassware, reagents, and other potential contaminant sources within the laboratory. Method blanks will be prepared with ultra-high purity (UHP) air or grade 5 nitrogen in a certified canister every day that samples are to be analyzed. If a target analyte is found at a concentration that exceeds the reporting limit, corrective action must be performed to identify and eliminate the contamination source. All associated samples must be reanalyzed, if appropriate, after the contamination source has been eliminated. No analytical data may be corrected for the concentration found in the blank.

9.6 Laboratory Control Sample

The LCS will be prepared with grade 5 nitrogen in a certified canister spiked with known amounts of target analytes. The spike levels should be as specified in the method or less than or equal to the midpoint of the calibration range. If LCS results are outside the specified control limits, corrective action must be taken if appropriate, including sample reanalysis.

9.7 Surrogates

Surrogates are organic analytes that behave similarly to the analytes of interest but are not expected to occur naturally in the samples. Surrogates are spiked into the standards and into the analytical samples and QC samples prior to preparation. Recoveries of surrogates are used as an indicator of accuracy, method performance, and extraction efficiency. If surrogate recoveries are outside the specified control limits, corrective action must be taken if appropriate, including sample reanalysis.

SECTION 10

Data Validation and Usability

10.1 Data Review, Validation, and Verification Requirements

All data for all parameters will be reviewed by laboratory personnel including the laboratory QA manager and by EPA using independent data validators. With the exception of the data from EPA Region 9 laboratory, 90 percent of the data will be reviewed for all the analytical parameters at the Tier 1b level, as defined by the regional EPA Quality Assurance Office guidance (EPA, 2001b). All of the results from EPA Region 9 laboratory will be reviewed at the Tier 1A level.

Ten percent of the analytical batches will be selected for Tier 3 (full validation) for all parameters. The analytical batches selected for Tier 3 review will be selected at random from the subset of samples with detections. If significant analytical problems are identified during the Tier 3 validation, additional Tier 3 validation will be requested.

Trend charts for tracking COC QC (calibration, continuing calibration, laboratory control samples, matrix spike, matrix spike duplicate, surrogate or deuterated, blank) results, will be used to aid in data review.

10.2 Validation and Verification Methods

Initial data reduction, validation, and reporting at the laboratory will be carried out as described in the laboratory SOPs, by the EPA.

10.3 Reconciliation with Data Quality Objectives

Results obtained from the project will be reconciled with the requirements specified in Appendix E. Assessment of data for precision, accuracy, and completeness will be per the following quantitative definitions.

10.3.1 Precision

If calculated from duplicate measurements:

$$|RPD| = (C_1 - C_2) \times 100\% / ((C_1 + C_2) /2) \qquad (1)$$

Where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

If calculated from three or more replicates, use relative standard deviation (RSD) rather than RPD:

$$\% \text{ RSD} = (s / \bar{y}) \times 100\% \qquad (2)$$

Where:

RSD	=	relative standard deviation
s	=	standard deviation
$\bar{y}$	=	mean of replicate analyses

Standard deviation, s, is defined as follows:

$$S = \sqrt{\sum_{i=1}^{n} \frac{(y_i - \bar{y})^2}{n-1}} \qquad (3)$$

Where:

s	=	standard deviation
y_i	=	measured value of the ith replicate
$\bar{y}$	=	mean of replicate analyses
n	=	number of replicates

10.3.2 Accuracy

For measurements where matrix spikes are used:

$$\%R = 100\% \times \left[\frac{S - U}{C_{sa}}\right] \qquad (4)$$

Where:

%R	=	percent recovery
S	=	measured concentration in spiked aliquot
U	=	measured concentration in unspiked aliquot
C_{sa}	=	actual concentration of spike added

For situations where a standard reference material (SRM) is used instead of or in addition to MS:

$$\%R = 100\% \times \left[\frac{C_m}{C_{sm}}\right] \qquad (5)$$

Where:

%R	=	percent recovery
Cm	=	measured concentration of SRM
Csm	=	actual concentration of SRM

10.3.3 Completeness (Statistical)

Defined as follows for all measurements:

$$\%C = 100\% \times \left[\frac{V}{T}\right] \quad (6)$$

Where:

%C	=	percent completeness
V	=	number of measurements judged valid
T	=	total number of measurement

SECTION 11

References

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Appendix A
Field Data Sheets

CH2M HILL *Applied Sciences Laboratory*

Sheet 1 of __

Ambient Air, Outdoor Air & Crawl Space Air Sampling Log (Summa Canister)

Project Information

Project Name: _____ Project # : _____

By: _____ Date: _____

Sampling Data Log

Sample Location	Field ID	Canister ID	Flow Controller ID	Initial Canister Pressure ("Hg)	Initial Flow Controller Rate (ml/min)	Start Date & Time	End Data & Time	Final Pressure ("Hg)	Final Flow Controller Rate (ml/min)

Sample Location Diagram

N

Note:
Draw in outline the structure's foundation and interior walls, identify rooms, and note other defining features. Show location of canister relative to physical objects, etc.

Other Observations and Comments (note any unique circumstances): _____

_____

Appendix B
Standard Operating Procedures

Integrated Ambient Indoor, Outdoor, and Crawl Space Air Sampling Method for Trace VOCs Using SUMMA Canisters

1. Scope and Application

This sampling method describes the procedure for collecting ambient air samples for targeted volatile organic compounds (VOCs). Reporting limits for these samples are usually very low and extremely prone to positive bias from interfering VOC sources. The method presented here is based on 'clean' sampling techniques. The requirements of 'clean' sampling dictate that sampling and sample handling are done by trained personnel. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project.

2. Summary of Method

A sample of air is withdrawn, using clean technique, into a certified clean and evacuated SUMMA canister using a certified clean flow controller. Sample collection can be integrated over time by adjusting the flow controller. Project-specific sample periods as short as 10 minutes to as long as 24 hours can be achieved based on the size of canister used and the sampling rate selected (see Table 1). Generally, 6-liter canisters are used for ambient air sampling. In cases where the crawl space is most conveniently sampled by access through crawl space vents, a sampling probe (sample delivery line made of Teflon or stainless steel) of sufficient length is attached to the inlet of the flow controller.

3. Apparatus and Materials

3.1. Canister, SUMMA polished, certified clean and evacuated. (Canisters are typically provided by the laboratory.)

3.2. Flow controller, certified clean and set at desired sampling rate. (Flow controllers are typically provided and set by the laboratory.)

3.3. Shipping container suitable for protection of canister during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped back to the laboratory in the same shipping container in which they were received.

3.4. Wrenches and screw driver (clean and free of contaminants), various sizes as needed for connecting fittings and making adjustment to the flow controller A 9/16-inch wrench fits the ¼-inch Swagelok® fittings, which most canisters and flow controllers have.

3.5. Negative pressure gauge, oil-free and clean, to check canister pressure. (The pressure gauges are typically provided by the laboratory.) The laboratory may either provide one pressure gauge to be used with all of the canisters, or a pressure gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in pressure gauges that are not removable.

3.6. Sampling probe, new Teflon or stainless steel tubing, fitted with compression fittings. (For crawl space samples)

4. Sample Collection

4.1. 'Clean' sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. Cleanliness of personnel who come in contact with the sampling equipment is also important: no smoking, no eating, no drinking, no perfumes, no deodorants, no dry cleaned clothing, etc. Canisters should not be transported in vehicles with gas-powered equipment or gasoline cans. Sharpie markers should not be used for labeling or note- taking during sampling.

4.2. The SUMMA canisters are certified clean and evacuated by the laboratory to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister

vacuum. ***Never open the canister's valve unless the intent is to collect a sample or check the canister pressure.***

4.3. When taking outdoor or crawl space samples, be sure to note on the field log any items that might bias analytical results (such as gasoline cans, garbage, fresh paint, etc.)

4.4. Inspect the canister for damage and do not use a canister that has visible damage.

4.5. Verify that the vacuum pressure of the canister is between 28 – 30 inches mercury(Hg). Do not use a canister that has an initial pressure less than 28 inches Hg because that canister likely leaked during shipment.

4.5.1. Remove the protective cap from the valve on the canister.

4.5.2. If using an external gauge, attach the gauge to the canister and open the valve. If the pressure gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, close the canister and remove the gauge.

4.5.3. If using assigned pressure gauges, attach the pressure gauge to the canister, then attach the flow controller. When sample collection begins, record the initial pressure.

4.6. Flow controllers (if used) should come pre-set by the laboratory to sample at a pre-determined rate based on specific project requirements (see Table 1 for the most common options). In some cases [that is, project-specific quality assurance (QA)], the flow rate will need to be verified in the field prior to use. This is accomplished with a bubble meter, vacuum source, and instructions supplied by the laboratory.

4.7. In the field log record the canister identification (ID), flow controller ID, initial vacuum, desired flow rate, sample location information, and all other information pertinent to the sampling effort. The indoor and outdoor temperature and barometric pressure should be recorded when sampling is begun and completed.

4.8. Connect the flow controller to the canister.

4.8.1. The flow controller fitting denoted "LP" or "OUT" is connected to the canister. Tighten the fitting to be leak free but <u>do not over-tighten</u> (a ¼ turn past snug is usually enough.) When tightening the fitting, be sure that the valve assembly does not rotate by using your other hand to hold the valve steady.

4.8.2. If an assigned pressure gauge is used for each canister, the pressure gauge should be attached to the canister first and then the flow controller should be attached to the pressure gauge.

4.8.3. When the flow controller and pressure gauge are attached correctly they will not move separately from the canister (they will not spin around).

4.9. For outdoor samples, be sure that the inlet to the flow controller is protected from precipitation. Either place the canister and flow controller under a shelter/enclosure, or use a clean piece of aluminum foil to build a tent over the flow controller inlet.

4.10. For sampling in public areas, outdoor air sample canisters should be secured to an immovable structure to ensure security. A bicycle lock or piece of chain and Master lock can be used. It may be a good idea to attach a label to the canister explaining that it is an environmental sample and should not be tampered with. The label can also include contact information.

4.11. Remove all work articles from the sampling area.

4.12. To begin sampling, slowly open the canister valve one full turn.

4.13. For canisters with built-in or assigned pressure gauges, monitor the vacuum pressure change several times during the course of the selected sample period to ensure the canister is filling at the desired rate.

4.14. At the end of the sample period, close the canister valve finger tight.

4.15. Remove the flow controller (and assigned pressure gauge) and replace the protective cap on the canister valve fitting.

4.16. If using an external vacuum gauge, re-attach it, open the canister valve, and record the final pressure. Then close the valve, remove the vacuum gauge, and replace the protective cap. Ideal pressure in the canister is between 2 - 10 inches Hg. More than 10 inches Hg can greatly increase reporting limits. No measurable vacuum can invalidate the sample. Immediately consult with the project team if either one of these conditions is encountered.

4.17. If the flow controller is going to be used for more than one sample collection, be sure to purge it between uses. To do this, attach the flow controller to a vacuum source and draw clean air or gas (ultra-high purity) through it for several minutes before attaching it to the canister.

5. Sample Handling and Shipping

5.1. Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory.

5.2. The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples do not need to be cooled during shipment. DO NOT put ice in the shipping container.

5.3. When packing the canisters for shipment, verify that the valve (just past finger tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the cans with other objects or materials that could cause them to be punctured or damaged.

5.4. **Do not place sticky labels or tape on any surface of the canister!**

5.5. Place a custody seal over the openings to the shipping container.

5.6. Make sure to insure the package for the value of the sample containers and flow controllers.

5.7. Ship canisters for overnight delivery.

6. Quality Control

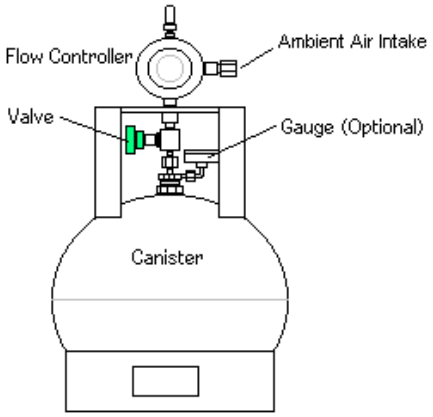
6.1. Canisters supplied by the laboratory must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.

6.2. Flow controllers supplied by the laboratory must follow the performance criteria and QA prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

Table 1 – Common Sampling Rates for Ambient Air Sampling

Can Size	Length of sampling time	Sampling Flow Rate (ml/min)
6 Liter	1 hour	90
6 Liter	8 hours	11.25
6 Liter	24 hours	3.75
1 Liter	5 minutes	180
1 Liter	1 hour	15
850 ml	5 minutes	150
850 ml	1 hour	12

FIGURE 1
Assembled Canister Sampler for Integrated Sample Collection



This SOP is to be used in conjunction with a work plan developed specifically for each project. .

CH2M HILL ***Applied Sciences Laboratory***

Sheet 1 of __

Ambient Air, Outdoor Air & Crawl Space Air Sampling Log (Summa Canister)

Project Information

Project Name: _____ Project # : _____

By: _____ Date: _____

Sampling Data Log

Sample Location	Field ID	Canister ID	Flow Controller ID	Initial Canister Pressure ("Hg)	Initial Flow Controller Rate (ml/min)	Start Date & Time	End Data & Time	Final Pressure ("Hg)	Final Flow Controller Rate (ml/min)

Sample Location Diagram

N

Note:
Draw in outline the structure's foundation and interior walls, identify rooms, and note other defining features. Show location of canister relative to physical objects, etc.

Other Observations and Comments (note any unique circumstances): _____

_____

Appendix C
Analytes, Reporting Limits, Precision Goals, and Accuracy Goals

TABLE C-1
Air/GAS VOC Analytes, Reporting Limits, Precision Goals, and Accuracy Goals for TO-15 SIM

Analyte	TO-15 SIM Air Reporting Limit ($\mu g/m^3$)*	Accuracy as Percent Recovery (air)	Precision as Relative Percent Difference (air)	Overall Completeness (%)
COCs				
DBCP	0.5	70-130	30	90
EDB	0.38	70-130	30	90
DCP	0.23	70-130	30	90
TCP	0.3	70-130	30	90
COPCs				
Bromoethene (vinyl bromide)	0.22[b]	70-130	30	90
1,2-Dichloroethane	0.2	70-130	30	90
Tetrachloroethene	0.34	70-130	30	90
Carbon tetrachloride	0.31	70-130	30	90
Chlorobenzene	0.23	70-130	30	90
m&p-Xylene	0.43	70-130	30	90
o-Xylene	0.22	70-130	30	90
1,1-Dichloroethane	0.2	70-130	30	90
Toluene	0.19	70-130	30	90
Methyl tert-butyl ether (MTBE)	0.18	70-130	30	90
Benzene	0.16	70-130	30	90
Vinyl chloride	0.13	70-130	30	90
1,3-Dichloropropane	0.2[b]	70-130	30	90
2,3-Dichloropropene	0.2[b]	70-130	30	90

*Reporting limits are based on 6-liter (L) SUMMA® canisters and take initial laboratory canister dilution factors into account. The table presents the best achievable reporting limits from the EPA Region 9 Laboratory.

Note:
$\mu g/m^3$ = microgram(s) per cubic meter

TABLE C-2
Summary of Calibration and QC Procedures for Method TO-15

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*
TO-15	Volatile Organics	Initial multipoint calibration (minimum 3 standards and humid zero air)	Initial calibration prior to sample analysis	%RSD for all calibration analytes ≤ 30%	Correct problem then repeat initial calibration
		Second-source calibration verification	Once per three-point initial calibration	All analytes within ±25% of expected value	Correct problem then repeat initial calibration
		Calibration verification (one point)	Daily, before sample analysis and every 12 hours of analysis time	All calibration analytes within ±25% of expected value	Correct problem then repeat initial calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, lab specific	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description	Retune instrument and verify
TO-14	Volatile Organics	ISs	Immediately after or during data acquisition for the calibration verification standard.	Retention time ±30 seconds from retention time of the mid-point std. in the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning
		Method blank	One per analytical batch	No analytes detected ≥ RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, lab specific	Correct problem then reanalyze If still out, reprep and reanalyze the LCS and all samples in the affected analytical batch
TO-15	Volatile Organics	MDL study	Once per 12 month period	Detection limits established shall be ≤ ½ the RLs in Table	None
		Results reported between MDL and RL	None	None	None

*All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

VOLATILE ORGANIC COMPOUNDS (VOCs) in Ambient Air
Using Summa Canister Sampling and Gas Chromatography (GC) Analysis

Table 1A. Summary of Holding Times and Preservation

Analytical Parameter [a]	**Technical and Contract Holding Times**	**Preservation**
Volatile Organic Compounds (VOCs) in SUMMA® canisters [b]	Technical: 14 days from collection; Contract: 12 days from receipt at laboratory	Ambient temperature; near atmospheric pres
VOCs in tedlar bags	Technical: 48 hours from collection; Contract: 36 hours from receipt at laboratory	Ambient temperature; near atmospheric pres

[a] Individual target compounds are listed in Table 1B.

[b] The laboratory must provide clean and certified 6-liter SUMMA® canisters with the manufacturer's serial number, or a unique permanent identification number attached. For cleaning and certification of SUMMA® canisters, follow the requirements specified in Sections 7.3 and 11 of EPA Method TO-14. After cleaning and certification, the SUMMA canisters will be shipped to the field with a vacuum of < 50 mm TORR. One canister shall be designated as the trip blank for each SDG.

Data Calculations and Reporting Units:

Calculate and report the sample results as specified in the EPA Method TO-14. Perform sample quantitation using the response factor (RF) from the average response factors of the calibrated range. Report results for all target analytes in concentration units of parts per billion by volume (ppbv).

Report tentatively identified compounds (TICs) with a response of <10% of the nearest internal standard.

TIC values should be estimated in ppbv based on the response of the corresponding internal standard.

Table 1B. Target Compound List and Contract Required Quantitation Limits for VOCs by EPA Method TO-14

Analyte	**CAS Numbers**	**CRQL(ppbv)**
Acetone	67-64-1	5
Acetonitrile	27521	5
Acrolein	39120	5
Acrylonitrile	39447	5
Benzene	71-73-2	2
Benzyl chloride	100-44-7	5
Bromodichloromethane	75-27-4	2
Bromomethane	74-83-9	5
1,3-Butadiene	106-99-0	5
2-Butanone	78-87-5	5
Carbon tetrachloride	56-32-5	2
Chlorobenzene	108-90-7	2
Chlorodifluoromethane		2
Chloroethane	0	2
Chloroform	67-66-3	2
Chloromethane	74-87-3	2
3-Chloro-1-propene		2
Cyclohexane	110-82-7	2
Dibromochloromethane	124-48-1	2
1,2-Dibromoethane	106-93-4	2
1,2-Dichlorobenzene	95-50-1	2
1,3-Dichlorobenzene	541-73-1	5
1,4-Dichlorobenzene	106-46-7	5
Dichlorodifluoromethane	75-71-8	2
1,1-Dichloroethane	75-34-3	2
1,2-Dichloroethane	39234	2
1,1-Dichloroethene	75-35-4	5
cis-1,2-Dichloroethene	156-59-2	2

trans-1,2-Dichloroethene	156-60-5	2
1,2-Dichloropropane	78-87-5	2
Dichlorofluoromethane	75-43-4	2
t-1,2-Dichloropropene		2
cis-1,2-Dichloropropene		5
1,2-Dichloro-1,1,2,2-tetra-fluoroethane		2
Ethylbenzene	100-41-4	2
Heptane	142-82-5	2
Hexachlorobutadiene	87-68-3	5
Hexane	110-54-3	2
Methanol	67-56-1	5
Methylene chloride	27638	5
Methyl methacrylate		2
4-Methyl-2-pentanone	39721	5
alpha-Methyl styrene		5
Octane	111-65-9	5
n-Pentane	109-66-0	2
Propylene	42185	5
Styrene	100-42-5	5
1,2,4-Trichlorobenzene	120-82-1	2
1,1,1-Trichloroethane	71-55-6	5
1,1,2-Trichloroethane	0	5
1,1,2,2-Tetrachloroethane	79-34-5	2
Tetrachloroethene	127-18-4	5
Toluene	108-88-3	5
Trichloroethene	28860	2
Trichlorofluoromethane	75-69-4	2
1,1,2-Trichloro-1,2,2-trifluoroethane		2
1,2,4-Trimethylbenzene	95-63-6	2
1,3,5-Trimethylbenzene	108-67-8	2
Vinyl acetate	39571	5
Vinyl chloride	27397	2

Xylenes (m- and p-)		5
Xylene (o-)		5

Table 2. Summary of Calibration Procedures

Calibration Element	**Frequency**	**Acceptance Criteria**	**Correctiv**
GC/MS Tuning with 4-bromofluorobenzene (BFB)	Beginning of each 12 hour period during which standards and samples are analyzed	Ion abundance criteria in Table 4 of Method TO-14	1. Identi 2. MS tur met befor
Initial Calibration (minimum blank + 3 to 5 points for each analyte) (ICAL) [a, b, c]	Initially; whenever required, due to failure of CCV	RSD for RFs #25%	1. Termir 2. Recali before sa
Continuing Calibration Verification (CCV) (middle of the calibration range)	Following ICV, after every 10 samples, and end of run	%D between RF of CCV and avg. RRFs from ICAL #25%	1. Recali 2. Reanal last gooc

[a] The ICAL low standard must be at concentrations equivalent to the CRQL.

[b] ICAL and CCV standards must contain all target analytes listed in Table 1B.

[c] Report the retention time (RT) window for each analyte. Determine RT windows as ±3 x the standard deviation (SD) of the average initial calibration RT for each analyte.

Follow the tuning and calibration procedures in Section 10.2.2 and 10.2.3 of EPA Method TO-14 and in SOP #1705, Section 3.7.1 and 3.7.2 of OSWER Directive 9360.4-05, May 1992.

The standards must be traceable to a known certified source.

Table 3. Summary of Internal Quality Control Procedures

QC Element	Frequency	Acceptance Criteria	Corrective
Method Blank (MB)	One for each day, minimum of one per SDG	< CRQL for each compound	1. Investig contaminati 2. Reanalyz processed w out of cont
Performance Evaluation (PE) sample [a]	One per day or for each SDG batch	80-120% of expected value	1. Reanalyz associated compliant P
Surrogate Spikes [b]	Every sample, standard and method blank	70-130% of expected value	1. Reanalyz non-complia recoveries.
Laboratory Duplicates	One of every 10 samples or one per day, whichever is greater	RPD #20 between duplicate results $5 times CRQL; ±CRQL for duplicate results #5 times CRQL	1. Reanalyz non-complia

[a] PE samples - The National Institute of Standards and Technology (NIST) standard reference materials (SRM) that are traceable to known concentrations.

[b] Surrogates - The laboratory must demonstrate that the selected three surrogates do not interfere with any target analytes.

Dilute and reanalyze samples which contain one or more target analytes at concentrations above the initial calibration range. Results for such reanalyses should fall within the mid-range of the calibration curve. Report results and submit documentation for both analyses.

VOLATILE ORGANIC COMPOUNDS (VOCs) in Air
(Ambient Air/Soil Vapor/Stack Gas) Samples Collected in Specially-Prepared Canisters
and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)

Table 1A. Summary of Holding Times and Preservation

Analytical Parameter [a]	**Technical and Contract Holding Times**	**Preservation**
Volatile Organic Compounds (VOCs) in SUMMA® canisters [b]	Technical: 14 days from collection; Contract: 10 days from receipt at laboratory	Ambient tempera
VOCs in tedlar bags	Technical: 48 hours from collection; Contract: 36 hours from receipt at laboratory	Ambient tempera

[a] Individual target compounds are listed in Table 1B.

[b] The laboratory must provide the following equipment certified as clean:

Cleaned and evacuated 6-liter SUMMA® canisters with the manufacturer's serial number, or a unique permanent identification number attached. For cleaning and certification of SUMMA® canisters, follow the requirements specified in Section 8.4 of EPA Method TO-15 (January 1999).

Cleaned and preset ultra-low flow orifices for each ambient air sample preset by the laboratory at a flow rate of 3.2 mL/min ±10% and digital flow meters capable of accurate measurements in the 3.2 mL/min range.

Leak test all canisters prior to sample collection according to Section 8.4 of Method TO-15 (January 1999).

Data Calculations and Reporting Units:

Calculate and report the sample results as specified in Section 10.8.4 of EPA Method TO-15 (January 1999).

Perform sample quantitation using the relative response factor (RRF) from the daily continuing calibration standard. Report results for all target analytes in concentration units of parts per billion by volume (ppbv). Report tentatively identified compounds(TICs) with a response of <10% of the nearest internal standard. TIC values should be estimated in ppbv based on the response of the corresponding internal standard.

Table 1B. Target Compound List, CAS Numbers, and Contract Required Quantitation Limits

Analyte	CAS Number	CRQL ppbv	CRQL ug/M3	CRQL ug/L	MDL ppbv
Benzene	71-43-2	1.0	3.5	0.0035	0.2
Bromomethane	74-83-9	1.0	4.2	0.0042	0.2
Carbon Tetrachloride	56-23-5	1.0	6.9	0.0069	0.2
Chlorobenzene	108-90-7	1.0	5.0	0.0050	0.2
Chloroethane	75-00-3	1.0	2.9	0.0029	0.2
Chloroform	67-66-3	1	5.3	0.0053	0.2
Chloromethane	74-87-3	1	2.3	0.0023	0.2
1,1-Dichloroethane	75-34-3	1	4.4	0.0044	0.2
1,2-Dichloroethane	107-06-2	1	4.4	0.0044	0.2
1,1-Dichloroethene	75-35-4	1.0	4.3	0.0043	0.2
cis-1,2-Dichloroethene	156-59-2	1.0	4.3	0.0043	0.2
trans-1,2-Dichloroethene	156-60-5	1.0	4.3	0.0043	0.2
1,2-Dichloropropane	78-87-5	1.0	5.0	0.0050	0.2
cis-1,3-Dichloropropene	10061-01-5	1.0	5.0	0.0050	0.2
trans-1,3-Dichloropropene	10061-02-6	1.0	5.0	0.0050	0.2
Ethylbenzene	100-41-4	1.0	4.7	0.0047	0.2
Methylene Chloride	75-09-2	1.0	3.8	0.0038	0.2
Styrene	100-42-5	1.0	4.6	0.0046	0.2
1,1,2,2-Tetrachloroethane	79-34-5	1.0	7.5	0.0075	0.2
Tetrachloroethene	127-18-4	1.0	7.4	0.0074	0.2
Toluene	108-88-3	1.0	4.1	0.0041	0.2
1,1,1-Trichloroethane (TCA)	71-55-6	1	6.0	0.0060	0.2
1,1,2-Trichloroethane	79-00-5	1	6	0.0060	0.2
Trichloroethene (TCE)	79-01-6	1.0	5.9	0.0059	0.2
Vinyl Chloride	75-01-4	1.0	2.8	0.0028	0.2
p-Xylene & m- Xylene	106-42-3 & 108-38-3	2.0	9.5	0.0095	0.4
o-Xylene	95-47-6	1.0	4.7	0.0047	0.2

EPA Method TO-15 (January 1999)

Table 2. Summary of Calibration Procedures

Calibration Element	Frequency	Acceptance Criteria	Correctiv
GC/MS Tuning with 4-bromofluorobenzene (BFB)	Beginning of each 12 hour period during which standards and samples are analyzed	Ion abundance criteria in Table 3 of Method TO-15	1. Identi 2. MS tur met befor
Initial Calibration (minimum blank + 5 points for each analyte) (ICAL) [a, b, c]	Initially; whenever required, due to failure of CCV	RRFs $0.05 for each analyte; RSD for RRFs #30%	1. Termir 2. Recali before sa

Continuing Calibration Verification (CCV) (middle of the calibration range)	Following ICV, every 12-hour, and end of run	RRFs $0.05 for each analyte; %D between RRF of CCV and avg. RRFs from ICAL #30%	1. Recali 2. Reanal last gooc
CRQL standard	Every 12 hour	65-135% of the expected value	1. Recali 2. Reanal last gooc
Internal Standards [d]	Every standard, sample, blank, and QC sample	IS area within ±40% of the IS area in the associated CCV	1. Invest 2. Re-ana analyzed malfuncti
Retention time evaluation	Each analysis	±0.50 minute of the IS retention time in the associated CCV	1. Re-cal 2. Re-ana to last g

[a] The ICAL low standard must be at concentrations equivalent to the CRQL.

[b] ICAL and CCV standards must contain all target analytes listed in Table 1B.

[c] Report the retention time (RT) window for each analyte. Determine RT windows as ±3 x the standard deviation (SD) of the average initial calibration RT for each analyte.

[d] Internal standards: Bromochloromethane, 1,4-Difluorobenzene, and Chlorobenzene-d5. The standards must be traceable to known certified source. Humidify calibration standards when used.

Table 3. Summary of Internal Quality Control Procedures

QC Element	Frequency	Acceptance Criteria	Corrective
Method Blank (MB)	Each 12-hour time period, minimum of one per SDG	< CRQL for each compound	1. Investig contaminati 2. Reanalyz processed w out of cont
Blank Spike Blank Spike Duplicate (BS/BSD)	One BS/BSD set per batch or SDG (1 MS/MSD set per 20 samples minimum)	65-135% of expected value; #35% RPD between BS and BSD	1. Report i
Surrogate Spikes [a]	Every sample, standard and method blank	80-120% of expected value	1. Reanalyz non-complia recoveries
Laboratory Duplicates	One per SDG	RPD #20 between duplicate results $5 times CRQL; ±CRQL for duplicate results #5 times CRQL	1. Reanalyz non-complia

[a] 1,2-dichloroethane-d_4, Toluene-d_8, and 4-Bromofluorobenzene. If other surrogates are used the laboratory must demonstrate that the surrogates do not interfere with any target analytes. The laboratory must also notify the Region in advance.

Reanalyze samples containing target analytes at concentrations greater than the initial calibration range. Analyze a smaller aliquot of sample from the SUMMA® canister. If after analyzing a smaller aliquot, the concentration is still greater than the initial calibration range, then dilute the sample and reanalyze according to

procedures outlined in EPA Method TO-15. If sample dilution is necessary, the dilution must be adjusted so that the target analyte is quantitated at a level in the upper half of the calibration range. Report the results and submit documentation for the analysis of both the diluted and undiluted sample.

Both the primary ions and the secondary ions must be present in the spectra. The acceptance level for relative abundance of the appropriate ions in all standards, method blanks, QC samples, laboratory duplicates and field samples is determined to be ±20% of the expected abundance observed in the most recent continuing calibration standard. All ions greater than 15% in the standard spectrum must be present in the sample spectrum.

Appendix D
Example Tracking Reports/Chain-of-Custody

Chain of Custody Record

COC Number: **FFAA-004**

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Project Name **Location** Davis, CA
Task Order 7 **Project:** FFAA_4Q09
Project Number 385112.CV.01/R09S90
Project Manager Paul Seday
Sample Manager
Turnaround Time 21 Days
PO Number R09S90

Sample ID	Sample Date/Time	Type	Matrix	# Containers	Preserv	TO-15SIM
AA01_A535	28-Dec-09 10:51	N	AmbientAir			
		Field Filtered: ☐		1	none	☑
		Total Containers:		1		
AA02_A535	28-Dec-09 10:55	N	AmbientAir			
		Field Filtered: ☐		1	none	☑
		Total Containers:		1		
AA03_A535	28-Dec-09 11:04	N	AmbientAir			
		Field Filtered: ☐		1	none	☑
		Total Containers:		1		
AA03_B535	28-Dec-09 11:05	N	AmbientAir			
		Field Filtered: ☐		1	none	☑
		Total Containers:		1		

+ regulators in separate box

MS = Matrix Spike **SD = Matrix Spike Duplicate**

	Signatures	Date/Time
Approved by	[signature]	12-29-09
Sampled by		
Relinquished by		
Received by		
Relinquished by		
Received by		

Shipping Details

Method of Shipment: FedEx
On Ice: yes / no
Airbill No: 866418771412
Lab Name: EPA Region 9 Laboratory
Lab Phone: (510) 412-2389

ATTN:

Sample Custody
and
Rich Bauer

Special Instructions:

Report Copy to
Matt Marlatt
916-920-0300``