

**Quality Assurance Project Plan**  
**Former Fort Ord, California, Volume I**  
**Appendix D, Revision 3**  
**Operable Unit 2 Landfills**



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USACE Contract No. W91238-C-14-0048  
Amendment No. P00003  
Task No. 8



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## Report Use and Limitations

Report Title: **Quality Assurance Project Plan  
Former Fort Ord, California, Volume I  
Appendix D, Draft Final Revision 3  
Operable Unit 2 Landfills**

Prime Contractor: Ahtna Environmental, Inc.  
USACE Contract No. W91238-C-14-0048  
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Ahtna Environmental, Inc. (Ahtna) prepared this report at the direction of the U.S. Army Corps of Engineers (USACE) for the sole use of the U.S. Department of the Army (Army), the intended beneficiary. No other party should rely on the information contained herein without the prior written consent of the Army. This report and its interpretations, conclusions, and recommendations use information presented in other documents, as cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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- F Responses to Comments on the QAPP, Volume I, Appendix D, Draft Revision 3, Operable Unit 2 Landfills

## Acronyms and Abbreviations (continued)

lb/MMBtu	pounds per million British thermal units
LCS	laboratory control sample
LDC	Laboratory Data Consultants
LFG	landfill gas
LOD	limit of detection
LOQ	limit of quantitation
MSL	mean sea level
N <sub>2</sub>	nitrogen
NA	not applicable
NELAP	National Environmental Laboratory Accreditation Program
NMOC	non-methane organic compounds
NO	nitrogen oxide
NO <sub>x</sub>	nitrogen oxides
O&M	operations and maintenance
O <sub>2</sub>	oxygen
OU2	Operable Unit 2
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCE	tetrachloroethene
PDL	project decision limit
PM	Project Manager
ppbv	parts per billion by volume
ppmv	parts per million by volume
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RRT	relative retention time
RSD	relative standard deviation
RSL	regional screening level
SARA	Superfund Amendment and Reauthorization Act
scfm	standard cubic feet per minute
SL	screening level
SO <sub>2</sub>	sulfur dioxide
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
THC	total hydrocarbons
TTU	thermal treatment unit
USACE	U.S. Army Corps of Engineers
VD	Passive Vent in Area D
VF	Passive Vent in Area F
VOC	volatile organic compound

## 1.0 Introduction

This Quality Assurance Project Plan (QAPP)<sup>1</sup> Appendix D Revision 3 describes the planning, implementation, acquisition, and assessment of data using effective methodologies and thorough quality assurance (QA) and quality control (QC) procedures to be used during sampling and analytical activities, so the data generated is accurate, precise, complete, representative of field conditions, and of sufficient quality to support project decisions. Ahtna Environmental, Inc. (Ahtna), on behalf of the U.S. Army Corps of Engineers (USACE), will implement the QAPP for sampling and laboratory analysis activities related to operations and maintenance (O&M) of the Operable Unit 2 (OU2) Landfills and landfill gas (LFG) extraction and treatment system at the Former Fort Ord, California (Figure 1). This QAPP also includes information for data management and analysis in support of the sampling program. The QAPP was updated and revised to:

- Reflect recent changes in project personnel;
- Update the laboratory analyses certifications and provide the source testing protocol in Attachment B; and
- Update the sample schedules for LFG probes and target analyte lists based on review of data collected in the last year and implementation of the analytic approaches in Worksheet #11.

The O&M activities are in accordance with the Record of Decision (ROD), Operable Unit 2, Fort Ord Landfills, Fort Ord, California (OU2 Landfills ROD; Army, 1994) and the *Operation and Maintenance Plan, Operable Unit 2 Landfills, Former Fort Ord, California* (O&M Plan; Shaw, 2008a). This document is intended for use by field operators, supervisors, and data processors and managers responsible for implementing and coordinating field activities for the project.

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<sup>1</sup> This document is Appendix D to the *Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Volume I is also the governing document for sampling and analysis of groundwater (Appendix A), soil (Appendix B), and soil gas (Appendix C). Volume II of the QAPP pertains to the former Fort Ord military munitions response program.

## 2.0 Project Management

### 2.1 Worksheets #1 and #2: Title and Approval Page

**Site Name/Project Name:** Operable Unit 2 (OU2)

**Site Location:** Former Fort Ord, California

**Document Title:** Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix D, Draft Revision 3, Operable Unit 2 Landfills

**Lead Organization:** U.S. Army Corps of Engineers

**Preparer's Name, Organization, and Contact Info:** Eric Schmidt, Ahtna  
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(831) 384-3735, eschmidt@ahtna.net

**Preparation Date:** October 19, 2018

**Revision Number:** 3

Project Role	Name Organization	Signature	Date
Investigative Organization's Project Manager	Derek S. Lieberman Ahtna		
Investigative Organization's Program Chemist	Christopher Ohland Ahtna		
Lead Organization's Technical Lead	Alex Kan USACE		
Lead Organization's Project Chemist	Jonathan Whipple USACE		



**Plans and reports from previous investigations relevant to this project:**

**Site Name/Project Name:** Former Fort Ord/Superfund Response Actions

**Site Location:** Monterey County, California

**Site Number/Code:** Not Applicable (N/A)

**Operable Units:** OU2

**Contractor Name:** Ahtna Environmental, Inc.

**Contract Number:** W91238-14-C-0048

**Contract Title:** Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring, Former Fort Ord, California

**Work Assignment Number:** N/A

**Guidance used to prepare QAPP:** Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets, March 2012, Revision 1.

Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1, January 2017

**Regulatory Program:** Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended by Superfund Amendment and Reauthorization Act (SARA)

**Approval Entities:** U.S. Environmental Protection Agency (EPA), California Department of Toxic Substance Control (DTSC), and Regional Water Quality Control Board, Central Coast Region (CCRWQCB)

**Data Users:** U.S. Department of the Army (Army), USACE, EPA (and its consultant TechLaw, Inc.), DTSC, CCRWQCB, Army/USACE contractors, citizen groups, and members of the public

**Organizational partners (stakeholders) and connection with lead organization:** USACE, Army (lead agency/owner), EPA (lead oversight agency), DTSC (support agency), and CCRWQCB (support agency)

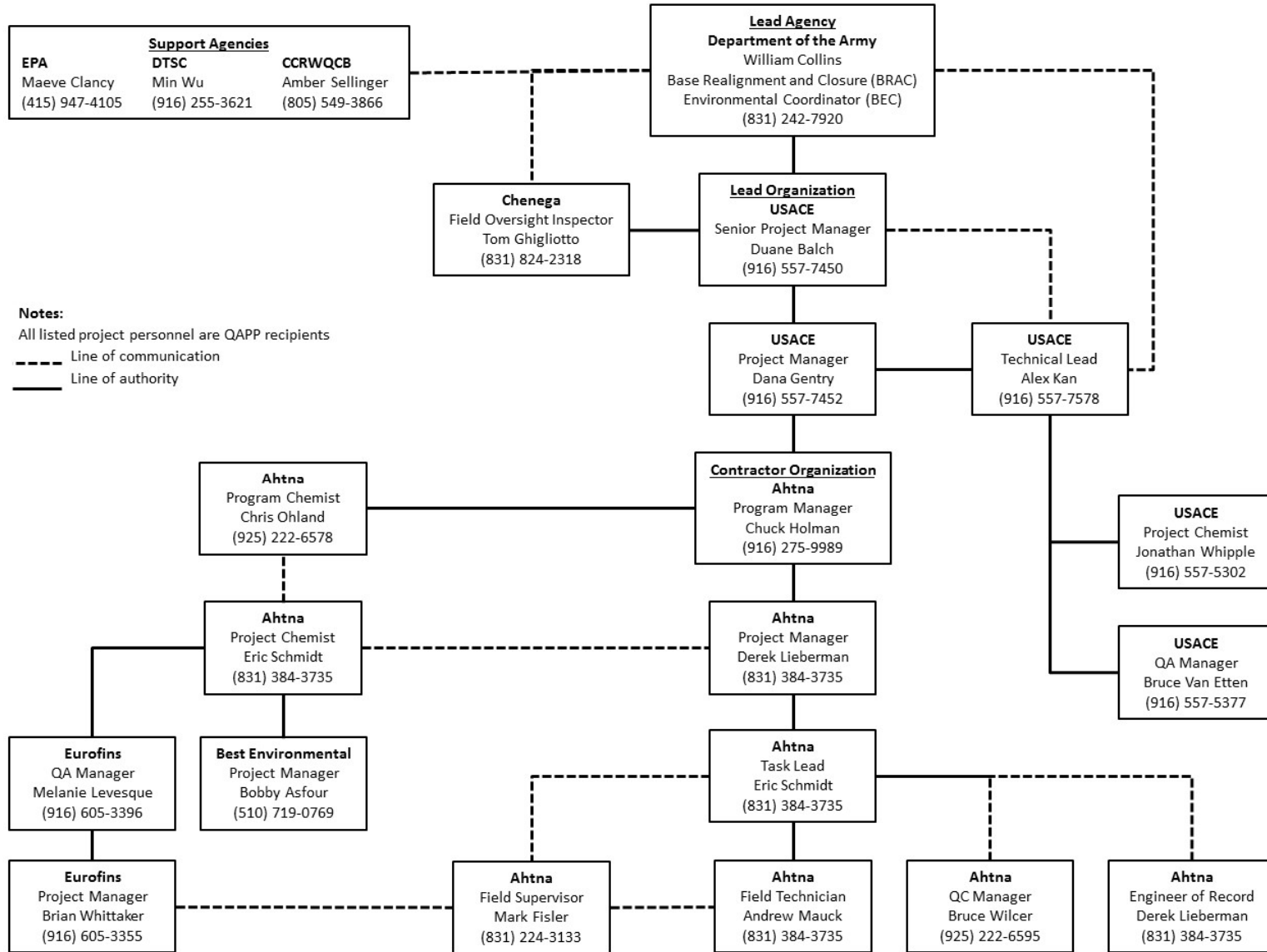
**The QAPP is (select one):** Generic: \_\_\_\_\_ Project Specific:  \_\_\_\_\_

Title	Company	Date
Record of Decision Operable Unit 2, Fort Ord Landfills Fort Ord, California	U.S. Department of the Army (Army)	07/15/94
Explanation of Significant Differences, Operable Unit 2, Fort Ord Landfill	Army	08/03/95

Title	Company	Date
Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs), OU2, Fort Ord Landfills	Army	10/04/06
Operation and Maintenance Plan Operable Unit 2 Landfills Former Fort Ord, California Revision 2	Shaw Environmental, Inc.	Sept. 2008
Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix D, Final Revision 1, Operable Unit 2 Landfills	Ahtna	09/04/2016
Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix D, Final Revision 2, Operable Unit 2 Landfills	Ahtna	09/11/2017

## 2.2 Worksheets #3 and #5: Project Organization and QAPP Distribution

Reporting relationships between organizations involved in the project, including the lead organization, contractors, and subcontractor organizations are identified below:



## 2.3 Worksheets #4, #7 and #8: Personnel Qualifications and Sign-off Sheet

### Ahtna

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications <sup>1</sup>	Signature <sup>2</sup>	Date
Derek Lieberman	Project Manager/Engineer of Record	Resume on file	First aid, CPR, MEC, PE, H&S, HAZWOPER		
Eric Schmidt	Project Chemist/Task Lead and Data Manager	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM		
Mark Fisler	Field Supervisor	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM		
Bruce Wilcer	QC Manager	Resume on file	HAZWOPER, CQM		
Andrew Mauck	Field Technician	Resume on file	First aid, CPR, MEC, HAZWOPER		

**Notes:**

<sup>1</sup>Specialized Training/Certifications Key:

CPR: cardiopulmonary resuscitation

CQM: Construction Quality Management.

H&S: health and safety training, including, but not limited to: hazard communication, fire extinguisher use, defensive driving, behavior-based safety, confined spaces.

HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response

MEC: munitions and explosives of concern recognition and safety training

PE: registered Professional Engineer

<sup>2</sup>Signatures indicate personnel has read and agree to implement this QAPP as written.

### Worksheets #4, #7 and #8: Personnel Qualifications and Sign-off Sheet

#### Laboratory: Eurofins Air Toxics, Inc. (Eurofins)

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature <sup>1</sup>	Date
Brian Whittaker	Project Manager	Resume on file	Not applicable		
Melanie Levesque	QA Manager	Resume on file	Not applicable		

**Notes:**

<sup>1</sup>Signatures indicate personnel has read and agree to implement this QAPP as written.

## Worksheets #4, #7 and #8: Personnel Qualifications and Sign-off Sheet

### Mobile Laboratory: Best Environmental

Name	Project Title/ Role	Education/ Experience	Specialized Training/ Certifications	Signature <sup>1</sup>	Date
Bobby Asfour	Project Manager	Resume on file	Not applicable		

**Notes:**

<sup>1</sup>Signatures indicate personnel has read and agree to implement this QAPP as written.

## 2.4 Worksheet #6: Communication Pathways

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathways, documentation, etc.)
Regulatory agency interface	Army	William Collins	831-242-7920	Project materials and information will be submitted to EPA, DTSC, and CCRWQCB as appropriate by William Collins via email or hardcopy.
Point of contact with Army Base Realignment and Closure (BRAC) Office	USACE	Alex Kan	916-956-2752	Materials and information regarding the project will be forwarded to Army BRAC Office through USACE Technical Lead.
Point of contact for the Lead Organization Technical Lead	Ahtna	Derek Lieberman	831-384-3735	Oversees and reviews materials and information about the project.
Status Reports	Ahtna	Derek Lieberman	831-384-3735	Derek Lieberman will provide updates to USACE during weekly status calls.
Stop work due to safety issues	Ahtna	Any person	831-384-3735	Any individual has the ability to stop-work based on an unsafe work condition, or a potential for an unsafe work condition.
QAPP variances in the field	Ahtna	Mark Fisler Andrew Mauck	831-384-3735	Notify Eric Schmidt by telephone or email of variances to QAPP made in the field and the reasons within 24 hours.
QAPP modifications and contract compliance	Ahtna	Eric Schmidt	831-384-3735	Prepares QAPP and QAPP amendments; issue valid QAPP variances with input from Project Manager (PM) and Sampling Team Lead. Assures Ahtna compliance with contract requirements.
Field and analytical corrective actions	Ahtna	Chris Ohland	925-222-6593	The need for corrective action for analytical issues will be determined by Chris Ohland.
QC and contract compliance	Ahtna	Bruce Wilcer	925-222-6856	Reviews project plans; assures Ahtna compliance with contract requirements.
Analytical contact with the field staff and laboratory	Ahtna	Eric Schmidt	831-384-3735	Oversees and reviews all analytical materials generated from the field and by the laboratory.

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathways, documentation, etc.)
Reporting fixed lab data quality issues	Eurofins	Brian Whittaker Melanie Levesque	800-985-5955	QC issues with project field samples will be reported by the laboratory to Eric Schmidt within 2 business days. Identify required variances from QAPP.
Reporting mobile lab data quality issues	Best Environmental	Bobby Asfour	510-719-0769	QC issues with mobile laboratory analysis will be reported to Eric Schmidt upon discovery. Identify required variances from QAPP.
Data import and export	Ahtna	Eric Schmidt	831-384-3735	Uploads field/fixed lab and data recorder data into the Fort Ord Data Integration System.
Hazardous or unsafe conditions that raise question of stopping work	Ahtna	Eric Schmidt Mark Fisler Andrew Mauck	831-384-3735	Confer with Derek Lieberman and/or the Ahtna Site Safety and Health Officer (SSHO) to determine whether work needs to be stopped; the Ahtna SSHO will report stop-work decision to the Ahtna PM.
Perform field QC checks to ensure proper sampling methods, custody procedures, packaging, and shipment are performed	Ahtna	Bruce Wilcer	925-222-6856	Report result of field checks to Derek Lieberman and Eric Schmidt.
Prepare initial write-up of field generated data to be included in final reports	Ahtna	Eric Schmidt	831-384-3735	Confer with Derek Lieberman on questions and resolutions.
Database setup and data management planning	Ahtna	Eric Schmidt	831-384-3735	Provides information on sample and analytical reporting groups, and types of report tables required for project.
Data verification/data validation	Ahtna / Laboratory Data Consultants	Eric Schmidt	831-384-3735	Report result of analytical QC checks to Chris Ohland.
Data review issues and corrective actions	Ahtna	Eric Schmidt	831-384-3735	Report result of analytical QC corrective action to Chris Ohland and Derek Lieberman.



## 2.5 Worksheet #9: Project Planning Session Summary

**Date of Planning Session #1:** August 1, 2018

**Purpose:** Determine whether revisions are appropriate per data quality objectives (DQOs) identified in QAPP Worksheet #11 and whether there are personnel changes needed for the third annual update.

### Participants:

Name	Title/Role	Affiliation	Telephone	email
Derek Lieberman	Project Manager	Ahtna	831-384-3735	dlieberman@ahtna.net
Eric Schmidt	Project Chemist/Task Lead	Ahtna	831-384-3735	eschmidt@ahtna.net

### Planning Session Summary:

- Reviewed contract requirements and QAPP schedule;
- Determined data review is necessary to evaluate changes in LFG monitoring frequency and target analyte lists per DQOs;
- Change in personnel for contract laboratory performing volatile organic compound (VOC) analyses.

### Action Items:

Action	Responsible Party	Due Date
Data review to determine whether changes sampling frequency and target analyte lists are required for QAPP revision.	Eric Schmidt, Ahtna	September 9, 2018
Review QAPP for inconsistencies or errors and correct as needed.	Eric Schmidt, Ahtna	September 11, 2018
Update QAPP per results of data review and personnel changes.	Eric Schmidt, Ahtna	September 12, 2018
Internal Ahtna QC review of QAPP and issue preliminary draft QAPP for Army and USACE review.	Eric Schmidt, Ahtna	September 14, 2018

### 3.0 Project Quality Objectives

#### 3.1 Worksheet #10: Conceptual Site Model

##### 3.1.1 Background and History

The former Fort Ord is located in northwestern Monterey County, California, approximately 80 miles south of San Francisco. The OU2 Landfills formerly included six landfill areas, one area north and five areas south of Imjin Parkway, covering approximately 150 acres, including the immediate surrounding area (Figure 1). The former Area A Landfill, north of Imjin Parkway, was approximately 33 acres separated from the Areas B through F Landfills to the south of Imjin Parkway (Figure 2). The Areas B through F Landfills encompass approximately 120 acres of undeveloped land. The six landfill areas were used for residential and on-base waste disposal. The former Area A was used from 1956 to 1966. Areas B through F were operated from 1960 until 1987, when interim closure of the facility began, which effectively terminated waste disposal activities at the OU2 Landfills (Shaw, 2008a).

The remedial action at the former Area A was conducted from 1996 to 1998 in accordance with the requirements of the OU2 Landfills ROD (Army, 1994) and the *Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill* (CAMU ESD; Army, 1997a). Approximately 585,000 cubic yards of refuse were excavated during the remediation. This material was placed and compacted as part of the general fill in Areas B, C, D, and F of the OU2 Landfills (IT Corporation, 2001). Closure is being completed as a remedial action at the OU2 Landfills in accordance with the OU2 Landfills ROD (Army, 1994).

The selected remedial action presented in the OU2 Landfills ROD includes placing an engineered cover system over buried refuse at the OU2 Landfills. The *Record of Decision, Basewide Remedial Investigation Sites, Fort Ord, California* (RI Sites ROD; Army, 1997b) in conjunction with the CAMU ESD (Army, 1997a) and the *Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs)* (Army, 2006) designate CAMU regulations as ARARs for the existing boundaries of Areas B through F. Such designation generally allows remediation waste to be placed at the OU2 Landfills and used as a foundation layer without triggering certain disposal regulations. Soil remedies for the RI Sites at the Former Fort Ord utilized the CAMU for placement of excavated soil and/or debris, which are managed, incorporated within the landfill foundation layer, and capped as part of the landfill.

The remedial actions for the debris and soil at the OU2 Landfills include a cover system, collection and removal of LFG (if necessary), institutional controls, and a groundwater extraction and treatment system for volatile organic compounds (VOCs). The Army completed construction of an engineered cover over Areas B through F from 1997 to 2002 (Shaw, 2005a) and began operating the groundwater extraction and treatment system in 1995. In 2001 the Army installed a pilot extraction and treatment system to mitigate LFG migration along the eastern perimeter of Area F where a residential area is located closest to the landfill (Shaw, 2005b). The system began operation on June 4, 2001 and included a series of LFG extraction wells (EWs), LFG treatment with granular activated carbon (GAC) to remove VOCs, and

potassium permanganate to remove vinyl chloride. Two 8-inch diameter perforated collector pipes, approximately 800 feet in total length, were installed in the foundation layer at Area E during construction in 2002 for possible future methane extraction. The collector pipes are collectively referred to as extraction point (EP) EP-36.

Based on the results of the pilot study, the extraction and treatment system was expanded by adding vertical extraction wells (EW) along the perimeter and within the interior of Area F, and replacing the existing treatment system with a thermal treatment unit (TTU), which started operation in April 2006. The TTU, unlike the GAC/potassium permanganate treatment system, removes and treats both VOCs and methane by combustion in an enclosed flare operating in excess of 1,400 degrees Fahrenheit (°F).

In 2008, an EW was installed in Area D to augment the methane output from the Area F extraction system. A conduit from EP-36 to the TTU also was installed as part of the LFG treatment system expansion (Shaw, 2008b). In April 2009, EP-36 was brought online to augment the methane output from the Area F extraction system. As part of Field Work Variance TII-138 to the O&M Plan (Shaw, 2008a), testing was performed on Area F passive vent (VF) VF-4 to determine if it was a viable source of methane that could be used in operation of the TTU. Results of this test determined that a significant increase in methane removal could be achieved through the addition of VF-4 into the extraction network. In June 2009, VF-4 was brought on line to augment the methane output from the Area F extraction system.

In February 2011, four additional passive vents in Areas D and F (VD-2, VD-3, VF-3, and VF-5) were converted to EPs to augment the methane output. These additions were documented in Field Work Variance TII-154 to the O&M Plan (Shaw, 2008a).

System monitoring includes all EPs and the combined collection points at the TTU. Since the remedy is being performed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA; 42 USC 9601 et seq.), as amended by the Superfund Amendment and Reauthorization Act of 1986 (SARA), the Monterey Bay Air Resources District (Air District) does not have jurisdiction over these remedial actions, and a permit for the TTU and exhaust stack is not required. However, the Air District's substantive requirements are being implemented.

Due to the need for remediation at the Site 39 Inland Ranges, and the availability of additional remediation waste capacity at Area E, the Army proposed to place contaminated soil from the Site 39 Inland Ranges within the existing footprint of Area E as a vertical expansion. The Army prepared the *Record of Decision Amendment, Site 39 Inland Ranges, Former Fort Ord, California* (Army, 2009) to present the soil cleanup levels and the volume of soil to be addressed under the selected remedial action for the Site 39 Inland Ranges originally identified in the RI Sites ROD (Army, 1997b). Additional capacity at the OU2 Landfills was available by placing remediation waste within the existing Area E footprint on top of the existing engineered cover system. Construction of the vertical expansion involved placing additional remediation waste above the existing geomembrane and installing a new engineered cover consisting of a foundation layer, geomembrane, and vegetative layer over the remediation waste. The vertical expansion allows for placement of approximately 200,000 cubic yards of remediation waste in at least two phases. When the vertical expansion is complete, the additional remediation waste will be sealed above and below by a geomembrane. Phase 1 was completed in 2013

with approximately 150,000 cubic yards placed in the vertical expansion at Area E. Additional remediation of Site 39 and placement of soil in the Area E vertical expansion may be necessary for the future.

The technical assessment of the remedies for OU2 completed for the 4<sup>th</sup> Five-Year Review for the Fort Ord Superfund Site identified no issues for OU2. The OU2 remedies were deemed to be protective of human health and the environment and, in the interim, potential exposure pathways that could result in unacceptable risks are being controlled (Army, 2012).

### **3.1.2 Sources of Known or Suspected Hazardous Waste**

No detailed records were kept on the amount or types of wastes disposed of at the OU2 Landfills; however, household and commercial refuse, ash from incinerated infectious wastes, dried sewage sludge, demolition material, and small amounts of chemical waste (such as paint, waste oil, pesticides, electrical equipment, ink and epoxy adhesives) are believed to have been disposed of in the OU2 Landfills (Dames & Moore, 1993).

### **3.1.3 Known Contaminants**

Known contaminants at the OU2 Landfills are methane and VOCs in LFG. For methane, the primary release mechanism is emanation from decomposing organic waste. For VOCs, the primary release mechanisms are emanation (within LFG) and infiltration/percolation to groundwater.

### **3.1.4 Fate and Transport Considerations**

VOCs remaining in waste disposed of at the OU2 Landfills and VOCs detected in LFG have the potential to travel through soil pore space to exposure points via a number of mechanisms:

- Advection: mass transport due to bulk flow of water in which contaminants are dissolved.
- Dispersion: transport due to the groundwater flow whether or not a compound is dissolved.
- Diffusion: spreading of contaminants due to molecular diffusion in response to concentration gradients.
- Volatilization: loss of chemical vapor to the atmosphere.

VOCs naturally undergo biological degradation processes in soil, soil gas and groundwater; however, the rate of such degradation is limited by oxygen and nutrient sources depending upon the type of degradation that is occurring (aerobic vs. anaerobic). Further, degradation of compounds is dependent on the biological pathway available.

Groundwater contamination at OU2 affected the upper three groundwater aquifers as described in the *Final Remedial Investigation/Feasibility Study, Fort Ord, California, Volume II – Remedial Investigation Introduction and Basewide Hydrogeologic Characterization* (HLA, 1995). These three aquifers include the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer. In the vicinity of OU2, the tops of each of these aquifers typically are first encountered at depths of about 60 feet bgs, 150 feet bgs, and 250 feet bgs, respectively. In monitoring well MW-OU2-73-A, located at the OU2 Landfills Area F source area, tetrachloroethene and trichloroethene are below their Aquifer Cleanup Levels or not detected, but vinyl chloride is detected at the highest concentrations for the OU2 A-Aquifer. Vinyl chloride is a

breakdown product in the natural reductive dechlorination process and may indicate this process is occurring locally at OU2 Landfills Area F.

With implementation of the remedy as prescribed in the OU2 Landfills ROD (engineered landfill cover system, and groundwater extraction and treatment system) in addition to operation of the LFG extraction and treatment system, impacts to the underlying groundwater from the OU2 Landfills have been greatly mitigated.

### **3.1.5 Potential Receptors and Exposure Pathways**

A residential area is located adjacent to OU2 Landfills Area F, with the closest residence located approximately 368 feet from the OU2 Landfills perimeter. There is a potential for residents to be exposed to VOCs from inhalation of vapors in ambient air, which may enter buildings through open windows or ventilation systems. To evaluate risks associated with this scenario, the Army performed ambient air monitoring in 2000, 2001, 2002 and 2003 to determine LFG dispersion in ambient air on the east side of Area F. The data were used to complete a screening-level human health risk assessment (HHRA). The updated HHRA indicated that the OU2 Landfills are not a significant contributor of VOCs in ambient air or a significant risk to downwind receptors (Shaw, 2005c). The HHRA also noted that the LFG collection and treatment system installed at Area F prevents LFG from migrating off-site in the direction of the residential area. Since the onset of TTU operations, the methane concentrations in perimeter monitoring probes have remained below 5 percent (%) per the requirements of Title 27 California Code of Regulations (27CCR) Section 20921(a)(2) (Ahtna, 2017 and 2018).

### **3.1.6 Land Use Considerations**

The OU2 Landfills encompass approximately 120 acres of land that is undeveloped other than use as a landfill. A residential housing area for California State University Monterey Bay is located adjacent to OU2 Landfills Area F, with the closest residence located approximately 368 feet from the OU2 Landfills perimeter.

Other land immediately adjacent to the OU2 Landfills was transferred from the Army to the Fort Ord Reuse Authority in 2004 and 2006 and remains undeveloped. These parcels of land are identified in the *Installation-Wide Habitat Management Plan for Former Fort, California* (HMP) as containing habitat occupied or potentially occupied by several sensitive wildlife and plant species, some of which are listed or proposed for listing as threatened or endangered under the federal Endangered Species Act. Accordingly, this land is categorized as “Development with Reserve Areas or Development with Restrictions” in the HMP. While the land may be developed, there are specific restrictions to protect biological resources as identified in the HMP and the quitclaim deeds associated with the land.

The quitclaim deeds for land within 1,000 feet of the OU2 Landfills also include a notification stating landowners should refer to 27CCR Section 21190, which identifies protective measures for structures built on or within 1,000 feet of a landfill.

### **3.1.7 Physiography and Topography**

Elevations at Fort Ord range from approximately sea level at the beach to 900 feet mean sea level (MSL) at Wildcat Ridge. At the OU2 Landfills, elevations range from approximately 160 feet MSL at the west end of Area B to 255 feet MSL at the top of the Area E ridgeline. Runoff is minimal due to the high rate

of surface water infiltration into the permeable dune sand; consequently, well-developed natural drainages are absent throughout much of this area. However, erosion has been observed primarily where roads were cut into slopes. In these areas, small gullies are present, but generally end shortly after the topography flattens out. Closed drainage depressions typical of dune topography are common.

### **3.1.8 Geology and Hydrogeology**

Remedial investigation at the OU2 Landfills indicated that the landfill materials were buried in relatively uniform sand dune deposits in shallow trenches approximately 30 feet wide, 10 to 15 feet apart, and extending from ground surface to 10 to 30 feet below ground surface (bgs). Soil samples collected below the OU2 Landfills do not contain chemicals associated with the Landfills; however, chemicals associated with landfilled materials have been detected in soil vapor samples obtained from soil overlying the Landfills and in the groundwater collected from beneath the Landfills. The chemicals are believed to have migrated away from the landfilled materials as vapors or as solutes in leachate (Army, 1995).

Groundwater in the uppermost A-Aquifer in the area of the OU2 Landfills generally flows northwest toward the Monterey Bay; however, groundwater east of the OU2 Landfills generally flows northeast toward the Salinas River due to a groundwater divide located east of Area F. Due to extensive local and regional pumping of water from the Upper and Lower 180-Foot Aquifers for agricultural and domestic use, the natural westward flow of groundwater is reversed to the east toward the Salinas Valley. The Upper 180-Foot Aquifer is separated from the A-Aquifer by a relatively impermeable clay layer known as the Salinas Valley Aquitard; however, near the Monterey Bay, these two aquifers are connected because the aquitard pinches out in this area. Therefore, chemicals of concern (COCs) in the A-Aquifer have the potential to migrate into the Upper 180-Foot Aquifer (Army, 1995).

## 3.2 Worksheet #11: Project/Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from data. The DQO process used for developing data quality criteria and performance specifications for decision-making is consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 2006). The DQO process consists of the following seven steps:

- Step 1: State the problem
- Step 2: Identify the goals of the study
- Step 3: Identify information inputs
- Step 4: Define the boundaries of the study
- Step 5: Develop the analytical approach
- Step 6: Specify performance or acceptance criteria
- Step 7: Develop the plan for obtaining data

There are DQOs for the three types of testing at the OU2 Landfills: (1) TTU source testing, (2) TTU operational influent LFG testing, and (3) LFG monitoring at the Landfills perimeter.

### 3.2.1 DQO #1: TTU Source Testing

**Problem Statement.** Even though the Air District does not have jurisdiction over the TTU and the exhaust stack, the Army will perform annual source testing of the TTU to determine whether it operates efficiently and meets local regulatory standards. The optimum operating conditions, based on permits issued for similar facilities for the type of TTU at the OU2 Landfills, are:

- Minimum destruction efficiency of total hydrocarbons (THC) shall be 98% by weight, or reduction of the outlet non-methane organic compounds (NMOC) concentration to less than 20 parts per million by volume (ppmv), dry basis as hexane, at 3% oxygen (O<sub>2</sub>).
- Minimum destruction efficiency of methane shall be 99% by weight.
- Combustion temperature shall be maintained at a minimum of 1,400 °F within 30 minutes of any startup; minimum combustion residence time shall be 0.6 seconds.
- Instrumentation shall record combustion temperature continuously during operation.
- Nitrogen oxide (NO) emissions shall not exceed 0.06 pounds per million British thermal units (lb/MMBtu).
- Carbon monoxide (CO) emissions shall not exceed 0.18 lb/MMBtu.
- THC emissions shall not exceed 0.03 lb/MMBtu.
- Sulfur dioxide (SO<sub>2</sub>) emissions shall not exceed 0.2% by volume (%v; 2,000 ppmv).
- Inlet sulfur content shall not exceed 50 grains hydrogen sulfide per 100 cubic feet of gas.
- Instrumentation shall continuously record the amount of LFG flow to the flare during operation.
- No air contaminant which is as dark as or darker than Ringlemann 1 or equivalent (20% opacity) shall be discharged for more than an aggregate 3 minutes in any hour.
- No emission shall constitute a public nuisance.

Influent LFG and exhaust emission concentrations and flow rates (measured under maximum available throughput loads) will be used to calculate the mass emission rates of LFG constituents and the mass emission factors for secondary pollutants that result from the combustion process.

**Study goals.** The goals of the study are to determine whether the TTU operates efficiently under current operating conditions and meets local regulatory standards. The system may require adjustments to increase its efficiency and/or to achieve the target operating conditions.

**Information inputs.** To meet the goals of the study, the following inputs will be required:

Stack Emissions (Effluent)

- Gas stream volumetric flow rate
- Nitrogen oxides (NO<sub>x</sub>), CO, O<sub>2</sub>, carbon dioxide (CO<sub>2</sub>)
- NMOCs/THC
- SO<sub>2</sub> (calculated)
- Methane (CH<sub>4</sub>)
- VOCs listed in Worksheet #15 (Section 3.6.3)
- Flare temperature

Influent LFG

- Heating value (calculated based on hydrocarbon content; caloric content of gas)
- O<sub>2</sub>, CO<sub>2</sub>, nitrogen (N<sub>2</sub>)
- CH<sub>4</sub>
- VOCs listed in Worksheet #15 (Section 3.6.3)
- NMOCs
- Reduced sulfur compounds
- LFG flow rate

A certified mobile laboratory provided and staffed by Best Environmental will be on site to measure the above parameters (with the exception of VOCs, fixed gases, and reduced sulfur compounds, which will be analyzed in a certified fixed laboratory). Best Environmental is certified by the State of California Air Resources Board to conduct compliance testing pursuant to California Code of Regulations, Title 17, Section 91207. Section 6.0 provides details of the analytical methods to be employed. The LFG flow rate and flare temperature will be measured using a calibrated flow meter and thermocouple on site.

Sample data from stack emissions and influent LFG testing, in combination with gas flow rates and other parameters, will be used to perform calculations to determine whether the TTU achieves the optimum operating conditions.

**Study boundaries.** Emission samples will be collected from two sampling ports on the TTU stack. The sampling ports are in the same horizontal cross-section of the stack but are 90 degrees apart. Influent LFG samples will be collected from a sampling port located before the TTU.



**Analytical approach.** TTU stack emissions and the influent LFG concentrations for specific gases are measured to determine the TTU's efficiency, its ability to achieve optimum operating conditions, and its ability to meet regulatory standards.

- If mathematical calculations and direct measurement data obtained from stack emissions and influent LFG testing demonstrate that it meets the target operating conditions, then the TTU will be considered to be operating efficiently.
- If mathematical calculations and direct measurement data obtained from stack emissions and operational influent LFG testing do not demonstrate that it meets the target operating conditions, then the TTU may require adjustments to increase its efficiency and meet target operating conditions.
- If stack emission data show that the system does not achieve regulatory standards, then the TTU may require optimization or upgrading to achieve the regulatory standards.
- If stack emission data show that the system meets regulatory standards, then the TTU will not require further optimization.
- If a VOC has not been detected in any of the samples associated with the LFG extraction system (TTU influent, extraction legs, stack) for five consecutive annual monitoring events, the VOC will be removed from the TO-15 target analyte list (Worksheet #15) for operational extraction system sampling only.
- The eleven VOCs identified as COCs for groundwater in the OU2 Landfills ROD will remain on the TO-15 target analyte list, regardless of whether they have been non-detect for five consecutive annual monitoring events.
- If the list of VOCs identified as COCs for groundwater is revised in a subsequent OU2 decision document, then the most current list of COCs for groundwater will remain on the TO-15 target analyte list.
- To confirm compliance with regulatory standards, the full TO-15 list of VOCs will be reported once every 5 years<sup>2</sup> for samples associated with the TTU system. If a VOC that was previously removed from the TO-15 target analyte list for DQO #1 is detected, this VOC will be added to the TO-15 target analyte list for DQO #1 (Worksheet #15).
- These criteria are applied retroactively as part of a previous QAPP revision to include VOC analytical data collected since TTU operations began in April 2006 (Ahtna, 2016a).

**Performance or acceptance criteria.** Decisions could be affected adversely by errors in field and/or fixed laboratory measurements. By adhering to standard procedures, and approved methods to obtain the most reliable data, decision errors will be minimized and should not be a factor in making decisions.

**Plan for obtaining data.** The TTU should be operated and maintained properly to achieve continuous optimum performance and efficiency per the requirements of the O&M Plan (Shaw, 2008a). The field

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<sup>2</sup> The full TO-15 list of VOCs was last reported in the *Final Annual Report, 2015, Operations and Maintenance, Operable Unit 2 Landfills, Former Fort Ord, California* (2015 Annual Report, Administrative Record No. OU2-703) and will next be reported in the 2019 Annual Report. The full TO-15 list of certified compounds is provided in Attachment B, Analytical Laboratory Information.

test methods, parameters, numbers of tests, durations of tests for stack emission testing, and information inputs for effluent LFG are:

Sample Parameter	Test Method	Number of Runs/Samples	Test Duration	Information Input Source
Flow Rate	EPA Method 19	3	40 minutes	Mobile Laboratory
O <sub>2</sub> , CO <sub>2</sub>	EPA Method 3A	3	40 minutes	Mobile Laboratory
CH <sub>4</sub> /NMOC/THC	EPA Method 25A	3	40 minutes	Mobile Laboratory
CO	EPA Method 10	3	40 minutes	Mobile Laboratory
NO <sub>x</sub>	EPA Method 7E	3	40 minutes	Mobile Laboratory
VOCs	EPA Method TO-15	1	NA	Fixed Laboratory

Access to the stack will be through a shared sample line provided by the source testing contractor. For all sample parameters except VOCs, a heated and filtered stainless steel probe will be used to extract the gas sample from the stack. A heated, 3/8-inch Teflon<sup>®</sup> line will transport the sample from the point of extraction to the non-contact gas conditioning chiller system. The gas conditioning system and all analytical equipment will be provided by the source testing contractor in a self-contained mobile test laboratory. The moisture will be condensed and removed from the gas stream, while the pollutants pass through to the analytical equipment. The analyzer will be located in a temperature-controlled area to minimize thermal effects on the calibration of the instrument used in taking the measurements. For VOCs, the sample is collected at the sample port on the stack, using a vacuum pump and Tedlar<sup>™</sup> bag, and shipped to the fixed laboratory (Eurofins) for analysis.

The laboratory test methods, parameters, numbers of tests, and information inputs for influent LFG are as follows:

Sample Parameter	Test Method	Number of Samples	Information Input Source
Heating Value (calculated), O <sub>2</sub> , CO <sub>2</sub> , NMOC	ASTM D1945	1	Fixed Laboratory
VOCs	EPA Method TO-15	1	Fixed Laboratory
Total Reduced Sulfurs	ASTM D5504	1	Fixed Laboratory
LFG rate	Field measurement	Continuous	Flow meter
Flare temperature	Field measurement	Continuous	Thermocouple

Source testing will be performed annually to demonstrate that the TTU is operating within the substantive requirements of Air District emission limits.

### 3.2.2 DQO #2: Operational Influent LFG Testing

**Problem Statement.** The composition and concentration of the operation influent gas stream need to be known in order to operate the TTU efficiently and to establish a schedule of treatment and extraction operations. The composition and characteristics from operational EWs need to be monitored to maintain compliance with 5%v standard at the property boundary. VOC mass extraction rates may need to be adjusted to maximize removal.

**Study goals.** The principal study goals are to determine the operational influent LFG composition and characteristics so that methane concentrations can be maintained below the lower explosive limit of 5%v, and to determine the composition and characteristics of operational EWs and other wells and probes to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds.

**Information inputs.** To determine trends in composition and characteristics present in the TTU operational influent LFG and the EWs, the following inputs are required using a portable LFG analyzer:

Influent LFG

CH<sub>4</sub>

CO<sub>2</sub>

O<sub>2</sub>

Balance gas (a combination of the remainder of gases, but the majority is N<sub>2</sub>)

Temperature

Flow

Vacuum

Input will also come from the analysis by EPA Method TO-15 at a fixed-base laboratory for the list of VOCs provided in Worksheet #15 (Section 3.6.3).

**Study boundaries.** The boundaries of the study are the frequency and the locations of monitoring points for the TTU and the compliance perimeter probes and EWs on the Eastern side of Area F, where the OU2 Landfills are closest to a residential housing area.

**Analytical approach.** The composition of gases from the operational EWs and perimeter probes will be monitored.

- If the concentration of methane is below 40%v, and the flow rate is below 30 standard cubic feet per minute (scfm), or if methane is below 30%v and the flow rate is below 50 scfm as measured in the influent LFG, then the system parameters will be adjusted (e.g., EW flow rates may be adjusted, the TTU may be shut down and operated intermittently, or supplemental fuel may be added to operate the TTU continuously).
- If the concentration of methane is greater than 50%v, and the flow rate is 180 scfm or greater, or if the concentration of methane is greater than 30%v, and the flow rate is 300 scfm or greater, resulting in maximum influent conditions greater than 5 million Btu per hour (Btu/hr), then the system may be adjusted or shut down.
- If the methane concentrations exhibit a downward trend, possibly due to short-term over-extraction of the available LFG, then the TTU may be operated intermittently, or shut down, or fuel may be added to avoid permanently damaging the methane-generating potential of the waste and substantially reducing the long-term availability of fuel for self-sustaining TTU operations.
- If methane concentrations in the compliance perimeter monitoring probes associated with the eastern perimeter leg are greater than the regulatory compliance concentration of 5%v, then the eastern perimeter leg will be operated more frequently to maintain compliance.
- If methane concentrations in the eastern perimeter probes are below 5%v, then this leg may be shut down.

- If methane concentrations in the northern or southern perimeter leg are less than 10%v, then these leg(s) may be shut down.
- If methane concentrations in individual interior EWs at Area F are below 40%v, then the individual wells may be shut down.
- If methane concentrations in individual interior EWs at Area D are below 30%v, then the individual wells may be shut down.
- If methane concentrations in the interior legs of Area D or Area F are below 50%v, then operation of the TTU will be intermittent rather than continuous.
- If EW temperatures are greater than 120 °F, then the individual well(s) or the leg will be shut down.
- If a VOC has not been detected in any of the samples collected from the LFG extraction system for five consecutive annual monitoring events, the VOC will be removed from the TO-15 target analyte list (Worksheet #15) for LFG extraction system sampling only.
- The eleven VOCs identified as COCs for groundwater in the OU2 Landfills ROD will remain on the TO-15 target analyte list, regardless of whether they have been non-detect for five consecutive annual monitoring events.
- If the list of VOCs identified as COCs for groundwater is revised in a subsequent OU2 decision document, then the most current list of COCs for groundwater will remain on the TO-15 target analyte list.
- The full TO-15 list of VOCs will be reported once every 5 years<sup>3</sup> for samples associated with the operational LFG extraction legs. If a VOC that was previously removed from the TO-15 target analyte list for DQO #2 is detected, this VOC will be added to the TO-15 target analyte list for DQO #2 (Worksheet #15).
- These criteria will be applied retroactively as part of a previous QAPP revision to include VOC analytical data collected since TTU operations began in April 2006 (Ahtna 2016a).

**Performance or acceptance criteria.** Decisions could be affected adversely by errors in field and/or fixed laboratory measurements. By adhering to standard procedures and approved methods to obtain the most reliable data, decision errors will be minimized and should not be a factor in making decisions.

**Plan for obtaining data.** The TTU should be operated and maintained properly to achieve continuous optimum performance and efficiency per the requirements of the O&M Plan (Shaw, 2008a). As required, field measurements will be performed using a portable LFG analyzer.

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<sup>3</sup> The full TO-15 list of VOCs was last reported in the 2015 Annual Report (Administrative Record No. OU2-703) and will next be reported in the 2019 Annual Report. The full TO-15 list of certified compounds is provided in Attachment B, Analytical Laboratory Information.

Sample Parameter	Location	Test Method	Frequency
CH <sub>4</sub> , O <sub>2</sub> , CO <sub>2</sub> , balance gas, temperature, flow rate, vacuum	Interior Extraction Legs, and points (wells and vents) in operation	Portable LFG analyzer	Biweekly or when system is in operation
	Influent	Portable LFG analyzer	Biweekly or when system is in operation
VOCs	Influent	EPA Method TO-15	Annual (during source testing)
VOCs	Interior Extraction Legs	EPA Method TO-15	Annual

### 3.2.3 DQO #3: Compliance Perimeter Probes

**Problem statement.** To provide for the protection of public health and safety and the environment, methane concentrations will not exceed 5%v at the landfill perimeter and trace gases will be controlled to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds.<sup>4</sup> Methane and VOCs are measured to determine whether concentrations are in compliance with the regulatory requirements or whether corrective actions need to be implemented.

**Goals of the study.** The primary decision is whether the concentrations of methane in the compliance perimeter probes meet the regulatory requirement. The secondary decision is whether the trace gas concentrations are at a level where they need to be controlled. The alternative actions that could result from these decisions are:

- Methane concentrations along the perimeter of the landfill do not exceed regulatory requirements, and no corrective actions are required, or methane concentrations along the perimeter of the landfill exceed the regulatory requirements and corrective actions need to be implemented.
- Methane concentrations along the eastern perimeter of Area F, where residential housing is located closest to the OU2 Landfills, are below 5%v and LFG migration is being controlled by operations of the TTU; or methane concentrations along the eastern perimeter of Area F are above 5%v and LFG migration is not being controlled by operations of the TTU and the operational schedule of the TTU needs to be modified.
- Trace gases need to be controlled to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds, or trace gases do not need to be controlled.

**Identify information inputs.** To resolve the decision statement, methane and VOC concentrations will be measured at the compliance perimeter probes.

Twenty-one compliance perimeter probes will be sampled annually for VOCs. Samples will be analyzed using EPA Method TO-15 for the list of VOCs provided in Worksheet #15 (Section 3.6.4). Results will be compared to historical ranges.

Compliance perimeter probes will be monitored quarterly for methane. A portable LFG analyzer will be used in the field to measure CH<sub>4</sub>, O<sub>2</sub>, CO<sub>2</sub>, and balance gas.

<sup>4</sup> For the purposes of this QAPP, “trace gases” means VOCs.

**Study boundaries.** To determine the concentrations of methane and trace gases compliance perimeter probes installed along the perimeter of the OU2 Landfills will be monitored.

**Analytical approach.** The parameters of interest are the concentrations of the methane and trace gases at the OU2 Landfills perimeter. Compliance perimeter probes (Figure 2) will be monitored quarterly for methane and annually for VOCs.

The following decision rules apply to methane in the compliance perimeter probes:

- If the concentration of methane is less than 5%v, then there is no LFG migration and the OU2 Landfills are in compliance with the regulatory requirements.
- If the concentration of methane is greater than 5%v, then there is a potential for LFG migration, and corrective actions need to be implemented.
- If methane concentrations along the eastern perimeter of Area F, where residential housing is located closest to the OU2 Landfills, are less than 5%v, then LFG migration is being controlled by operations of the TTU.
- If methane concentrations along the eastern perimeter of Area F, where residential housing is located closest to the OU2 Landfills, are greater than 5%v, then LFG migration is not being controlled by operations of the TTU and the operational schedule of the TTU needs to be modified.

The following decision rules relate to VOCs and are based on comparison of current analytical data with historical data since startup of the pilot LFG extraction and treatment system:

- For compliance perimeter probes with previous measured detections greater than 1,000 times the most current DTSC residential air screening level (DTSC-SL) for vinyl chloride (1,000 times the DTSC-SL equals 9.5 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) or 3.7 parts per billion by volume (ppbv) based on the current DTSC-SL (DTSC, 2018)), if the concentration of vinyl chloride exceeds the previous maximum recorded value, the probe will be sampled quarterly until two successive measurements show declining or constant concentrations.
- For compliance perimeter probes with previous measured detections greater than 1,000 times the most current DTSC-SL for tetrachloroethene (PCE) (1,000 times the DTSC-SL equals 460  $\mu\text{g}/\text{m}^3$  or 67.8 ppbv based on the current DTSC-SL (DTSC, 2018)), if the concentration of PCE exceeds the previous maximum recorded value, the probe will be sampled quarterly until two successive measurements show declining or constant concentrations.
- For compliance perimeter probes with previous measured detections greater than 100 times the most current EPA Residential Ambient Air Regional Screening Level (EPA-RSL) for chloroform (100 times the EPA-RSL equals 12  $\mu\text{g}/\text{m}^3$  or 2.5 ppbv based on the current EPA-RSL (EPA, 2018)): if the concentration of chloroform exceeds the previous maximum recorded value, the probe will be sampled quarterly until two successive measurements show declining or constant concentrations.
- For compliance perimeter probes with no previous measured detections greater than 1,000 times the most current DTSC-SL for vinyl chloride or PCE in gas: if the concentration remains less than 1,000 times the DTSC-SL, then no action is required.
- For compliance perimeter probes with no previous measured detections greater than 100 times

the most current EPA-RSL for chloroform in gas: if the concentration remains less than 100 times the EPA-RSL, then no action is required.

- For compliance perimeter probes with no previous measured detections greater than 1,000 times the most current DTSC-SL for vinyl chloride or PCE in gas: if the concentration exceeds 1,000 times the DTSC-SL, then the probe will be sampled quarterly until two successive measurements show declining or constant concentrations.
- For compliance perimeter probes with no previous measured detections greater than 100 times the most current EPA-RSL for chloroform in gas: if the concentration exceeds 100 times the EPA-RSL, then the probe will be sampled quarterly until two successive measurements show declining or constant concentrations.
- If a VOC has not been detected in any of the samples collected from compliance perimeter probes for five consecutive annual monitoring events, the VOC will be removed from the TO-15 target analyte list (Worksheet #15) for compliance perimeter probes only.
- The eleven VOCs identified as COCs for groundwater in the OU2 Landfills ROD will remain on the TO-15 target analyte list, regardless of whether they have been non-detect for five consecutive annual monitoring events.
- If the list of VOCs identified as COCs for groundwater is revised in a subsequent OU2 decision document, then the most current list of COCs for groundwater will remain on the TO-15 target analyte list.
- To confirm compliance with regulatory standards, the full TO-15 list of VOCs will be reported once every 5 years<sup>5</sup> for samples collected from compliance perimeter probes. If a VOC that was previously removed from the TO-15 target analyte list for DQO #3 is detected, this VOC will be added to the TO-15 target analyte list for DQO #3 (Worksheet #15).
- These criteria will be applied retroactively as part of a previous QAPP revision to include VOC analytical data collected since TTU operations began in April 2006 (Ahtna, 2016a).

**Performance or acceptance criteria.** Decisions could be affected adversely by errors in field and/or fixed laboratory measurements. By adhering to standard procedures and approved methods to obtain the most reliable data, decision errors will be minimized and should not be a factor in making decisions.

**Plan for obtaining data.** The compliance perimeter probes were installed at approximately 1,000 feet apart at the perimeter of the OU2 Landfills.

### 3.2.4 DQO #4: Monitoring Probes and Vents

**Problem statement.** To provide for the protection of public health and safety and the environment, methane concentrations will not exceed 5%v at the landfill perimeter and trace gases will be controlled to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds. Methane needs to be measured at monitoring probes and vents to provide additional data to ensure compliance with the regulatory requirements and to determine whether corrective actions need to be implemented.

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<sup>5</sup> The full TO-15 list of VOCs was last reported in the 2015 Annual Report (Administrative Record No. OU2-703) and will next be reported in the 2019 Annual Report.

**Goals of the study.** The primary decision is whether methane concentrations are exhibiting upward trends in the monitoring probes or landfill vents. The alternative actions that could result from these decisions are:

- Methane concentrations in the compliance perimeter probes adjacent to monitoring locations may be negatively impacted by increasing methane concentrations monitored in perimeter monitoring probes and landfill vents and corrective actions need to be implemented.
- Methane concentrations along the eastern perimeter of Area F, where residential housing is located closest to the OU2 Landfills, are below 5%v and LFG migration is being controlled by operations of the TTU; or methane concentrations along the eastern perimeter of Area F are above 5%v and LFG migration is not being controlled by operations of the TTU and the operational schedule of the TTU needs to be modified.

**Identify information inputs.** To resolve the decision statement, methane concentrations will be measured at the perimeter monitoring probes and landfill vents.

Forty-six monitoring probes will be sampled quarterly for methane. In addition to the monitoring probes, two shallow probes installed in the utility trench located within the OU2 Landfills also will be monitored. The 12 passive vents installed along the center ridgeline of each landfill area also will be monitored. Methane concentrations in all passive vents consistently are above 5%v; however, there is no regulatory standard for methane concentration in passive vents, nor are there any regulatory actions for methane concentrations exceeding 5%v in passive vents in solid waste landfills. Vents are not intended to be representative sampling locations for LFG conditions in the waste, and monitoring results are used as only a non-quantitative indicator of trends in LFG accumulation in the foundation cover soils. A portable LFG analyzer will be used in the field to measure CH<sub>4</sub>, O<sub>2</sub>, CO<sub>2</sub>, and balance gas.

Additional investigations, such as the installation of permanent or temporary probes, may be conducted to measure methane and/or VOCs. Additional investigations may be prepared and implemented as an amendment to this QAPP or as a separate plan.

**Study boundaries.** To determine any upward methane trends, monitoring probes and vents at OU2 Landfills will be monitored.

**Analytical approach.** The parameters of interest are the concentrations of the methane at the OU2 Landfills.

The following decision rules apply to methane in the perimeter probes:

- If the concentration of methane is greater than 5%v, an upward trend in concentration is observed, then there is a potential for LFG migration, and corrective actions need to be implemented.
- If methane concentrations along the eastern perimeter of Area F, where residential housing is located closest to the OU2 Landfills, are less than 5%v, then LFG migration is being controlled by operations of the TTU.
- If methane concentrations along the eastern perimeter of Area F, where residential housing is located closest to the OU2 Landfills, are greater than 5%v, then LFG migration is not being



controlled by operations of the TTU and the operational schedule of the TTU needs to be modified.

The following decision rules apply to monitoring frequency of the perimeter probes:

- Probes designated as Additional LFG Monitoring Probes (Figure 2) will be monitored quarterly for methane except:
  - If methane concentrations in the probe are less than 1%v for 20 consecutive quarterly monitoring events, then the probe will be moved to an annual monitoring schedule.
  - If methane concentrations in the probe are less than 1%v for five consecutive annual monitoring events, then the probe will be removed from the monitoring program.

These decision rules will be applied retroactively as part of a previous QAPP revision to include methane concentration data collected since TTU operations began in April 2006 (Ahtna, 2016a).

- If the TTU is unintentionally nonoperational for technical reasons or other unforeseen circumstances for more than 2 months, additional LFG Monitoring Probes in Area F that are on an annual monitoring schedule will be monitored for methane concentrations in the next quarterly monitoring event. Additional probes may be added to the monitoring program depending upon the results of the additional annual probes added. This data will be used to determine TTU operational parameters when the TTU is online again.

The following decision rules apply to methane in the utility trench probes:

- If the concentration of methane is less than 5%v, then there is no potential for LFG migration via the utility trench and the OU2 Landfills are in compliance with the regulatory requirements.
- If the concentration of methane is greater than 5%v, then there is a potential for LFG migration via the utility trench and corrective actions need to be implemented.

**Performance or acceptance criteria.** Decisions could be affected adversely by errors in field measurements. By adhering to standard procedures and approved methods to obtain the most reliable data, decision errors will be minimized and should not be a factor in making decisions.

**Plan for obtaining data.** The probes along the northern and eastern perimeters of Area F, which are closer to residential areas, are spaced a maximum of 500 feet apart due to the landfill proximity to the housing area. Additional investigations, such as the installation of permanent or temporary perimeter probes or ambient air monitoring, also may be conducted to characterize methane and trace gas concentrations.

### 3.3 Worksheet #12: Measurement Performance Criteria

The following sections provide measurement performance criteria for the fixed laboratory methods. For measurement performance criteria for the mobile laboratory continuous sampling EPA Methods 3A, 7E, 10 and 25A, refer to the method documentation.

#### 3.3.1 Analytical Group/Method: Fixed Gases/ASTM D1945

Estimated Concentration Level: Low

Matrix: Gas (ppmv)

Data Quality Indicators (DQIs)	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field Duplicates	Relative Percent Difference (RPD) < 50%
Precision	Laboratory Duplicate	RPD < 25%
Accuracy	Laboratory Control Sample	85-115%
Bias/Sensitivity	Method Blanks	< Limit of Quantitation (LOQ) <sup>1</sup>
Completeness	Data Assessment	≥ 90%
Comparability	Data Review: compare results to previous sampling events	Same unit of measure and LOQs are consistent with previously collected data

#### 3.3.2 Analytical Group/Method: Sulfur Gases/ASTM D5504

Estimated Concentration Level: Low

Matrix: Gas (ppbv)

DQIs	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field Duplicates	RPD < 50%
Precision	Laboratory Duplicate	RPD < 25%
Accuracy	Laboratory Control Sample	70-130%
Bias/Sensitivity	Method Blanks	< LOQ <sup>1</sup>
Completeness	Data Assessment	≥ 90%
Comparability	Data Review: compare results to previous sampling events	Same unit of measure and LOQs meet project decision limits (PDLs) <sup>1</sup>

<sup>1</sup>See Worksheet #15 for LOQ values

### 3.3.3 Analytical Group/Method: Volatile Organic Compounds (VOC)/TO-15

Estimated Concentration Level: Low

Matrix: Gas (ppbv)

DQIs	QC Sample or Measurement Performance Activity	Measurement Performance Criteria	
Precision	Field Duplicates	RPD < 50%	
Precision	Laboratory Duplicate	RPD < 25%	
Accuracy	Surrogate	1,2-dichloroethane-d4	70-130 %
		Toluene-d8	70-130 %
		4-Bromofluorobenzene	70-130 %
Accuracy	Laboratory Control Sample (LCS) <sup>1,2</sup>	Benzene	70-130 %
		Carbon Tetrachloride	70-130 %
		Chloroform	70-130 %
		1,1-Dichloroethane	70-130 %
		1,2-Dichloroethane	70-130 %
		cis-1,2-Dichloroethane	70-130 %
		1,2-Dichloropropane	70-130 %
		Dichloromethane (Methylene chloride)	70-130 %
		Tetrachloroethene	70-130 %
		Trichloroethene	70-130 %
		Vinyl chloride	70-130 %
Bias/Sensitivity	Method Blanks	<LOQ <sup>3</sup> (common laboratory contaminants) and < ½ LOQ (all other compounds)	
Completeness	Data Assessment	≥ 90%	
Comparability	Data Review: compare results to previous sampling events	Same unit of measure and LOQs meet PDLs <sup>3</sup>	

**Analytical Group/Method: Volatile Organic Compounds (VOC)/TO-15 (continued)**

**Notes:**

<sup>1</sup>Samples will be spiked for all compounds on the TO-15 project reporting list(s) (presented in Sections 3.6.3 and 3.6.4); however, only the compounds presented will be controlled per the requirements presented in the table. Compounds presented are those listed as COCs for groundwater in Table 1 of the OU2 Landfills ROD (Army, 1994). VOCs in LFG are not identified as COCs in the OU2 Landfills ROD (Army, 1994); however, ARARs identified in the OU2 Landfills ROD require control of trace gases to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds; therefore, the comprehensive project report list(s) of TO-15 analytes are reported to ensure the substantive requirements of these ARARs are met.

<sup>2</sup>The remaining compounds need to meet the following requirements:

- a. Standard compounds: 70 - 130% for at least 90% of the compounds
- b. Non-standard compounds: 60 - 140% for at least 80% of the compounds
- c. Hexachlorobutadiene: 50-150%

<sup>3</sup>See Worksheet #15 for LOQs

### 3.4 Worksheet #13: Secondary Data Uses and Limitations

Secondary data and information that will be used, including originating sources, are identified below. How the secondary data will be used and the limitations on their uses are specified. Data from these documents will be utilized as appropriate.

<b>Data Type</b>	<b>Data Source</b> (originating organization, report title and date)	<b>Data Uses Relative to Current Project</b>	<b>Factors Affecting the Reliability of Data and Limitations on Data Use</b>
Soil Gas, Inspection Reports, Figures, Analytical Data	Gilbane Company Final Annual Report, 2014, Operations and Maintenance, Operable Unit 2 Landfills. July 2015	Trend analysis, design optimization	None
Soil Gas, Inspection Reports, Figures, Analytical Data	Ahtna Final Annual Report, 2015, Operations and Maintenance, Operable Unit 2 Landfills. April 2016	Trend analysis, design optimization	None
Soil Gas, Inspection Reports, Figures, Analytical Data	Ahtna Final Annual Report, 2016, Operations and Maintenance, Operable Unit 2 Landfills. July 2017	Trend analysis, design optimization	None
Soil Gas, Inspection Reports, Figures, Analytical Data	Ahtna Final Annual Report, 2017, Operations and Maintenance, Operable Unit 2 Landfills. May 2018	Trend analysis, design optimization	None

### 3.5 Worksheets #14 and #16: Project Tasks and Schedule

Sixty-nine monitoring probes and two utility trench probes are located around Areas B through F (Figure 2). Figure 2 also shows the locations of the probes designated as compliance probes for quarterly methane monitoring and annual VOC monitoring.

Annual monitoring is conducted to collect samples for VOCs for fixed-base laboratory analysis. Annual monitoring generally occurs in the second quarter. Source testing generally is concurrent with the annual VOC sampling.

Activity	Responsible party	Frequency	Deliverable(s)
TTU Monitoring	Ahtna	Biweekly or during TTU operation	Annual Report
Landfill O&M	Ahtna	After major rain events and as needed	Annual Report
TTU Inspection / maintenance	Ahtna	During operation, Quarterly	Annual Report
Landfill methane monitoring	Ahtna	Quarterly	Annual Report
Landfill Inspections	Monterey County Department of Health	Quarterly	Annual Report
Landfill Inspections	Ahtna <sup>2</sup>	Annually	Annual Report
VOC Monitoring	Ahtna	Annually <sup>1</sup>	Annual Report

**Notes:**

<sup>1</sup>The landfill methane monitoring frequency may be decreased to annual or discontinued based on decision rules presented in Worksheet #11, DQO #4.

<sup>1</sup>VOC monitoring frequency may be increased to quarterly based on decision rules presented in Worksheet #11, DQO #3.

<sup>2</sup>The annual landfill inspection will be performed by a California registered professional civil engineer.

### 3.6 Worksheet #15: Laboratory-Specific Detection/Quantitation Limits<sup>1,2</sup>

#### 3.6.1 Analytical Group/Method: Fixed Gases/ASTM D1945

Estimated Concentration Level: Low

Matrix: Gas (%)

Analyte	CAS Number	Laboratory LOD	Laboratory LOQ
Acetylene	74-86-2	0.0001	0.001
Butane	106-97-8	0.0001	0.001
NMOC (C6+)	NA	0.0001	0.01
Carbon dioxide	124-38-9	0.007	0.01
Ethane	74-84-0	0.0001	0.001
Ethene	74-85-1	0.0001	0.001
Isobutane	75-28-5	0.0001	0.001
Isopentane	78-78-4	0.0001	0.001
Methane	74-82-8	0.0008	0.0001
Neopentane	463-82-1	0.0001	0.001
Pentane	109-66-0	0.0001	0.001
Propane	74-98-6	0.0001	0.001
Oxygen	7782-44-7	NA <sup>3</sup>	0.1
Nitrogen	7727-37-9	NA <sup>3</sup>	0.1
Carbon monoxide	630-08-0	0.007	0.01
Hydrogen	1333-74-0	0.004	0.01

**Notes:**

CAS = Chemical Abstracts Service

LOD = limit of detection

LOQ = limit of quantitation

NMOC = non-methane organic compound (quantified using calibration of hexane and heptane)

<sup>1</sup>Project action limits are not listed in Worksheet #15 because there are no action limits for LFG constituents identified in the OU2 Landfills ROD (Army, 1994); however, these analyses are performed to meet the substantive requirements of ARARs identified in the OU2 Landfills ROD.

<sup>2</sup>The laboratory will report results that are non-detect to the LOQ. Results will be quantified as estimated between the LOD and the LOQ.

<sup>3</sup>LOD analysis requires dilution of the lowest concentration standard, but O<sub>2</sub> and N<sub>2</sub> cannot be reported from a diluted analysis.

### 3.6.2 Analytical Group/Method: Sulfur Gases/ASTM D5504

Estimated Concentration Level: Low

Matrix: Gas (ppbv)

Analyte	CAS Number	Laboratory LOD	Laboratory LOQ
Hydrogen sulfide	7783-06-4	3.0	4.0
Carbonyl sulfide	463-58-1	3.0	4.0
Methyl mercaptan	74-93-1	3.0	4.0
Ethyl mercaptan	75-08-1	3.0	4.0
Dimethyl sulfide	75-18-3	3.0	4.0
Carbon disulfide	75-15-0	3.0	20.0
Isopropyl mercaptan	75-33-2	3.0	4.0
tert-Butyl mercaptan	75-66-1	3.0	4.0
n-Propyl mercaptan	107-03-9	3.0	4.0
Ethyl methyl sulfide	624-89-5	3.0	4.0
Thiophene	110-02-1	3.0	4.0
Isobutyl mercaptan	513-44-0	3.0	4.0
Diethyl sulfide	352-93-2	3.0	4.0
n-Butyl mercaptan	109-79-5	3.0	4.0
Dimethyl disulfide	624-92-0	3.0	4.0
3-Methylthiophene	616-44-4	3.0	4.0
Tetrahydrothiophene	110-01-0	3.0	4.0
2-Ethylthiophene	872-55-9	3.0	4.0
2,5-Dimethylthiophene	638-02-8	3.0	4.0
Diethyl disulfide	110-81-6	3.0	4.0

**Notes:**

CAS = Chemical Abstracts Service

LOD = limit of detection

LOQ = limit of quantitation



**3.6.3 Analytical Group/Method: VOC/TO-15 – DQO #1: TTU Source Testing and DQO #2: Operational Influent LFG Testing (see Worksheet #11)**

Estimated Concentration Level: Low

Matrix: Gas (ppbv)

Analyte	CAS Number	Laboratory LOD	Laboratory LOQ
1,1-Dichloroethane	75-34-3	0.25	0.5
1,1-Dichloroethene	75-35-4	0.25	0.5
1,2,4-Trimethylbenzene	95-63-6	0.25	0.5
1,2-Dichlorobenzene	95-50-1	0.25	0.5
1,2-Dichloroethane	107-06-2	0.25	0.5
1,2-Dichloropropane	78-87-5	0.25	0.5
1,3,5-Trimethylbenzene	108-67-8	0.25	0.5
1,3-Dichlorobenzene	541-73-1	0.25	0.5
1,4-Dichlorobenzene	106-46-7	0.25	0.5
1,4-Dioxane	123-91-1	1	2
2-Butanone	78-93-3	1	2
2-Hexanone	591-78-6	1	2
2-Propanol	67-63-0	1	2
4-Ethyltoluene	622-96-8	0.25	0.5
4-Methyl-2-pentanone	108-10-1	0.25	0.5
Acetone	67-64-1	1	5
Benzene	71-43-2	0.25	0.5
Bromodichloromethane	75-27-4	0.25	0.5
Bromomethane	74-83-9	1	5
Carbon disulfide	75-15-0	1	2
Carbon tetrachloride	56-23-5	0.25	0.5
Chlorobenzene	108-90-7	0.25	0.5
Chloroethane	75-00-3	1	2
Chloroform	67-66-3	0.25	0.5
Chloromethane	74-87-3	1	5
cis-1,2-Dichloroethene	156-59-2	0.25	0.5
Cyclohexane	110-82-7	0.25	0.5
Ethanol	64-17-5	1	2
Ethyl benzene	100-41-4	0.25	0.5
Freon 11	75-69-4	0.25	0.5
Freon 113	76-13-1	0.25	0.5
Freon 114	76-14-2	0.25	0.5
Freon 12	75-71-8	0.25	0.5

Analyte	CAS Number	Laboratory LOD	Laboratory LOQ
Heptane	142-82-5	0.25	0.5
Hexane	110-54-3	0.25	0.5
m,p-Xylene	108-38-3	0.25	0.5
Methyl tert-butyl ether	1634-04-4	0.25	0.5
Methylene chloride	75-09-2	1	5
o-Xylene	95-47-6	0.25	0.5
Styrene	100-42-5	0.25	0.5
Tetrachloroethene	127-18-4	0.25	0.5
Tetrahydrofuran	109-99-9	0.25	0.5
Toluene	108-88-3	0.25	0.5
trans-1,2-Dichloroethene	156-60-5	0.25	0.5
trans-1,3-Dichloropropene	10061-02-6	0.25	0.5
Trichloroethene	79-01-6	0.25	0.5
Vinyl chloride	75-01-4	0.25	0.5

**Notes:**

CAS = Chemical Abstracts Service

LOD = limit of detection

LOQ = limit of quantitation

VOCs in LFG are not identified as COCs in the OU2 Landfills ROD (Army, 1994); however, Title 14 CCR Chapter 3, Article 8 (since superseded by 27CCR Chapter 3, Article 6 [Section 20921]) and Air District Rule 207 and Rule 1000 are identified as ARARs. These ARARs require control of trace gases to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds; therefore, the full list of TO-15 analytes is reported once every 5 years (next in 2019) to ensure the substantive requirements of these ARARs are met. The list presented contains VOCs that have been consistently detected in samples associated with TTU source testing and operational influent testing (Ahtna, 2016b, 2017, and 2018). Reduction of VOCs from this list (or addition) is per the analytical approach of DQOs #1 and #2. Accordingly, 1,1,1-trichloroethane and 1,3-butadiene were removed from the list and no VOCs were added to the list.

**3.6.4 Analytical Group/Method: VOC/TO-15 – DQO #3: Compliance Perimeter Probes (see Worksheet #11)**

Estimated Concentration Level: Low

Matrix: Gas (ppbv)

Analyte	CAS Number	Laboratory LOD	Laboratory LOQ
1,1,1-Trichloroethane	71-55-6	0.25	0.5
1,1-Dichloroethane	75-34-3	0.25	0.5
1,2,4-Trimethylbenzene	95-63-6	0.25	0.5
1,2-Dichloroethane	107-06-2	0.25	0.5
1,3,5-Trimethylbenzene	108-67-8	0.25	0.5
1,4-Dichlorobenzene	106-46-7	0.25	0.5
1,4-Dioxane	123-91-1	1	2
2-Butanone	78-93-3	1	2
2-Hexanone	591-78-6	1	2
2-Propanol	67-63-0	1	2
4-Ethyltoluene	622-96-8	0.25	0.5
4-Methyl-2-pentanone	108-10-1	0.25	0.5
Acetone	67-64-1	1	5
Benzene	71-43-2	0.25	0.5
Bromodichloromethane	75-27-4	0.25	0.5
Carbon disulfide	75-15-0	1	2
Carbon tetrachloride	56-23-5	0.25	0.5
Chloroethane	75-00-3	1	2
Chloroform	67-66-3	0.25	0.5
Chloromethane	74-87-3	1	5
cis-1,2-Dichloroethene	156-59-2	0.25	0.5
Cyclohexane	110-82-7	0.25	0.5
Ethanol	64-17-5	1	2
Ethyl benzene	100-41-4	0.25	0.5
Freon 11	75-69-4	0.25	0.5
Freon 113	76-13-1	0.25	0.5
Freon 114	76-14-2	0.25	0.5
Freon 12	75-71-8	0.25	0.5
Heptane	142-82-5	0.25	0.5
Hexane	110-54-3	0.25	0.5
m,p-Xylene	108-38-3	0.25	0.5
Methylene chloride	75-09-2	1	5
o-Xylene	95-47-6	0.25	0.5
Tetrachloroethene	127-18-4	0.25	0.5

Analyte	CAS Number	Laboratory LOD	Laboratory LOQ
Toluene	108-88-3	0.25	0.5
Trichloroethene	79-01-6	0.25	0.5
Vinyl chloride	75-01-4	0.25	0.5

**Notes:**

CAS = Chemical Abstracts Service

LOD = limit of detection

LOQ = limit of quantitation

VOCs in LFG are not identified as COCs in the OU2 Landfills ROD (Army, 1994); however, Title 14 CCR Chapter 3, Article 8 (since superseded by 27CCR Chapter 3, Article 6 [Section 20921]) and Air District Rule 207 and Rule 1000 are identified as ARARs. These ARARs require control of trace gases to prevent adverse acute and chronic exposure to toxic and/or carcinogenic compounds; therefore, the full list of TO-15 analytes is reported once every 5 years (next in 2019) to ensure the substantive requirements of these ARARs are met. The list presented contains VOCs that have been consistently detected in samples associated with compliance perimeter probe testing. Reduction of VOCs from this list (or addition) is per the analytical approach of DQO #3. This list required no changes from QAPP Revision 2.

### 3.6.5 Mobile Laboratory Analytical Group/Methods – DQO #1: TTU Source Testing (see Worksheet #11)

Matrix: Gas (ppmv)

Analyte	EPA Method	CAS Number	Laboratory LOQ
Carbon monoxide	10	630-08-0	0.5
Nitrogen oxides	7E	10024-97-2/10102-44-0	0.5
Oxygen	3A	7782-44-7	0.25
Carbon dioxide	3A	124-38-9	0.25
Methane/NMOC/THC	25A	Various	1.0

**Notes:**

CAS = Chemical Abstracts Service

LOQ = limit of quantitation

NMOC = non-methane organic compounds

## 4.0 Sample Design

### 4.1 Worksheet #17: Sampling Design and Rationale

The O&M Plan (Shaw, 2008a) provides procedures for monitoring the operation of the TTU, including vents, probes, and EWs. Section 5.0 of the O&M Plan (Shaw, 2008a) describes the perimeter monitoring system that is used to test the operational influent and effluent LFG.

Passive vents were installed at 19 locations to minimize the potential for gas buildup beneath the geomembrane (Figure 2). Five vents (VD-2, VD-3, VF-3, VF-4, and VF-5) were converted to EPs to provide supplemental methane to the TTU. All other vents, with the exception of VE-7 and VE-8, were capped in 2001 to mitigate a potential fire hazard. VE-7 and VE-8 were placed in the vertical expansion portion of Area E and are left open because this is a sealed area of the landfill. The 14 passive vents are not monitored for compliance but are monitored quarterly for methane using a portable LFG analyzer. The vents that were converted to EPs are monitored during TTU operations.

To monitor LFG migration, 46 monitoring, 21 compliance, and 2 utility trench probes are located around Areas B through F. Twenty-one compliance probes were installed at a spacing of approximately 1,000 feet around the property boundary as required by 27CCR. The monitoring probes are used to measure CH<sub>4</sub>, O<sub>2</sub>, CO<sub>2</sub>, and balance gas (collectively termed LFG) at additional points around the OU2 Landfills at depths ranging from 12 to 32 feet bgs. A LANDTEC GEM™2000 instrument is used to measure these parameters. The utility trench probes are 4 feet deep. Samples collected from the 21 compliance probes are sent to an off-site laboratory annually for VOC analysis by EPA Method TO-15.

Two types of testing are conducted for the TTU: source testing and operational influent LFG testing. The primary objective of the source testing is to determine whether the TTU operates efficiently. A certified mobile laboratory conducts the source test, which includes analysis of the TTU influent and effluent for the parameters listed below.

Parameter	Monitoring and Analytical Protocols
NO <sub>x</sub> , CO, O <sub>2</sub> , and CO <sub>2</sub>	EPA Methods 7E, 10, and 3A
Outlet CH <sub>4</sub> /NMOC/THC and Speciated VOCs	EPA Method 25A and TO-15
Inlet NMOC and Speciated VOCs	ASTM D1945 and EPA Method TO-15
Inlet Total Reduced Sulfurs	ASTM D5504
LFG Higher Heating Value and Outlet Volumetric Flow Rate	ASTM D1945 and EPA Method 19

Operational influent LFG testing is used to establish the schedule of operations for optimum operation of the TTU. Operational influent LFG testing also aids in quantifying the amounts of VOCs that are being removed from the OU2 Landfills.

Figure 3 presents the locations of the EWs/vents, the collection system, and the TTU system. Section 3.2 lists the sampling locations and methods.

## 4.2 Worksheet #18: Sampling Locations and Methods

### 4.2.1 Operable Unit 2 Landfills

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
B	SGP-1B	LFG	Sample Port	12	Fixed Gases <sup>2</sup>	1	NA	Monitoring Point DQO#3
B	SGP-2B	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
B	SGP-3B	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
B	SGP-4B	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
B	SGP-5B	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
C	SGP-1C	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
C	SGP-2C	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOC	2	Annually – Fixed Lab	
C	SGP-3C	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
D	SGP-1D	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
D	SGP-1D	LFG	Sample Port	22	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
D	SGP-2D	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
D	SGP-2D	LFG	Sample Port	22	Fixed Gases	1	NA	Monitoring Point DQO#3
D	SGP-3D	LFG	Sample Port	12	Fixed Gases	1	Annual	Monitoring Point DQO#3
D	SGP-3D	LFG	Sample Port	22	Fixed Gases	1	Annual	Monitoring Point DQO#3
D	SGP-4D	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
D	SGP-4D	LFG	Sample Port	22	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
D	SGP-5D	LFG	Sample Port	4	Fixed Gases	1	NA	Monitoring Point DQO#3



Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
D	SGP-6D	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
D	SGP-6D	LFG	Sample Port	22	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
E	SGP-1E	LFG	Sample Port	12	Fixed Gases	2	Quarterly	Monitoring Point DQO#3
E	SGP-2E	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
E	SGP-3E	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
E	SGP-4E	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
E	SGP-5E	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
E	SGP-6E	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
E	SGP-7E	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
E	SGP-8E	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
E	SGP-9E	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-1F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-1F	LFG	Sample Port	22	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-2F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-2F	LFG	Sample Port	32	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
F	SGP-3F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-3F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-4F	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Monitoring Point DQO#3

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
F	SGP-4F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-5F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-5F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-6F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-6F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-7F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-7F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-8F	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-8F	LFG	Sample Port	22	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
F	SGP-9F	LFG	Sample Port	22	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-10F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-10F	LFG	Sample Port	22	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-11F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-11F	LFG	Sample Port	32	Fixed Gases	1	Quarterly	Monitoring Point DQO#3
F	SGP-12F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-13F	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-13F	LFG	Sample Port	32	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-14F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
F	SGP-14F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-15F	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-15F	LFG	Sample Port	32	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-16F	LFG	Sample Port	4	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-17F	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-17F	LFG	Sample Port	32	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-18F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-18F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-19F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3

Area	Probe ID	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference <sup>1</sup>	Frequency	Rationale
F	SGP-19F	LFG	Sample Port	22	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-20F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-20F	LFG	Sample Port	32	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-21F	LFG	Sample Port	12	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-21F	LFG	Sample Port	22	Fixed Gases	1	NA	Monitoring Point DQO#3
F	SGP-22F	LFG	Sample Port	12	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	
F	SGP-22F	LFG	Sample Port	32	Fixed Gases	1	Quarterly	Compliance DQO#3
					VOCs	2	Annually – Fixed Lab	

#### 4.2.2 Thermal Treatment Unit/Extraction Points

Area	TTU Location	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference	Frequency	Rationale
D	VD-3	LFG	Sample Port	6	Fixed Gases	1	Biweekly	System Optimization DQO#2
D	EW-35	LFG	Sample Port	75	Fixed Gases	1	Biweekly	System Optimization DQO#2
D	VD-2	LFG	Sample Port	6	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	VF-3	LFG	Sample Port	6	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	EW-34	LFG	Sample Port	60	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	VF-4	LFG	Sample Port	6	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	EW-33	LFG	Sample Port	70	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	EW-32	LFG	Sample Port	60	Fixed Gases	1	Biweekly	System Optimization DQO#2

Area	TTU Location	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference	Frequency	Rationale
F	VF-5	LFG	Sample Port	6	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	EW-31	LFG	Sample Port	60	Fixed Gases	1	Biweekly	System Optimization DQO#2
F	EW-30	LFG	Sample Port	60	Fixed Gases	1	Biweekly	System Optimization DQO#2
TTU	Area F Header	LFG	Sample Port	NA	Fixed Gases	1	Biweekly	System Optimization DQO#2
TTU	Mixed	LFG	Sample Port	NA	Fixed Gases	1	Biweekly	Source Test Calculation of quantity of VOCs removed DQO#1
					VOCs Fixed Gases Sulfur	2	Annually – Fixed Lab	
TTU	Stack Outlet	LFG	Sample Port	NA	VOCs	1	Annually – Fixed Lab	Source Test DQO#1
TTU	Area D Vents	LFG	Sample Port	NA	Fixed Gases	1	Biweekly	Trend analysis DQO#2
					VOCs	2	Annually – Fixed Lab	
TTU	Area F EWs	LFG	Sample Port	NA	VOCs	2	Annually – Fixed Lab	Trend analysis DQO#2



Area	TTU Location	Matrix	Type	Depth (feet)	Analytical Group	Sampling SOP Reference	Frequency	Rationale
TTU	Area E Header	LFG	Sample Port	NA	Fixed Gases	1	Biweekly	Trend analysis DQO#2
					VOCs	2	Annually – Fixed Lab	
TTU	Area F Extraction Vents	LFG	Sample Port	NA	VOCs	2	Annually – Fixed Lab	Trend analysis DQO#2

**Notes:**

<sup>1</sup>SOPs are listed on Worksheet #21.

<sup>2</sup>Fixed Gases include CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>, and balance gas. Barometric pressure data is collected during probe monitoring, and induced vacuum is measured during system monitoring.

The sampling number system that will be employed is as follows: The three-digit area location is followed by the source location or probe identifier, followed by a sequential sample numbering system of up to four numbers for each location. For example, the stack outlet sample at the TTU will be recorded as TTU-FO-XXXX, and SGP-15F-depth will be recorded as OU2GMXXXX; where XXXX is the next four-digit sequential number.

EW = Extraction Well

LFG = landfill gas

NA = not applicable (the probe is no longer monitored per decision criteria presented in Worksheet #11, DQO #3)

OU = operable unit

SGP = soil gas probe

SOP = standard operating procedure

TTU = thermal treatment unit

VB = Passive Vent in Area B

VC = Passive Vent in Area C

VD = Passive Vent in Area D

VE = Passive Vent in Area E

VF = Passive Vent in Area F

## 5.0 Sampling Requirements

### 5.1 Worksheets #19 and #30: Sample Containers, Preservation, and Hold Times

Laboratory: Eurofins

180 Blue Ravine Road, Suite B

Folsom, CA 95630-4719

Telephone: 916-985-1000

Point of Contact: Brian Whittaker

Email: BrianWhittaker@eurofinsus.com

Sample Delivery Method: Courier or Hand Delivery

Analytical Group	Matrix	Analytical Method	Accreditation Expiration <sup>1</sup>	Containers (number, size, and type)	Preservation	Analytical Holding Time	Data Package Turnaround
Fixed Gases	Soil Gas	ASTM D1945	Oregon ELAP: 10-17-18; Certification No: CA30005-010 DoD ELAP: 04-18-18 through 04-27-20; Certificate Number: ADE-1451	Tedlar™ Bag <sup>2</sup>	None	72 hours	21 days
VOCs	Soil Gas	TO-15		6L-stainless steel SUMMA™ Canister	None	30 days	21 days
				Tedlar™ Bag	None	48 - 72 hours	21 days
Sulfur Gases	Soil Gas	ASTM D5504	South Coast Air Quality Management District exp. 11/30/18	Tedlar™ Bag	None	24 hours	21 days

#### Notes:

DoD = Department of Defense

ELAP = Environmental Laboratory Accreditation Program

NELAP = National ELAP

<sup>1</sup> The Oregon ELAP certification satisfies NELAP requirements.

<sup>2</sup> Tedlar™ bags used only during the annual source test.

## 5.2 Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group	Preparation/ Analysis Reference	Approximate Number of Primary Sampling Locations <sup>1</sup>	No. of Field Duplicates	No. of LCSs	No. of Equipment Blanks	Total Number of Analyses
Soil Gas	Fixed Gases	ASTM D1945	1	1	1	NA	2
Soil Gas	VOCs	TO-15	28	3	3	NA	31
Soil Gas	Sulfur Gases	ASTM D5504	1	1	1	NA	2

**Notes:**

<sup>1</sup> Samples collected at different depths at the same location are counted as separate sampling locations or stations.

LCS = laboratory control sample

NA = not applicable

### 5.3 Worksheet #21: Field SOPs/Methods

This worksheet documents specific field procedures and methods that will be implemented for work conducted at the OU2 Landfills. The field SOPs will be readily available to all field personnel responsible for their implementation. The SOPs listed below are included in Attachment A.

SOP Reference Number	Title, Revision, Date	Equipment Type	Modified for Project Work? (Y/N)	Comments
1	GEM™2000 Gas Analyzer and Extraction Monitor, Operation Manual (LANDTEC, 2013)	Portable landfill gas analyzer	N	Includes instrument calibration procedures.
2	Guide to Air Sampling Canister and Bags (Eurofins, 2014)	SUMMA™ Canister or Tedlar™ Bag	N	Methods for sampling soil gas.
3	DoD Environmental Field Sampling Handbook, Revision 1.0, April 2013, Chapter 3. "Common Sampling Procedures" (DoD, 2013)	NA	N	Includes sample documentation, packaging, shipping, and chain of custody requirements.

NA = not applicable

## 5.4 Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Instrument specifications for source testing are as follows<sup>1</sup>:

<b>NOx/NO Chemiluminescent Analyzer – Ecophysics Model 70E</b>	
Zero drift	Negligible after 30-minute warm up
Linearity	±1% of full scale
Accuracy	±1% of full scale
Output	0-10 V
Range	0-50, 100 ppmv
<b>O<sub>2</sub> Analyzer, Fuel Type – Teledyne Model 326A</b>	
Accuracy	±1% of scale at constant temperature or ±1% of scale at ±5% of reading, whichever is greater, over the operating temperature range
Output	0-1 V
Range	0-10, 25%
<b>CO Infrared Analyzer – Horiba Model VIA 510</b>	
Zero drift	±1%
Span drift	±1%
Linearity	±1%
Output	0-1 V
Range	0-100 ppmv
<b>THC FID Analyzer – TECO Model 51</b>	
Zero drift	±1%
Span drift	±1%
Linearity	±1%
Output	0-10 V
Range	0-50 ppmv

**Notes:**

<sup>1</sup> See SOP ST-1, Source Test Protocol (Attachment B) for mobile laboratory equipment calibration, maintenance, testing, and inspection procedures.

Field Equipment <sup>1</sup>	Activity	SOP/ Method Reference	Responsible Person	Frequency	Acceptance Criteria	Corrective Action
Gas Analyzer	Calibration	Operations Manual	Field Team Lead (FTL)	Daily during use	Manufacturer's Specifications	Adjust instrument
Infrared Oxygen Analyzer	Calibration	EPA Method 3A		Daily during use prior to and after completion of analytical batch	2% of span	
	Bias Check				5% of span	
	Response time check				< 2 minutes	
Flame ionization detector	Calibration	EPA Method 25A		Daily, prior to and after completion of analytical batch	5% of span	
	Drift Test				3% of span	
Nondispersive infrared sensor CO analyzer	Calibration	EPA Method 10		Daily, prior to and after completion of analytical batch	2% of span	
	Calibration error check				3% of span	
	Bias Check				5% of span	
	Response time check				< 2 minutes	
Chemiluminescent Analyzer	Calibration	EPA Method 7E			2% of span	
	Bias Check				5% of span	
	Response time check				< 2 minutes	

**Notes:**

<sup>1</sup> See SOP ST-1, Source Test Protocol (Attachment B) for mobile laboratory equipment calibration, maintenance, testing, and inspection procedures.

## 6.0 Analytical Requirements

### 6.1 Worksheet #23: Analytical SOPs

The SOPs referenced below are the laboratory-specific procedures for the tests for which the laboratory is certified under DoD ELAP and NELAP (fixed laboratory) and California Air Resources Board (mobile laboratory). Copies of certifications, including the specifically referenced method, are included in Attachment B.

Data will be evaluated based on the guidance provided in the DoD QSM Version 5.1, published methods, and laboratory standard operating procedures.

SOP Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix/ Analytical Group	Equipment Type	Modified for Project Work? (Y/N)
6	Analysis of Volatile Organic Compounds in SUMMA™ Polished Canisters by Modified EPA Methods TO-14A/TO-15, 03/24/15, Revision737	Definitive	VOCs	Mass Spectrometer	N
54	Analysis of Natural Gases by Modified ASTM D1945 12/8/16, Revision 22	Definitive	Fixed Gases	Gas Chromatograph	N
A.5504.04	SOP, Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence 9/11/2018, Revision 5	Definitive	Sulfur Gases	Sulfur Chemiluminescence Detector	N
ST-1 <sup>1</sup>	Source Test Protocol, Former Fort Ord, Monterey, CA. Thermal Treatment Unit (TTU). June 4, 2018	Definitive	Various	Various	N

**Notes:**

<sup>1</sup>SOPs is for mobile laboratory analysis used during the source test.

## 6.2 Worksheet #24: Analytical Instrument Calibration

Instrument	Calibration Procedure	Calibration Frequency	Acceptance Criteria	Corrective Action	Responsible Person(s)	SOP Reference <sup>1</sup>
Gas Chromatograph (GC)	Initial Calibration (ICAL)	Prior to sample analysis and annually	< 15% Relative Standard Deviation (RSD)	Correct problem, then repeat Initial Calibration.	Laboratory Analyst/Section Manager	54 ASTM D1945
GC	Initial Calibration Verification and Laboratory Control Sample (ICV and LCS)	After each initial calibration and once per analytical batch	85-115% Recovery (%R)	Check the system and reanalyze the standard. Re-prepare the standard if necessary. If the primary standard is found to be in error, re-prepare the primary and calibrate the instrument.	Laboratory Analyst/Section Manager	54 ASTM D1945
GC	Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 reportable samples	Percent Difference (% D) < 15%	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.	Laboratory Analyst/Section Manager	54 ASTM D1945
GC	ICAL	Prior to sample analysis	A minimum of 5 points (3 points may be accepted to meet sample hold times) % RSD ≤ 30	Evaluate system. Re-prepare and/or reanalyze calibration points.	Laboratory Analyst/Section Manager	A.5504.04 ASTM D5504
GC	ICV	With each ICAL; with each analytical batch	70 - 130% of the expected values for all the compounds	Check the system, re-prepare and/or reanalyze standard. Recalibrate instrument if CCV shows similar recoveries. If recoveries are high and no detections are expected, sample analysis may proceed. If hold time is at risk, flagging and narration of non-compliance may be appropriate.	Laboratory Analyst/Section Manager	A.5504.04 ASTM D5504



Instrument	Calibration Procedure	Calibration Frequency	Acceptance Criteria	Corrective Action	Responsible Person(s)	SOP Reference <sup>1</sup>
GC	CCV	Daily prior to sample analysis	%R: 70 - 130%	Check the system, re-prepare and/or reanalyze standard. Recalibrate instrument if reanalysis shows similar recoveries. If recoveries are high and no detections are expected, sample analysis may proceed. If hold time is at risk, flagging and narration of non-compliance may be appropriate.	Laboratory Analyst/Section Manager	A.5504.04 ASTM D5504

Instrument	Calibration Procedure	Calibration Frequency	Acceptance Criteria	Corrective Action	Responsible Person(s)	SOP Reference <sup>1</sup>
Gas Chromatograph/ Mass Spectrometer (GCMS)	Tuning Criteria	Every 24 hours	TO-15 ion abundance criteria	Correct problem then repeat tune.	Laboratory Analyst/Section Manager	6 TO-15
GCMS	Minimum 5-Point ICAL	Prior to sample analysis	% RSD $\leq$ 30 for COCs, with two compounds (non-COCs) allowed out to $\leq$ 40% RSD <sup>2</sup>	Correct problem then repeat Initial Calibration Curve.	Laboratory Analyst/Section Manager	6 TO-15
GCMS	ICV (second source)	After each initial calibration curve, and daily prior to sample analysis	Percent Difference (%D) $\pm$ 30% for COCs; Corrective action initiated when $>$ 15% of non-COCs exceeds $\pm$ 30% D for ICV or any recovery is $<$ 50%	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.	Laboratory Analyst/Section Manager	6 TO-15
GCMS	CCV	Prior to the analysis of samples and blanks, but after tuning criteria have been met	%D $\pm$ 30% for COCs; Corrective action initiated if more than 2 non-COCs recover outside $\pm$ 30%D	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.	Laboratory Analyst/Section Manager	6 TO-15

**Notes:**

<sup>1</sup> SOPs are listed on Worksheet #23.

<sup>2</sup> Applies only to compounds not listed as COCs for groundwater in Table 1 of the OU2 Landfills ROD (Army, 1994).

### 6.3 Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Analytical instruments used for this project will be maintained in accordance with the requirements presented in the Eurofins QA Manual and the individual analytical method SOPs. The Eurofins QA Manual also presents the documentation requirements for maintenance activities.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person(s)	SOP Reference <sup>1</sup>
GCMS	Check for leaks, replace gas line filters, replace column, clean injection port/liner	VOC	Monitor instrument performance via tune and CCV	As needed	Calibration and QC criteria met	Replace connections, clean source, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port, replace electron multiplier	Laboratory Analyst/ Section Manager	6
GC- Flame Ionization Detector	Clean injection port and replace liner, clip/replace column	Gases	Monitor instrument performance via Continuing Calibration	Daily	Calibration and QC criteria met	Change column instrument maintenance	Laboratory Analyst/ Section Manager	54
Sulfur Chemiluminescence Detector	Inspect the system, clean sample introduction line	Sulfur Gases	Monitor instrument performance via Continuing Calibration	Daily	Calibration and QC criteria met	Evaluate system	Laboratory Analyst/ Section Manager	13

<sup>1</sup>SOPs are listed on Worksheet #23.

#### 6.4 Worksheets #26 and #27: Sample Handling, Custody, and Disposal

Sampling Organization: Ahtna

Laboratory: Eurofins

Method of sample delivery (shipper/carrier): Overnight Courier

Number of days from reporting until sample disposal: No less than 30 days after final report sent to the client

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference <sup>1</sup>
Sample labeling	Ahtna/Field Technician	Field SOP #3
Chain of custody form completion		
Packaging		
Shipping coordination		
Sample receipt, inspection, & log-in	Eurofins Sample Management Supervisor	Not applicable
Sample custody and storage		
Sample disposal		

<sup>1</sup>Field SOPs are listed in Worksheet #21 and included in Attachment A.

## 6.5 Worksheet #28: Analytical Quality Control and Corrective Action

The following tables provide guidance for the evaluation of QC analyses and the implementation of corrective action for situations outside of acceptance limits. The method-specific acceptance criteria are presented in the applicable table in Worksheet #12 and Worksheet #15. For QC and corrective action specific to the field methods used by the mobile laboratory, refer to the method (EPA Methods 3A, 7E, 10, and 25A), which can be found at <https://www.epa.gov/emc/emc-promulgated-test-methods>.

### 6.5.1 Analytical Group/Method/SOP: Fixed Gases/ASTM D1945/SOP #54

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Responsible Person(s)	Project Measurement Performance Criteria
Method Blank	1 per extraction batch	Target analytes not detected $\geq$ LOQ and $>1/10$ the amount measured in any sample or $1/10$ the regulatory limit (whichever is greater)	Reanalyze samples; qualify as needed	Laboratory Analyst/Section Manager	Representativeness
LCS (Lab QC)	1 per batch	Analyte-specific %R acceptance criteria	Evaluate system; reanalyze	Laboratory Analyst/Section Manager	Accuracy/Bias
Laboratory Duplicate	1 per batch	Analyte-specific RPD acceptance criteria	Evaluate system; reanalyze	Laboratory Analyst/Section Manager	Precision
Relative Retention Time (RRT) Position	Confirmed at method setup and after major maintenance	RT windows established by calculating the standard deviation of the mean absolute retention time over a 72-hour period. 3 x standard deviation must be $<0.08$ min for analysis to proceed	Correct problem; recalibrate instrument; reanalyze results as necessary	Laboratory Analyst/Section Manager	Analyte Identification

**6.5.2 Analytical Group/Method/SOP: Sulfur Gases/ASTM D5504/A.5504.04**

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Responsible Person(s)	Measurement Performance Criteria
Method Blank	1 per extraction batch	Target analytes not detected $\geq$ LOQ and $>1/10$ the amount measured in any sample or $1/10$ the regulatory limit (whichever is greater)	Reanalyze samples; qualify as needed	Laboratory Analyst/Section Manager	Representativeness
LCS (Lab QC)	1 per batch	Analyte-specific %R acceptance criteria	Evaluate system; reanalyze	Laboratory Analyst/Section Manager	Accuracy/Bias
Laboratory Duplicate	1 per batch	Analyte-specific RPD acceptance criteria	Evaluate system; reanalyze	Laboratory Analyst/Section Manager	Precision

### 6.5.3 Analytical Group/Method/SOP: VOCs/TO-15/SOP #6

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Responsible Person(s)	Measurement Performance Criteria
Method Blank	1 per extraction batch	Target analytes not detected >½ LOQ for all compounds with the exception of common laboratory contaminants which not detected >LOQ; and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	Reanalyze samples; qualify as needed	Laboratory Analyst/Section Manager	Representativeness
LCS (Lab QC)	1 per batch	See Worksheet #12	Evaluate system; reanalyze	Laboratory Analyst/Section Manager	Accuracy/Bias
Laboratory Duplicate	1 per batch	Analyte-specific RPD acceptance criteria	Evaluate system; reanalyze	Laboratory Analyst/Section Manager	Precision
Surrogate	1 per blank, sample, and standard	Surrogate-specific %R acceptance criteria	Evaluate system and samples; reanalyze	Laboratory Analyst/Section Manager	Accuracy/Bias
Internal Standard Performance	Every sample	Peak area ± 40 % of the peak area in the corresponding CCV; retention time within ±20 seconds of the corresponding CCV	Reanalyze or qualify results as necessary	Laboratory Analyst/Section Manager	Accuracy/Bias
RRT Position	Once per initial calibration and at the beginning of the analytical shift	RRT within ±0.06 RRT units for each analyte and surrogate	Correct problem; recalibrate instrument; reanalyze results as necessary	Laboratory Analyst/Section Manager	Analyte Identification
Mass Spectrometer Results	All positive results must be confirmed	Spectral match to reference spectrum	Analyst must evaluate results to confirm identification if spectral match does not meet criteria; Section Manager must review analyst's determination	Laboratory Analyst/Section Manager	Analyte Identification

## 7.0 Data Management and Data Review

### 7.1 Worksheet #29: Project Documents and Records

At a minimum, the following documentation will be used for sample collection and field measurement activities. Examples of field forms are presented in Attachment C.

<b>Sample Collection and Field Records</b>			
<b>Record</b>	<b>Generation</b>	<b>Verification</b>	<b>Storage location/archive</b>
Field notes/logbook	Field Team Lead	Project Manager	Project File*
Chain of custody forms	Field Team Lead	Project Manager	Project File
Laboratory raw data package	Eurofins	Project Chemist	Project File
PDF copy of analytical data	Eurofins	Project Chemist	Fort Ord Administrative Record
Audit/assessment checklists/reports	Field Team Lead/Project Chemist	Project Manager	Project File
Corrective action reports	Field Team Lead/Project Chemist	Project Manager	Project File
Laboratory sample custody log	Eurofins	Project Chemist	Project File
Laboratory equipment calibration logs	Eurofins	Project Chemist	Project File
Sample preparation logs	Eurofins	Project Chemist	Project File
Run logs	Eurofins	Project Chemist	Project File
Sample disposal records	Eurofins	Project Chemist	Project File
Validated data	Project Chemist	Program Chemist	Project File
Electronic Validated data	Data Validation Subcontractor	Project Chemist	Fort Ord Data Integration System (FODIS) chemistry database
Data Validation Reports	Project Chemist	Program Chemist	Project File
Annual Report	Task Manager	USACE Project Manager	Fort Ord Administrative Record

\*The Project File is maintained on a secure server accessible at the OU2 Groundwater Treatment Plant.



## 7.2 Worksheets #31, #32 and #33: Assessments and Corrective Action

### Assessments:

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Assessment Deliverable	Deliverable Due Date
Review of QAPP, SOPs, and Accident Prevention Plan with Field Staff	FTL/Ahtna	Prior to sampling startup and with all new field staff prior to assignment	Completed acknowledgement signature pages	48 hours following assessment
Work performed in accordance with site-specific QAPPs	FTL/Ahtna	Ongoing during all phases of fieldwork	Daily progress reports	24 hours following conclusion of business day
Logbook and Field Form Review	FTL/Ahtna	Daily	NA; corrections will be made directly to reviewed documents	24 hours following assessment
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	Project Chemist/Ahtna	Prior to sampling mobilization, as new laboratories are contracted	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling startup. QAPP sign-off sheet received from laboratory	48 hours following assessment
Tailgate Safety Meeting	SSHO/Ahtna	Daily	Verbal debriefing and daily sign-off log. If a safety incident occurs, a Supervisor Injury Employee Report is completed	Weekly; any safety incidents will be reported to the PM and Corporate Health and Safety Officer immediately
Daily QC Reports	FTL/Ahtna	Ongoing during all phases of fieldwork	Three Phase Inspection Forms (Attachment D)	24 hours following conclusion of business day
Field Sampling and Chain of Custody Form Review Against QAPP Requirements	Project Chemist/Ahtna	Daily	Corrections will be made directly to reviewed documents; communication may be in the form of email	24 hours following assessment

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Assessment Deliverable	Deliverable Due Date
Data Validation	Data Validation Chemist/ Laboratory Data Consultants	Per Sample Delivery Group	Communication may be in the form of email traffic. Amendment of the analytical report or corrective actions due to deficiencies identified in the validation process	24 hours following assessment
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	Project Chemist/Ahtna	As discrepancies are identified in the validation process	Memorandum or email to PM and Project Chemist	72 hours following assessment

**Assessment Response and Corrective Action:**

Assessment Type	Individual(s) Notified of Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing Corrective Action	Responsibility for Monitoring Corrective Action
Review of QAPP, SOPs, and Accident Prevention Plan with Field Staff	FTL	Completed acknowledgement signature pages	48 hours following assessment	FTL	PM and QC Manager
Work performed in accordance with site-specific QAPP	PM	Interim CA documented pending final approval	By close of same business day	FTL	PM and QC Manager
Logbook and Field Form Review	FTL	Corrections will be made directly to reviewed documents	NA	FTL	PM
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	Project Chemist	Response to email or memorandum	48 hours after notification	Laboratory PM	Project Chemist

Assessment Type	Individual(s) Notified of Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing Corrective Action	Responsibility for Monitoring Corrective Action
Tailgate Safety Meeting	FTL	Included as part of the process of the Supervisor Injury Employee Report	24 hours after notification	Ahtna PM	Corporate H&S Manager
Daily QC Reports	FTL	Corrections will be made directly to reviewed documents	NA	FTL	PM and QC Manager
Field Sampling and Chain of Custody Form Review Against QAPP Requirements	Project Chemist	Response to email	48 hours after notification	FTL	PM and QC Manager
Data Validation	Project Chemist	If required, laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report	1 business week	Data Validation PM	Project Chemist
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	Project Chemist	If required laboratory reports will be amended and corrections noted in the analytical narrative	72 hours after notification	Laboratory PM	Laboratory QA Manager/ Project Chemist

### 7.3 Worksheet #34: Data Verification and Validation Inputs

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs and the QAPP.

Item	Description	Verification (completeness)	Validation (conformance to specifications)
<b>Planning Documents/Records</b>			
1	Approved QAPP	X	
2	Contract	X	
4	Field SOPs	X	
5	Laboratory SOPs	X	
<b>Field Records</b>			
6	Field Logbooks	X	X
7	Equipment Calibration Records	X	X
8	Chain of Custody Forms	X	X
9	Sampling Diagrams/Surveys	X	X
10	Relevant Correspondence	X	X
11	Change Orders/Deviations	X	X
12	Field Audit Reports	X	X
13	Field CA Reports	X	X
<b>Analytical Data Package</b>			
14	Cover Sheet (laboratory identifying information)	X	X
15	Case Narrative	X	X
16	Sample Chronology (e.g., dates and times of receipt, preparation, and analysis)	X	X
17	LOD/LOQ Establishment and Verification	X	X
18	Standards Traceability	X	X
19	Instrument Calibration Records	X	X
20	Definition of Laboratory Qualifiers	X	X
21	Results Reporting Forms	X	X
22	QC Sample Results	X	X
23	CA Reports	X	X
24	Raw Data	X	X
25	Electronic Data Deliverable	X	X

## 7.4 Worksheet #35: Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Methods	QAPP, SOP	Records support implementation of the SOP-sampling and analysis.	Project Chemist, Ahtna
Performance Requirements	QAPP, SOP	Verify laboratory method SOPs are sufficient to satisfy DQOs.	Program Chemist, Ahtna
Sampling Locations, Number of Samples	QAPP, SOP	Verify that sample locations and quantities will be sufficient to satisfy DQOs.	Program Chemist, Ahtna
Three phase inspection forms and Other Field Documentation	QAPP, SOP	Review daily sampling activity reports including pertinent field sampling data.	Project Chemist, Ahtna
Chain of Custody	QAPP, SOP	Examine traceability of data from sample collection to generation of project reported data.	Project Chemist, Ahtna
Deviations	QAPP, SOP	Determine impacts of any deviations from methods.	Program Chemist, Ahtna
Sensitivity	QAPP, SOP	Verify that LODs and LOQs are achieved as outlined in the QAPP and that the laboratory successfully analyzed a standard at the LOD.	Project Chemist, Ahtna
Precision	QAPP, SOP	Review data against performance criteria and determine impact of any result out of criteria.	Project Chemist, Ahtna
Accuracy	QAPP, SOP	Review data against performance criteria and determine impact of any result out of criteria.	Project Chemist, Ahtna
QC samples	QAPP, SOP	Ensure that a sufficient number of QC samples are analyzed, as outlined in the QAPP, to meet DQOs.	Project Chemist, Ahtna
Field Change Requests	QAPP, SOP	Review any change request or corrective action documentation. Determine impact to project objectives.	Project/Program Chemist, Ahtna
Electronic Data Deliverables (EDDs)	QAPP	Verify that acceptable EDDs have been qualified. The Laboratory Data Consultants Automated Data Review (LDC ADR) EDD format files will be uploaded into the FODIS chemistry database, EDD files will be submitted to USACE. EDD File Specifications are provided in Attachment E.	Project Chemist, Ahtna

## 7.5 Worksheet #36: Data Validation Procedures

Analytical Group/Method:	Volatile Organics – TO-15 (Modified)	Gases – ASTM D1945, D5504
Data deliverable requirements:	LDC ADR	LDC ADR
Analytical specifications:	Worksheet #28	Worksheet #28
Measurement performance criteria:	Worksheet #12	Worksheet #12
Percent of data packages to be validated:	100%	100%
Percent of raw data reviewed:	10%	10%
Percent of results to be recalculated:	10%	10%
Validation procedure:	EM-200-1-10	EM-200-1-10
Validation qualifiers:	See table below	See table below
Electronic validation program:	LDC ADR	LDC ADR

EM-200-1-10 = USACE Guidance for Evaluating Performance-Based Chemical Data (USACE, 2005)

LDC ADR = Laboratory Data Consultants Automated Data Review format

### Summary of Data Qualifiers

Qualifier	Definition
J	Estimated (quantitatively) and tentatively usable
J-	Estimated (quantitatively) with low bias
J+	Estimated (quantitatively) with high bias
U	Below reporting limit
N	Qualitatively estimated (tentative detection)
X	Tentatively rejected
R	Rejected
UN	Tentative non-detection
NJ	Quantitatively and qualitatively estimated

## 7.6 Worksheet #37: Data Usability Assessment

<b>Step 1</b>	<p><b>Review the project’s objectives and sampling design</b></p> <p>The goal for O&amp;M activities at Fort Ord is to implement remedies as necessary to protect human health and the environment while maximizing the number of site closures or advance sites as close to site closure as practicable during the Period of Performance in a cost-effective manner. The site-specific QAPPs will indicate the project objectives and sampling design. To that end, the usability assessment will incorporate the activities listed below.</p> <p><b>Field Certification</b></p> <p>Field personnel will generate field forms, maps, and notes describing the daily procedures. The three-phase inspection forms (Attachment D), generated during sampling, will discuss any successes and/or deviations from the QAPP. The FTL will review all field documentation as it is generated for consistency and errors. Any anomalies identified will be discussed with the project team to determine if any changes to the sampling design are needed. Any changes will be documented in a QAPP amendment.</p> <p><b>Data Quality Indicators: Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity (PARCCS)</b></p> <p>The PARCCS parameters will be used to help identify deficiencies in the sample data that would affect the achievement of the project DQOs. Laboratory limits and QC samples will be used as part of the PARCCS assessment to detect anomalies in the dataset. In addition, the laboratory will create trend charts to track variability in laboratory processes and establish in-house precision and accuracy criteria.</p> <p>Laboratory limits used in the sensitivity review consist of the LOD and LOQ. Laboratory QC samples consist of method blanks, LCSs, surrogates, and laboratory duplicates. All samples will be spiked with surrogate compounds where recommended or required by the method.</p> <p><b>Precision</b></p> <p>Precision is defined as the degree of mutual agreement between individual measurements of the same property under similar conditions and provides a measurement of the reproducibility of an analytical result. Precision will be evaluated through the analysis of field duplicate samples and LCSs. Field duplicate samples will be collected at a frequency of one per 10 field samples of a given matrix. The duplicate sample will not be reanalyzed when the RPD criteria are not met. Discussion of QC failures will be documented in the laboratory case narrative. The Project Chemist will work with the laboratory to determine the cause of the failure and to determine if any of the QC failures are due to matrix or sampling error and if the failures have an impact on the project objectives.</p>
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The variance between the samples, in terms of RPD, is calculated according to the following equation:

$$RPD = \frac{|A - B|}{(A + B)/2} \times 100\%$$

where: A = First duplicate concentration

B = Second duplicate concentration

For this project, the goal for precision of field duplicates is listed in Worksheet #12. In the event that both of the duplicate sample results are less than the LOD, the RPD will not be calculated

### **Accuracy**

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as a true value. The accuracy of a measurement system can be affected by errors introduced by field contamination, sample preservation, sample handling, sample preparation, or analytical techniques. A program of sample spiking will be conducted to evaluate laboratory accuracy. Accuracy will be evaluated by the percent recovery of the spiked compounds in the LCSs, surrogates, and proficiency samples (if requested by the PM). LCSs and surrogates will be spiked prior to extraction. LCS samples will be spiked with the method target compounds indicated in this QAPP, and surrogates will be added to every sample and spike. Proficiency samples will be taken through the entire sample preparation and analysis process. LCS or blank spike samples will be analyzed at a frequency of 5%, or one per sample delivery group/analytical batch (sample sets can be up to 20 field samples). Proficiency samples will be analyzed once per sampling event if required. The results of the spiked and proficiency samples are used to calculate the percent recovery for evaluating accuracy, using the following equation:

$$\text{Percent Recovery} = \frac{S - C}{T} \times 100$$

where:

S = Measured spike sample concentration

C = Sample concentration

T = True or actual concentration of the spike or proficiency

Worksheet #12 presents accuracy goals for this investigation based on the percent recovery of LCSs and surrogate spikes. The data reviewer will use the accuracy results to help determine if any of the QC failures are due to matrix or sampling error and if the failures have an impact on the project objectives.

The presence of high levels of target compounds in the sample chosen for spiking may necessitate a dilution of the sample, or may otherwise result in errors in spiked



compound recovery. Discussion of laboratory QC failures will be documented in the laboratory case narrative. The Project Chemist will work with the laboratory to determine the cause of the failure and to determine if any of the QC failures are due to matrix or sampling error and if the failures have an impact on the project objectives.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that the data are intended to represent. For this project, representative data will be obtained through careful selection of sampling locations and analytical parameters, through proper collection and handling of samples to avoid interference and minimize cross-contamination, and through consistent application of the appropriate established field and laboratory procedures.

To aid in evaluating the representativeness of the sample results, laboratory blank samples will be evaluated for the presence of contaminants. Laboratory procedures will be reviewed to verify that SOPs were followed and method requirements were met during the analysis of project samples. Laboratory sample storage practices, holding times, sub-sampling procedures, method blanks, and will be assessed for potential impacts on the representativeness of the data. Data determined to be non-representative will be used only if accompanied by appropriate qualifiers and limits of uncertainty.

Representativeness as it relates to field procedures refers to the collection of samples that allow accurate conclusions to be made regarding the composition of the sample media at the entire site. Representativeness will be assessed qualitatively by evaluating whether the procedures described in this QAPP were followed.

**Completeness**

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with the procedures outlined in this QAPP and when none of the QC criteria used to determine the usability of the data is critically exceeded to the point of rejection.

When data validation is completed, the percent completeness value will be calculated by dividing the number of usable sample results by the total number of sample results planned for this investigation. The evaluation of completeness will help determine whether any critical deficiencies identified during the validation process resulted in non-attainment of project objectives.

Completeness will be evaluated by reviewing the tasks that contribute to the sampling event, such as sample handling and storage procedures, chain of custody procedures, analytical procedures, and data validation procedures. The procedures and determined impact on the sample results will be used to identify any problems along the data path

that will render the decision-making process useless and the data set incomplete. The completeness goal for this project that still allows for attainment of the project objectives is 90%.

$$\frac{\text{Number of possible analyte results} - \text{Number of rejected and unreported results}}{\text{Possible number of analyte results}} \times 100$$

The project team may determine that an individual sampling point or area is more critical than others for decision-making. Any sampling locations identified as such will have a completeness goal of 95% as determined by the validation process.

**Comparability**

Comparability expresses the confidence with which one dataset can be compared with another. Comparability of data will be achieved by following standard field and laboratory procedures outlined in SOPs and published methods. In addition, standard units of measurement will be used in reporting analytical and field data. Analytical and field methods selected for this investigation are consistent with the methods used during previous investigations of this type. Oversight by experienced team members will ensure that the procedures are conducted in a manner appropriate to attaining the project objectives. Any deviations from field or laboratory methods will be documented on a change request form. The project team will review the change request to determine if the change will impact the comparability of the data.

**Sensitivity**

The LOD, and LOQ will be evaluated by the project team prior to sample analysis to determine if the laboratory is able to attain the sensitivity required for the project. If project decision limits are too sensitive, it will be determined prior to sample analysis whether a sensitivity variance will be issued to the laboratory based on the method chosen and the technology available.

The LOD is the minimum quantity of an analyte that can be reliably detected for a specific analytical method at a 99% confidence level that the value is not a false negative. The LOQ represents the smallest quantity of an analyte that can be quantified accurately and reproducibly in a given sample matrix (e.g., three to five times the LOD). The LOD and/or the LOQ shall be sensitive enough to meet the project decision limits. The LOD and LOQ will be evaluated after sample analysis to determine if there were any matrix effects, operator errors, or analytical process errors that interfered with the ability to compare the results to the project decision limits. The LOD will be used to determine if detectable amounts of analytes are present. If no detectable amounts are reported, and all data are acceptable (as determined by the verification and validation process), then the data are usable. The LOD will be used to determine if any detectable amounts of contaminants of concern are present. If detectable amounts are reported and the verification and validation are acceptable, then the data are usable. Any detections falling between the

	<p>LOD and LOQ will be qualified as estimated. If anomalies in sensitivity are present, the rationale for use or non-use of the affected samples will be discussed in the data validation reports. Worksheet #15 presents the laboratory LODs and LOQs for the selected analytical method(s) used to support the project decision limits.</p>
<b>Step 2</b>	<p><b>Review the data verification and data validation outputs</b></p> <p>The outputs from the verification and validation process will be used to determine data usability. Data validation reports and three phase inspection forms will be reviewed. Data will be summarized as necessary using graphs, maps, and/or tables. The entire project team is responsible for assessing whether the data meet the project objectives. Personnel at all levels will generate data and documentation that will be reviewed to identify trends, relationships, and/or anomalies in the dataset.</p>
<b>Step 3</b>	<p><b>Implement the statistical method</b></p> <p>For each analytical method, the laboratory will use the LCS data to track and analyze trends in the laboratory. From these trends, they can recognize deficiencies in the method and create in-house acceptance criteria. For this project, the limits are based on laboratory control limits. The precision and accuracy of the entire dataset will be used to determine if any systemic problems have occurred during the sampling event that will result in deficiencies in the dataset. The occurrence of systemic problems and the resulting consequences will be discussed in the data validation report. The data reviewer will make every effort to identify any critical elements or trends that would result in non-usability of data as early as possible.</p>
<b>Step 4</b>	<p><b>Document data usability and draw conclusions</b></p> <p>Again, the entire project team is responsible for assessing whether the data meet the project objectives. The site-sampling layout, including sampling locations, frequency of sampling, and timing of sampling activities, will be reviewed by the project team. Data usability will be assessed in accordance with the guidance provided in DoD QSM Version 5.1 and additional applicable USACE and EPA guidance as well as the professional experience of the decision maker during data validation. The conclusions will be discussed in the final annual report. If the data indicate anomalies, the impacted data will be qualified as described in EM-200-1-10. The impact will be documented along with the rationale for limited use of the data.</p>

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<sup>6</sup> At the end of references included in the Fort Ord Administrative Record are the Administrative Record Numbers (AR#s) (e.g. OU2-123). To find the referenced document, this number may be typed into the online search tool at: <http://www.fortordcleanup.com/documents/search/>. Please note the referenced documents were available in the Fort Ord Administrative Record at the time this document was issued; however, some may have been superseded by more current versions and were subsequently withdrawn.

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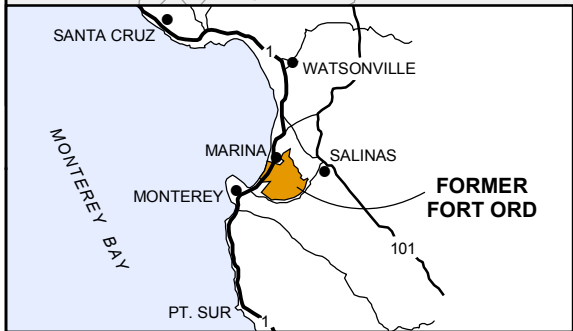
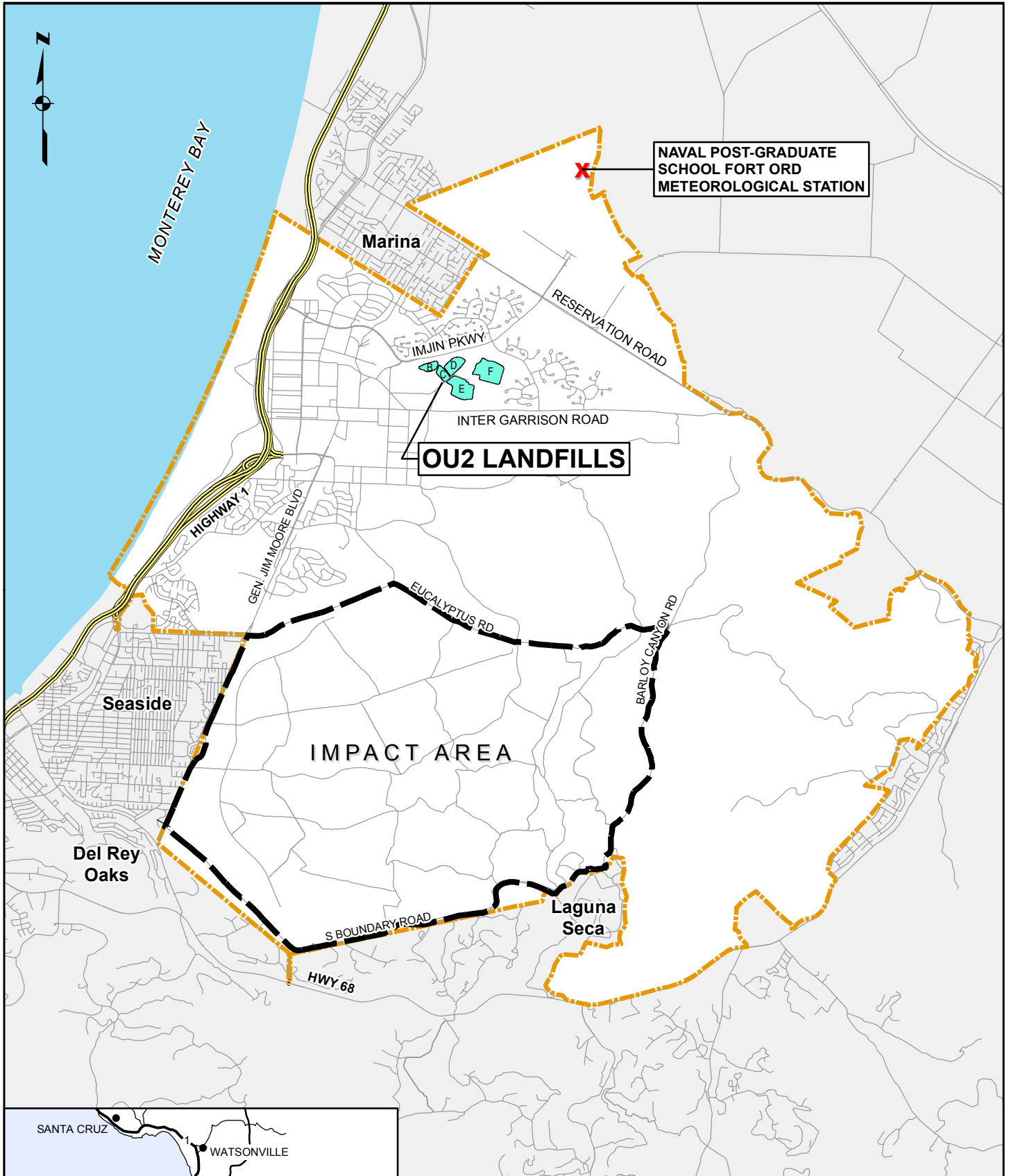
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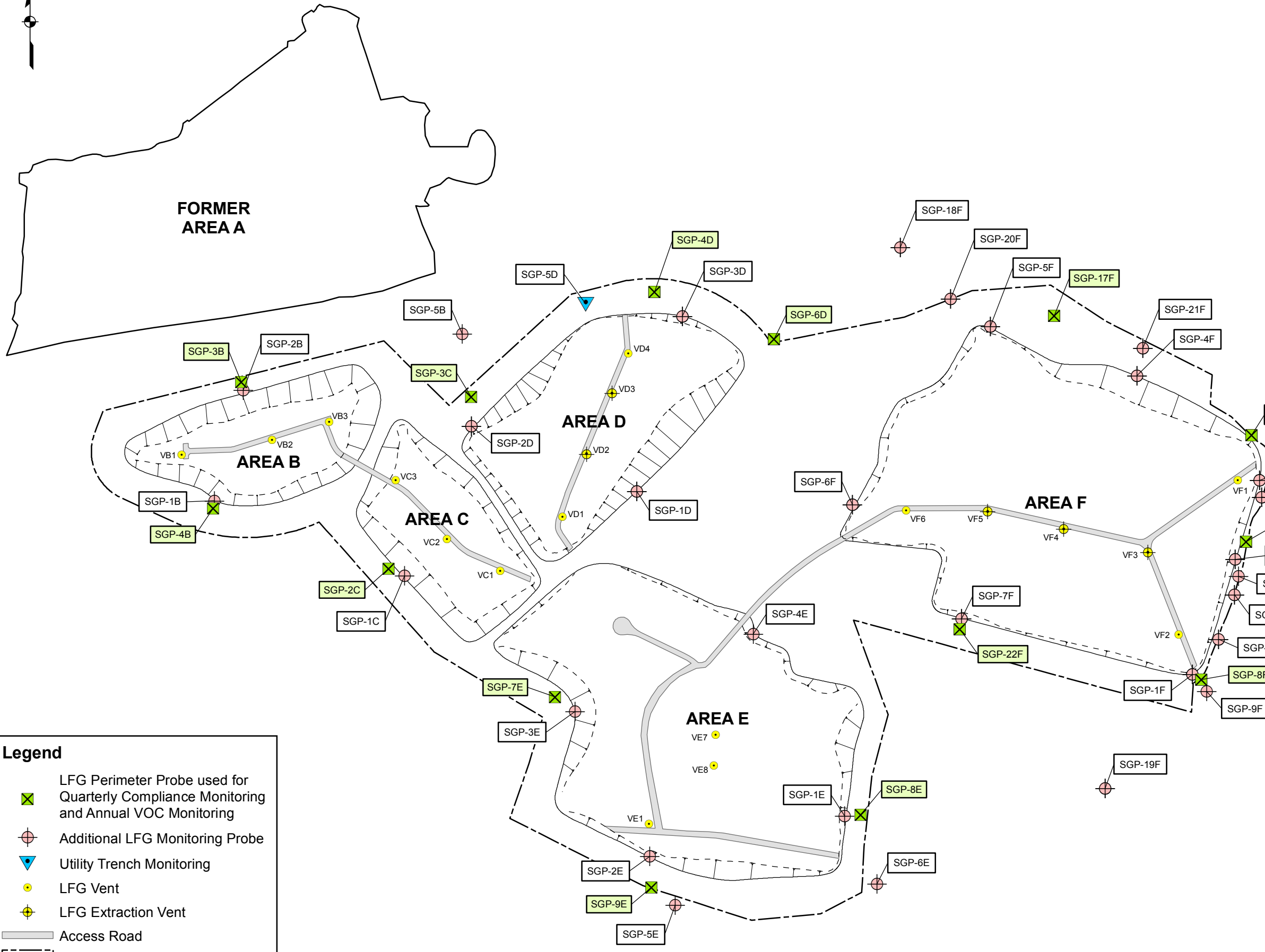
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## FIGURES



<b>FORMER FORT ORD</b>		
LOCATION MAP OU2 LANDFILLS		
		<b>FIGURE NUMBER</b> 1



**PROBE DEPTH TABLE**

PROBE	DIMENSIONS (ft)		PROBE	DIMENSIONS (ft)	
	A	B		A	B
SGP-1B	12	-	SGP-1F	12	22
SGP-2B	12	-	SGP-2F	12	32
SGP-3B	12	-	SGP-3F	12	32
SGP-4B	12	-	SGP-4F	12	32
SGP-5B	12	-	SGP-5F	12	32
SGP-1C	12	-	SGP-6F	12	32
SGP-2C	12	-	SGP-7F	12	32
SGP-3C	12	-	SGP-8F	12	22
SGP-1D	12	22	SGP-9F	22	-
SGP-2D	12	22	SGP-10F	12	22
SGP-3D	12	22	SGP-11F	12	32
SGP-4D	12	22	SGP-12F	32	-
SGP-5D	4	-	SGP-13F	12	32
SGP-6D	12	22	SGP-14F	12	32
SGP-1E	12	-	SGP-15F	12	32
SGP-2E	12	-	SGP-16F	4	-
SGP-3E	12	-	SGP-17F	12	32
SGP-4E	12	-	SGP-18F	12	32
SGP-5E	12	-	SGP-19F	12	22
SGP-6E	12	-	SGP-20F	12	32
SGP-7E	12	-	SGP-21F	12	22
SGP-8E	12	-	SGP-22F	12	32
SGP-9E	12	-			

"-" in B dimension column means single probe

**Legend**

- LFG Perimeter Probe used for Quarterly Compliance Monitoring and Annual VOC Monitoring
- Additional LFG Monitoring Probe
- Utility Trench Monitoring
- LFG Vent
- LFG Extraction Vent
- Access Road
- Landfill Parcel Boundary

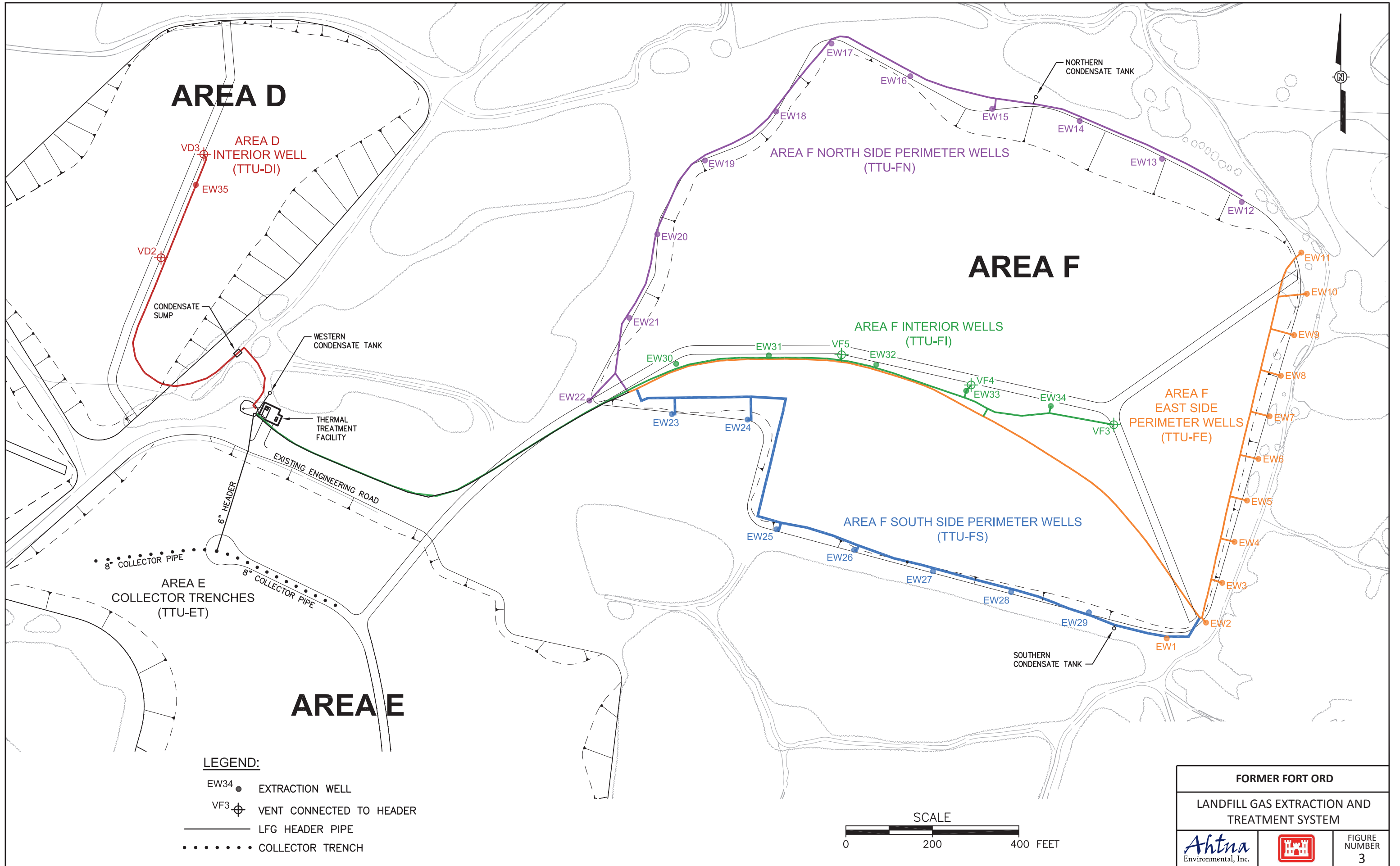
**FORMER FORT ORD**

Landfill Gas Monitoring Locations

Ahtna  
Environmental, Inc.

FIGURE  
NUMBER  
**2**





# AREA D

AREA D  
INTERIOR WELL  
(TTU-DI)

# AREA F

AREA F NORTH SIDE PERIMETER WELLS  
(TTU-FN)

AREA F INTERIOR WELLS  
(TTU-FI)

AREA F SOUTH SIDE PERIMETER WELLS  
(TTU-FS)

AREA F EAST SIDE PERIMETER WELLS  
(TTU-FE)

AREA E  
COLLECTOR TRENCHES  
(TTU-ET)

# AREA E

**LEGEND:**

- EW34 ● EXTRACTION WELL
- VF3 ⊕ VENT CONNECTED TO HEADER
- LFG HEADER PIPE
- ..... COLLECTOR TRENCH

SCALE



FORMER FORT ORD

LANDFILL GAS EXTRACTION AND  
TREATMENT SYSTEM



FIGURE  
NUMBER  
3

## **ATTACHMENTS**

## ATTACHMENT A

### Standard Operating Procedures (SOPs)

SOP No.	SOP Title	Author Organization
1	GEM™2000 Gas Analyzer & Extraction Monitor Operation Manual	LANDTEC
2	Guide to Air Sampling, Canisters and Bags	Eurofins
3	Common Sampling Procedures (Chapter 3 from DoD Environmental Field Sampling Handbook)	DoD



# **GEM<sup>TM</sup>2000**

GAS ANALYZER & EXTRACTION MONITOR

**OPERATION MANUAL**

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**CES-LANDTEC Release Date: July 26, 2005**

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## 1 Introduction

CES-LANDTEC is the premier manufacturer of products, instruments and software for landfill gas extraction and for regulatory monitoring compliance. CES-LANDTEC has provided the landfill industry with a technologically innovative family of products for more than a decade. These products are the result of field-proven experience in design, operation and maintenance of landfills for environmental compliance.

The GEM™2000, designed by CES-LANDTEC, is specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares and migration control systems. The GEM™2000 samples and analyses the Methane, Carbon Dioxide and Oxygen content of LFG. The readings are displayed and can be stored in the instrument or downloaded to a personal computer for reporting, analysing and archiving.

The GEM™2000 instrument is frequently shipped in an optional protective hard case with a foam interior offers additional protection, transportation convenience and component hardware storage. When properly sealed, the hard case is watertight. The hard case is equipped with a pressure relief valve (located under the handle on the case) that is normally kept closed. If there is a change in elevation, the hard case may not open until turning the pressure relief valve equalizes internal pressure. When shipping a GEM™2000 back to CES-LANDTEC for calibration or service, always ship it in the original packaging to protect unit from damage.

Carefully unpack the contents of the GEM™2000, inspect and inventory them. The following items should be contained in your package:

- The GEM™2000 instrument
- GEM™2000 Operation Manual
- Registration/Warranty Card
- Soft carrying case with replaceable protective window and carrying strap
- Clear ¼" vinyl sampling hose assembly (5 ft.) with external water trap filter assembly
- Blue ¼" vinyl pressure sampling hose (5 ft.)
- Spare internal particulate filter element
- Polypropylene male connector (hose barb) connects to blue vinyl tubing
- Spare external water trap filter element
- 100-240 volt battery charger
- DataField CS software on CD-ROM
- RS-232 serial cable for computer/printer data downloading
- Temperature probe (optional)
- Hard carrying case (optional)

Complete the Registration/Warranty Card and return it to CES-LANDTEC. The model and serial numbers are located on the back of the GEM™2000 instrument.

**Immediately notify shipping company if the GEM™2000 unit or accessories are damaged due to shipping.** Contact CES-LANDTEC immediately if any items are missing.

For questions regarding instrument operation and procedures, please contact CES-LANDTEC at:

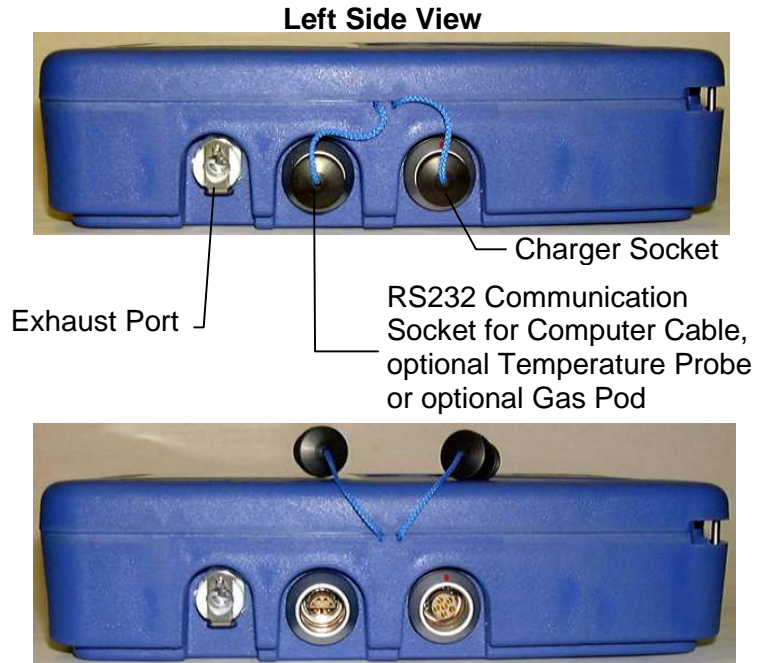
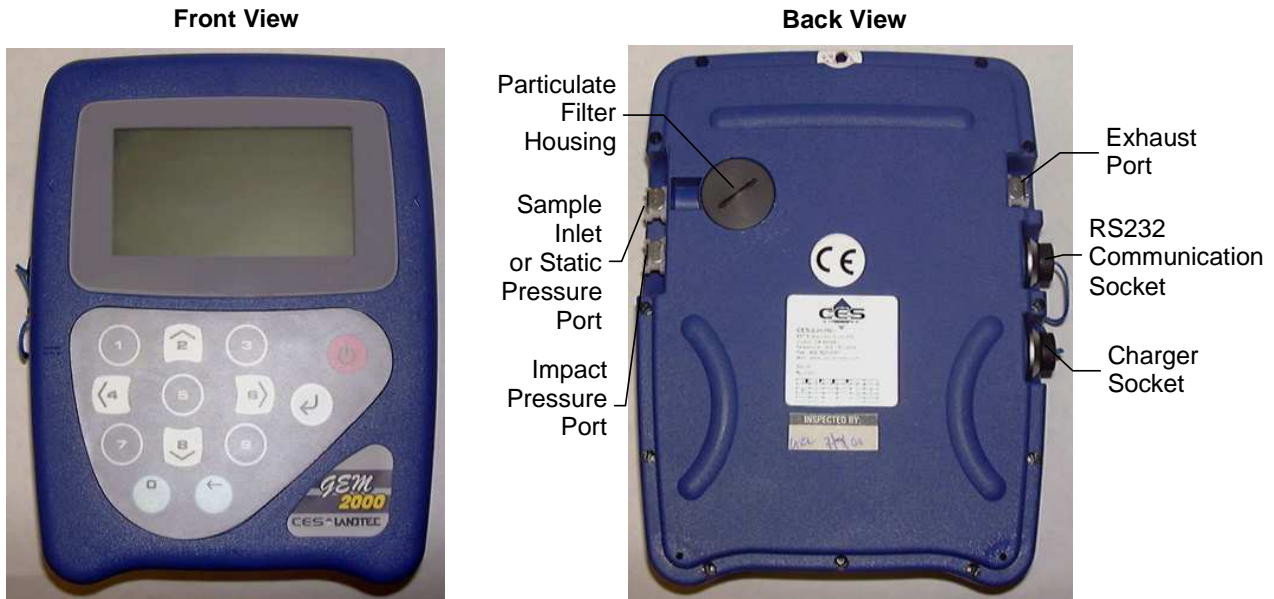
Customer Service or Technical Support  
Factory Service  
Spare Parts and Calibration Gas  
DataField Software Support

(800) 821-0496

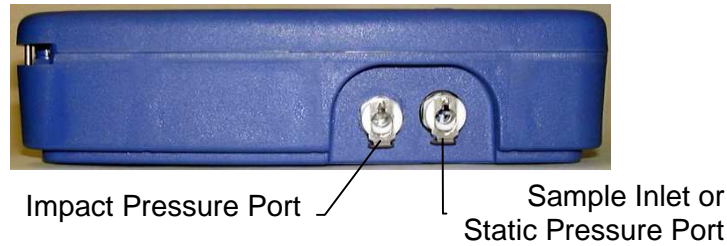


## 2 General Operational Features

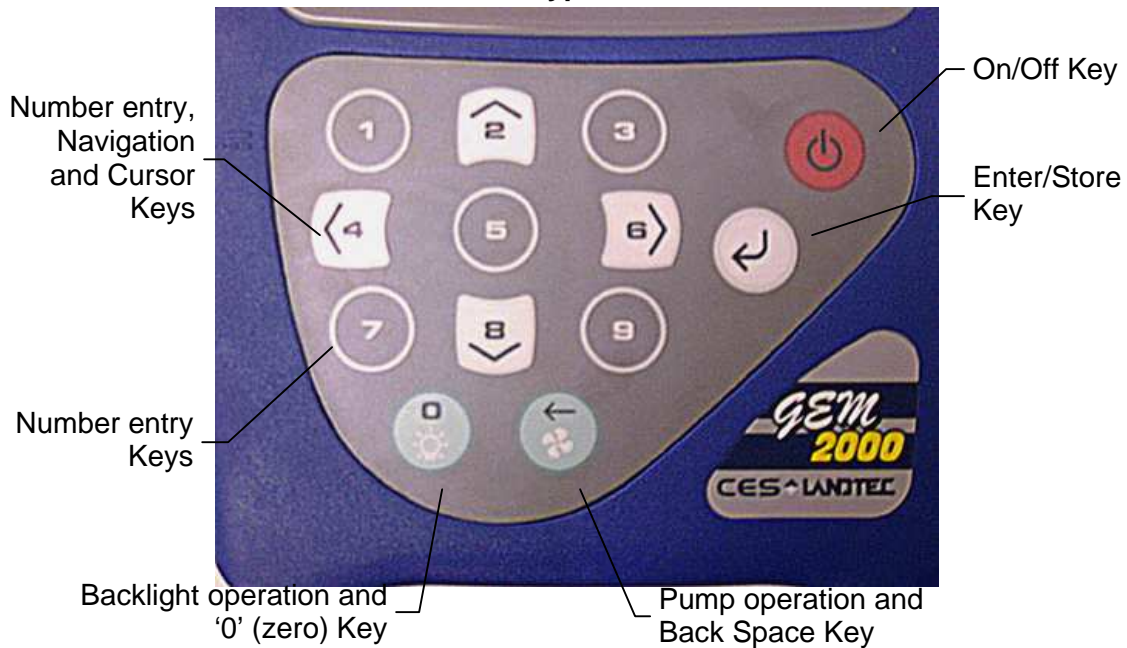
### 2.1 Physical Characteristics of the GEM™2000



**Right Side View**



**Keypad**



Whenever a key is pressed the unit will emit a short 'beep' as an acknowledgement. This function cannot be turned off.

**2.2 Turning the Instrument On/Off**

When switching the instrument on, a long beep will sound, followed by the CES-LANDTEC logo being displayed and the self-test will commence.

When switching the instrument off, the On/Off button must be held down for approximately 15 seconds, at which point a clean air purge will be carried out. If for any reason the instrument 'locks-up' and will not switch off, press and hold the On/Off button for 15 seconds. This will force the instrument to switch off.

**2.3 Warm-up Self Test**

When switched on, the instrument will perform a predetermined self-test sequence taking approximately 20 seconds, during this time many of the instrument's functions are tested, including:

- General operation
- Pump function
- Gas flow measurement
- Calibration
- Backlight function
- Solenoid function

During the self-test, the following information is also displayed:

- Calibration due date.
- Software version.
- Lifetime guarantee covered (or not).
- Date format.
- Serial Number.
- Operating language.

Upon self-test completion, the GEM™2000 should automatically enter the read gas levels screen.

### 2.4 Warning and Error Display

During the self-test, if any operational parameters are out of specification or the pre-programmed recommended calibration/service date has passed errors or warnings may be displayed. Only three errors/warnings can be displayed at any time. To ascertain if more errors occurred, use the '∧' and '∨' key to scroll up/down the list.

#### 2.4.1 WARNING Displayed

All warnings displayed will be prefixed by the word '**WARNING**' followed by a relevant description. Two types of warnings may be displayed.

1. General warnings that may not have an effect on the instrument's function and those where the self-test has detected a function that is outside the usual programmed operating criteria (e.g. Battery charge low, memory nearly full, etc.).
2. Specific warnings of operational parameters that can affect the performance of the instrument (e.g. O<sub>2</sub> Cell out of calibration, CH<sub>4</sub> out of calibration, CO<sub>2</sub> out of calibration, etc.).

The most likely reason for the errors is either an incorrect user calibration, or sensor failure. If an incorrect user calibration has caused the warning, it should be correctable by way of returning the instrument to factory settings, zeroing or carrying out a user calibration as necessary for the relevant function.

#### 2.4.2 ERROR Displayed

All errors displayed will be prefixed by the word '**ERROR**' followed by a number and description. The errors detected by the self-test are usually caused by a user calibration being out of specification or possibly memory corruption. This will have an effect on the functionality of the instrument and should be corrected before use (e.g. 01 - User cal data, CH<sub>4</sub> reading or channel out of specification, 02 - User cal data, CO<sub>2</sub> reading out of specification).

*If any other Warnings or Errors are displayed, contact CES-LANDTEC for further information.*

**CES-LANDTEC is the ONLY authorized service center for the GEM™2000 instruments in the Americas**

### 2.5 Storage

Do not keep the instrument in the trunk of a car or shed because it may be exposed to temperature extremes.

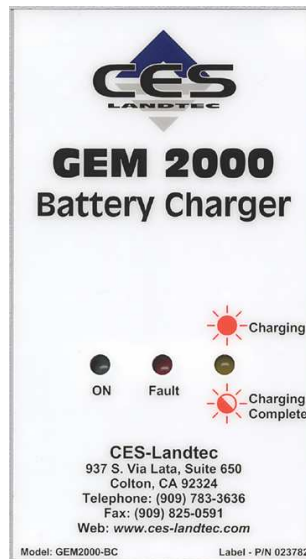
When not in use, instruments should be kept in a clean, dry and warm environment such as an office.

The instrument batteries should be discharged and fully charged at least once every four weeks regardless of indicated charge state. The discharge function may be carried out with the use of the Data Logging Function in GA mode of operation.

### 2.6 Battery/Charging

**The Battery Charger IS NOT covered by the unit UL certification. Therefore, when connected to the Battery Charger, the instrument IS NOT intrinsically safe and should not be used in confined spaces.**

The battery used in the GEM™2000 is a Nickel Metal Hydride manufactured as an encapsulated pack from six individual cells. This type of battery is not so susceptible to “memory effects” as Nickel Cadmium batteries, although it is not recommended that the unit be given short-term charges. When the flashing LED indicates “Charging Complete”, disconnect the charger.



The battery charger indicates when the unit is charging, charged or if there is a fault. A full charge should take approximately 2 hours. Charge the batteries until the ‘Charging Complete’ indicator is flashing.

### 2.7 Read Gas Levels Screen (GA mode of operation)

The read gas levels screen is also considered the normal operation screen and all operations are carried out from this starting point. The following information is displayed in various boxed sections at this time:

- Current programmed time and date.
- Current selected ID code.
- Pump status.
- Pump run time.
- Three main constituent gases – CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub> (in %).
- Balance gas.
- Last read time/date (if previous data is in memory), the benefits of this are, 1 – it is easily noted if a reading has been taken/stored, 2 – the current and previous readings can be easily compared.
- External Gas Pod “Not Fitted” (displays pod type when attached).
- Peak CH<sub>4</sub> reading (in %) (GA mode only).
- LEL CH<sub>4</sub> (GA mode only).
- Current barometric pressure reading.
- Current relative pressure reading (GA mode only).
- Gas Pod or Temperature Probe reading (if connected).
- Battery Charge graph (5 segment, flashes at 20% remaining).
- Memory Usage graph (5 segment, flashes at 5% remaining).

Other options:

- ① Menu                      Allows access to all instrument user functions.
- ③ Next ID                    Allows the next ID to be selected (if data available).
- ⌚ Previous Reading        Allows the previous reading of the selected ID to be viewed (if data available).
- ↵ Store Reading            Stores the current displayed reading. (GA mode only)

## 2.8 Optional Gas Pods

Optional gas pods are available for use with the GEM™2000. These pods are available in seven different gases with nine different PPM ranges. Connection to the instrument is made via the data port and exhaust port. The detected PPM level is displayed in the upper right area of the gas read screen and is saved in the same manner as the other gas readings.

Gas Type	Range (PPM)	Resolution (PPM)
H <sub>2</sub> S	0-50	0.1
	0-200	1.0
CO	0-1000	1.0
SO <sub>2</sub>	0-20	0.1
	0-100	1.0
NO <sub>2</sub>	0-20	0.1
CL <sub>2</sub>	0-20	0.1
H <sub>2</sub>	0-1000	1.0
HCN	0-100	1.0

Gas pods are intended for use as an inexpensive detection means and not for regulatory reporting purposes. If the GEM™2000, fitted with a Gas Pod, indicates the presence of the selected gas, further testing should be performed with regulatory approved instrumentation. CES-LANDTEC recommends that field calibration be performed using the relevant gas and concentration, prior to sampling with a gas pod.

## 2.9 Cold Start

**THIS FUNCTION SHOULD BE USED ONLY AS A LAST RESORT.**

(For Gas Calibration Error Messages, confirm that Factory Setting and User Calibration is done).

A Cold Start should only be carried out to correct an instrument if no other course of action has proved successful. This function **WILL ERASE** the instrument memory entirely. After a cold start is performed the user will need to reset the instrument to factory settings, perform a field calibration and reset the internal time/date to the default settings. Please note, the time/date may only be updated through DataField software. It cannot be updated manually.

To carry out a cold start, turn the instrument on, during the self-test press and continue to hold the '↵' key until the self-test has been completed. Upon completion of the self-test, a pass code entry screen will be displayed. At this point the '↵' key may be released. Enter the code **12345** and press '↵' to confirm.

After the pass-code entry has been accepted, the instrument serial number will be displayed along with the hours of operation and two options:

- 1 - Cold Start
- 0 - Continue

ONLY select option '1' if a Cold Start is to be carried out. Press key '1' to confirm this operation. The cold start menu will be displayed again, press key '0' to continue with normal operation.

### **3 General Operations Menu**

The following features and functions are selectable from the main menu via key 'Ⓞ **Menu**' from the read gas levels screen. Various options are available to the user including:

#### **3.1 Zero Transducers**

This function allows the user to zero the pressure transducer(s). Upon selection, the current pressure reading is displayed. The operation will be carried out when the '↵' is pressed.

#### **3.2 Update Site Data**

Allows the user to answer questions (pre-defined in DataField software) relating to the site (e.g. name of operator, weather conditions, etc.). Site Questions are different from Site Comments.

This is covered in detail in Section 6 of this manual.

#### **3.3 Data Logging (GA mode only)**

Enables the user to leave the Instrument unattended to take samples at a pre-determined time. The reading interval and pump run time may be edited prior to commencing the logging cycle. The ID code may ONLY be set in DataField communication software.

Once the logging function is activated, the instrument will carry out a 30 second 'Warm-up' countdown (displayed bottom right) and begin the first sample. After each sample, the unit will shut down (sleep) to conserve power if the time between the pump ending and the next sample is greater than 30 seconds.

The instrument is reactivated (awakened) during a logging cycle, the company logo will be displayed for a few seconds and the read gas levels screen will be displayed. This will initiate a 30 second countdown to the next sample being taken unless the operator stops the logging function.

If for any reason during a logging cycle the inlet port were to become blocked the Instrument will sense this as a flow fail during the 'pump on' time and will automatically retry until a reading can be obtained. Therefore, position the sample tubing carefully to ensure no blockage due to water/moisture can occur.

#### **3.4 Print Data**

Allows ALL the data currently stored to be printed. This may ONLY be carried out with an appropriate RS232 cable (included with new instruments & available from CES-LANDTEC) and a printer with a serial port connection.

#### **3.5 Adjust Contrast**

The GEM™2000 automatically adjusts the screen contrast according to the ambient temperature to maintain normal viewing.

The contrast can be manually adjusted by using the '<' and '>' cursor keys. The manual contrast setting is stored when the instrument is switched off.

#### **3.6 Field Calibration**

Whenever carrying out a user calibration function it is important to ensure the correct value is entered. Additionally, in the case of a zeroing function, ensure only ambient air is used and no connection is made to a probe or wellhead fitting. The calibration cylinders sold by CES-LANDTEC have a volume of 17 liters. The regulator, sold by same, is set to 0.5 liters per minute and 15 psig maximum. A normal field calibration usually requires the gas to be running for about two minutes.

Upon selecting this option, the Field Calibration screen is displayed. A brief description of the user span calibration procedure and the current reading (row 'R') and user span calibration gas values (row 'S') are displayed.

The span gas values may be changed via the 'Ⓢ Edit Target Concentrations' option. Once this option has been selected, **all** the gas values will require entry. Each entry is to be confirmed by pressing the '↵' key.

### 3.6.1 Zero Channels

Selected from the 'Field Calibration' - '↵-Calibration Menu' allows the relevant reading to be zeroed. When selected, a list of the available options will be displayed, this usually includes CH<sub>4</sub>, and O<sub>2</sub>, also the Gas Pod (if fitted).

Supply a zero gas mixture to the instrument for the gas to be zeroed. Insure the reading for the selected gas has settled to its lowest value before selecting the zero function. When the required option is selected, the user zero function will be carried out automatically. The operation will be carried out when the '↵' key is pressed.

### 3.6.2 Span Channels

Spanning Channels should be carried out prior to use or when the ambient operating temperature changes greater than +/- 20 degrees. Selected from the 'Field Calibration' - '↵-Calibration Menu', allows the relevant reading to be span calibrated (in accordance with the calibration value entered). When selected, a list of the available options will be displayed, which includes CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>, and Gas Pod (if fitted).

When the required option is selected from the list, the span calibration function will be carried out automatically. When carrying out this procedure, ensure the span calibration procedure (as outlined below) is followed:

1. Apply the relevant known certified gas concentration through the inlet port of the Instrument.
2. Wait until the current gas reading has stabilized.
3. Select the required calibration option via the '↵-Calibration Menu'.

### 3.6.3 Factory Settings

This will clear any user zero and span calibration data. It will also restore the pre-programmed factory settings for **ALL** channels – CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub> or Gas Pod (if fitted) and pressure transducers.

### 3.6.4 Last Field Cal

Displays the date the last field calibration was carried out (zero or span).

## 3.7 Mode of Operation

Allows changing instrument between GA mode and GEM mode of operation.

## 4 Taking Probe Readings (GA Mode)

CES-LANDTEC classifies non-extraction wells as Probes when **NOT** connected to an active vacuum extraction system. Probes, (commonly known as migration probes), may be placed on the perimeter of the landfill to test for gas migration or may be placed next to a building or road to test for the presence of Methane. The GEM™2000 instrument may be configured as a Gas Analyzer (GA mode) for sampling probes. To access this function from the gas read screen press 'Ⓢ' for menu and scroll down to **Mode of Operation**, press the '↵' key and highlight **Landfill Gas Analyzer**, pressing the '↵' key again will select GA mode of operation.

### 4.1 Preliminary Checks

Prior to going to the test site, it is good practice to ensure:

- All necessary ID codes and readings have been uploaded via DataField software.
- The time and date are correct.
- The water trap has a clean and dry filter fitted.
- The inlet-port particulate filter is clean and dry.
- A supply of spare filters is available in case of accidental water blockage or contamination.
- The battery has a good charge (minimum 25% charge, even if only a few readings are required).
- The memory has sufficient space available.
- The CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> readings have been auto-zeroed, without gas concentration present.
- Check the span calibration with a known concentration calibration gas.

Travel to site with the analyzer in the vehicle's interior - not in the trunk or truck bed, where it may be subjected to extremes of temperature and possible shock damage. Do not place the analyzer against anything hot (e.g. gas extraction pipe, car body or in an unattended car during the summer). This may cause erroneous readings.

When moving around a site, protect the instrument from strong direct sunlight, heavy rain or wind-chill. Strong direct sunlight can raise the temperature of the instrument beyond its operating range. If this occurs, the LCD display will appear almost black and the contrast setting cannot alter the contrast.

**Always use the water trap!** If the water trap becomes flooded, change the filter immediately and ensure all tubes are clear before re-use.

### 4.2 Update Site Data

Prior to taking the readings at a particular site, the Site Data should be updated (if programmed). This is accessed via the General Menu 'Ⓢ **Update Site Data**'. This function removes the need for the site conditions to be recorded manually.

A series of up to five questions can be pre-programmed with the use of DataField and answered at this time. The answers to these questions are stored and appended to each reading stored thereafter, until the site data is updated for another site.

### 4.3 Taking Readings – With ID

For this function to be used it is essential that the relevant ID and if required, previous readings are uploaded to the Instrument. An ID **cannot** be entered from the Instrument.

1. When the read gas levels screen is displayed, option 'Ⓢ **Next ID**' should be selected. A list of stored IDs is displayed for selection via the '↑' and '↓' cursor keys, the 'next' ID on the list is automatically highlighted. To confirm selection, press the '↵' key. The display may be toggled to



display any relevant ID information such as a description of the probe location, work to be carried out, etc.

2. A reminder is displayed to disconnect sample tubes, as a clean air purge will automatically remove the previous sample from the instrument. Purge time may be set via DataField (default is 30 seconds). Once the '↵' key is pressed, purge will begin and the Read Gas Levels screen will be displayed upon completion. The purge may be aborted by pressing the 'EXIT' key.
3. The ID number selected and the pump runtime is displayed in the upper left corner of the read gas levels display.
4. At this point, connect the sample tube (with water trap) from the sample point to the inlet port of the instrument, ensuring the connector 'clicks' into place. Then connect the sample tube to the probe sample port. **Do not connect the sample tube to the probe port before connecting to the instrument as this will cause any pressure in the probe to dissipate and a proper pressure reading will not be taken.**
5. As soon as the connection is made, the relative/static pressure reading will be displayed. No sample is taken from the probe at this time. Once the reading stabilizes and the pump starts, the relative/static pressure reading is stored. The relative/static reading will remain displayed as the pressure last taken.
6. The pump will run for the pre-programmed time and a countdown timer will be displayed. The pump may be stopped or started at anytime by way of the 'P' (pump) key. The reading may be stored at anytime with the use of the '↵' key. When the pump automatically stops this should be used as a prompt to store the reading.
7. Upon storing the reading, any pre-programmed questions will be displayed for response. This may require a numeric, alphanumeric selectable comment, or exclusive comment answer. A maximum of eight selectable and exclusive comments may be entered.
8. Disconnect the sample tubing from the probe and proceed to Step 1 for the next probe.

For each reading, the following information will be stored:

- ID code.
- Current time/date.
- Site data (if entered).
- All gas readings and balance (CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>).
- LEL CH<sub>4</sub>.
- Barometric Pressure.
- Relative Pressure.
- Questions/comments.
- Temperature (if temperature probe is connected).
- Gas Pod (if connected).

When the instrument is switched off, a clean air purge is automatically started for a pre-determined period. This may be aborted with the use of the '↵' key, although it is not recommended.

A tone will sound and a flashing bell will be displayed next to the appropriate gas reading value if a preset alarm condition has been exceeded.

#### **4.4 Taking Readings – Without ID**

1. From the ID list press 'Select No ID' or, if ID information has not been uploaded to the instrument, an ID list will not be available. In either case, the ID will be displayed and stored as ' - - - - - '.
9. A reminder is displayed to disconnect sample tubes, as a clean air purge will automatically remove the previous sample from the instrument. Purge time may be set via DataField (default is 30 seconds). Once '↵' is pressed, purge will begin and the Read Gas Levels screen will be displayed upon completion. The purge may be aborted by pressing the 'EXIT' key.

2. At this point, connect the sample tube (with water trap) from the sample point to the inlet port of the instrument, ensuring the connector 'clicks' in to place.
3. Now connect the sample tube to the probe sample port. **Do not connect the sample tube to the probe port before connecting to the instrument as this will cause any pressure in the probe to dissipate and a proper pressure reading will not be taken.**
4. The pump may be started or stopped at anytime by way of the '⊕' (pump) key and a 'time-on' timer will be displayed. The pump should always be stopped using the '↵' key, before storing a reading.
5. Upon storing the reading, a virtual keyboard will be displayed for any alphanumeric comments to be entered.
6. Disconnect the sample tubing from the probe and proceed from step 1 for the next probe.

Except for the ID code information, which will be stored as '- - - - -', and probe questions, for each reading the information stored will be the same as that for a reading with an ID.

A tone will sound and a flashing bell will be displayed next to the appropriate gas reading value if a preset alarm condition has been exceeded.

### 4.5 Temperature Probe Reading

The GEM™2000 has the facility to automatically display and record the probe temperature via an optional temperature probe (TP-100). When a temperature probe is fitted to the RS232 Communication Socket, the temperature will be displayed in the read gas levels screen and recorded with all other data. The temperature probe is part of the GEM™2000 UL certification and is therefore certified for use under the same conditions as the instrument.

### 4.6 Cross-Gas Effects

#### 4.6.1 Methane, Carbon Dioxide and Oxygen

The Methane reading is filtered to an infrared absorption frequency of 3.41 $\mu$ m (nominal), the frequency specific to hydrocarbon bonds. Instruments are calibrated using certified Methane mixtures and will give correct readings provided there are no other hydrocarbon gasses present within the sample (e.g. ethane, propane, butane, etc.). If there are other hydrocarbons present, the Methane reading will be higher (never lower) than the actual Methane concentration being monitored.

The extent to which the Methane reading is affected depends upon the concentration of the Methane in the sample and the concentration of the other hydrocarbons. The effect is non-linear and difficult to predict.

The Carbon Dioxide reading is filtered to an infrared absorption frequency of 4.29 $\mu$ m (nominal), the frequency specific to Carbon Dioxide. Therefore, any other gases usually found on landfill sites will not affect the Carbon Dioxide reading.

The Oxygen sensor is a newly developed galvanic cell type and suffers virtually no influence from CO<sub>2</sub>, CO, H<sub>2</sub>S, NO<sub>2</sub>, SO<sub>2</sub> or H<sub>2</sub>, unlike many other types of Oxygen cell.

The infrared sensors will not be "poisoned" by other hydrocarbons. Normal operation will resume as soon as the gas sample has been purged.

Note - there has been one reported incident of a high reading due to the presence of Carbon Disulphide, which has a similar absorption frequency to Carbon Dioxide.

#### 4.6.2 H<sub>2</sub>S, CO and other Optional Gas Pods

The Gas Pods used to measure H<sub>2</sub>S and CO do suffer from cross-gas effects. Such effects are not accurately specified. However, the following table may be useful as a guide. This table represents how many ppm would be read by a Gas Pod if 100ppm of the interfering gas was applied, (with no other cross-contaminates being present in the sample).

Cell	CO	H <sub>2</sub> S	SO <sub>2</sub>	NO <sub>2</sub>	CL <sub>2</sub>	H <sub>2</sub>	CH <sub>4</sub>	CO <sub>2</sub>
CO	100	<3	0	<-20	0	<40	0	0
H <sub>2</sub> S	<0.5	100	~20	~-20		~0.1	0	0

**NOTE:** All readings are given in parts per million (ppm). The life of an electrochemical cell is determined by exposure to gasses, typical life being one to two years. It is recommended that Gas Pods be field calibrated at regular intervals.

#### 4.7 Memory

The instrument's memory is volatile. It is maintained by a battery back-up system, which will maintain the memory while the battery is being changed.

The memory is not to be used as a permanent storage medium and any data should be transferred to a more permanent storage medium as soon as possible. An Instrument should never be stored for prolonged periods with valuable data in its memory.

Although unlikely, sudden shocks, high levels of electromagnetic interference or static discharge may cause memory corruption or loss. If this occurs, the instrument should be Cold Started and the calibration reset to factory settings before further use. **Cold starting will erase all data in the instrument including resetting the time and date to the default value.**

## 5 Taking Extraction Well Readings (GEM Mode)

CES-LANDTEC classifies gas-producing penetrations on landfills as wells when used with vacuum extraction systems and flow determining devices such as the Accu-Flo wellheads, orifice plates or pitot tubes. The GEM™2000 may be configured as a Gas Extraction Monitor (GEM mode) for the purpose of sampling wells and obtaining flow measurements. To access this function from the gas read screen press 'ⓐ' and scroll down to **Mode of Operation**, press the '↓' key and highlight **Gas Extraction Monitor**, pressing the '↓' key again will select GEM mode of operation.

### 5.1 Preliminary Checks

Prior to going to site, it is good practice to ensure:

- All necessary ID codes and readings have been uploaded via DataField software.
- The time and date are correct.
- The water trap has a clean and dry filter fitted.
- The inlet-port particulate filter is clean and dry.
- A supply of spare filters is available in case of accidental water blockage or contamination.
- The battery has a good charge (minimum 25% charge, even if only a few readings are required).
- The memory has sufficient space available.
- The CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub> readings have been auto-zeroed without gas concentration present.
- Check the span calibration with a known concentration calibration gas.

Travel to the site with the analyzer in the vehicle's interior - not in the trunk or truck bed, where it may be subjected to extremes of temperature and possible shock damage. Do not place the analyzer against anything hot (e.g. gas extraction pipe, car body or in an unattended car during the summer). This may cause erroneous readings.

When moving around a site, protect the instrument from strong direct sunlight, heavy rain or wind-chill. Strong direct sunlight can raise the temperature of the instrument beyond its operating range. If this occurs, the LCD display will appear almost black and the contrast setting cannot alter the contrast.

**Always use the water trap!** If the water trap becomes flooded, change the filter immediately and ensure all tubes are clear before re-use.

### 5.2 Update Site Data

Prior to taking the readings at a particular site, the Site Data should be updated (if programmed). This is accessed via the General Menu 'ⓐ'. This function removes the need for the site conditions to be recorded manually. A series of up to five questions can be pre-programmed with the use of DataField and answered at this time. The answers to these questions are stored and appended to each reading stored thereafter, until the site data is updated for another site.

### 5.3 Taking Gas and Flow Readings (GEM Mode)

The GEM mode of operation is designed to allow for gas flow (SCFM) and energy measurements (BTU) to be calculated at the wellhead. This function requires the use of an ID that has been uploaded from DataField software with the type of flow device defined. **Gas flow and BTU will not be calculated if this action has not been performed.**

1. When the gas read screen is displayed select 'ⓐ Next ID'. A list of stored IDs will be displayed for selection via the '↵' and '↓' cursor keys, the 'next' ID is automatically highlighted, to confirm the selection press the '↓' key. The screen may be toggled to display any relevant ID information such as a description of the well location, work to be carried out, etc.

2. A reminder is displayed to disconnect sample tubes, as a clean air purge will automatically remove the previous sample from the instrument. Purge time may be set via DataField (default is 30 seconds). Once the '↵' key is pressed, purge will begin and the Read Gas Levels screen will be displayed upon completion. The purge may be aborted by pressing the 'ⓀEXIT' key.
3. Connect the sample tubes (with water trap filter) to the wellhead ensuring the gas sample tube and impact pressure tubes are properly oriented. Insert the temperature probe if used.
4. Press the 'Ⓚ' key to start the sample pump; a countdown timer will be displayed in the upper left area of the display. The pump may be stopped and restarted any time by pressing the 'Ⓚ' key. The pump run time is set in DataField software. Allow the gas readings to stabilize and press 'ⓀMeasure Flow' key, this will store the gas level readings and display the '**PRESSURE READINGS**' screen. Note; a flashing bell will be displayed next to the appropriate gas and a beeping tone will be heard, if a preset alarm condition has been exceeded.
5. The '**PRESSURE READINGS**' screen will prompt the user to disconnect the sample tubes and allow the pressure to stabilize. Once the pressure has stabilized press '↵ Zero Transducers'. Press 'Ⓚ' to continue. **Note**; if Accu-Flo wellheads are used this zero function may be performed prior to connecting the sample tubes to the well head by selecting 'Ⓚ MENU' and highlighting '**ZERO TRANSDUCERS**'. This eliminates the need to disconnect and re-connect the sample tubes on the same wellhead.
6. If a temperature probe is not connected, the user is prompted to manually input the gas temperature, press the '↵' key when entry is finished.
7. The gas flow and energy screen is now displayed showing all the gas level readings taken in the gas read screen as well as the level of gas flow (SCFM) and power (BTU). In addition, Adjusted, Current and Previous (if downloaded) readings are displayed so modifications may be made to the well if required.
8. Pressing '↵ STORE' will save the readings to memory. Then, the comments screen (if comments were loaded) will display and allow you to answer questions or select comments about the condition of the well. A total of seven comments and one exclusive comment may be stored with each ID.
9. Press 'Ⓚ NEXT ID' and proceed to the next wellhead. An automatic purge will be performed at this time to ensure the sample has been exhausted from the instrument.

For each reading, the following information will be stored:

- ID code.
- Current time/date.
- Site data (if entered).
- All gas readings and balance gas (CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>).
- Barometric Pressure.
- Temperature.
- Gas Pod (if connected).
- Gas flow (SCFM) and Power (BTU).
- Comments and exclusive comment.

When the Instrument is switched off, a clean air purge is automatically started for a pre-determined global period. This may be aborted by pressing the '↵' key, although we do not recommend this action.

## 6 DataField CS Software

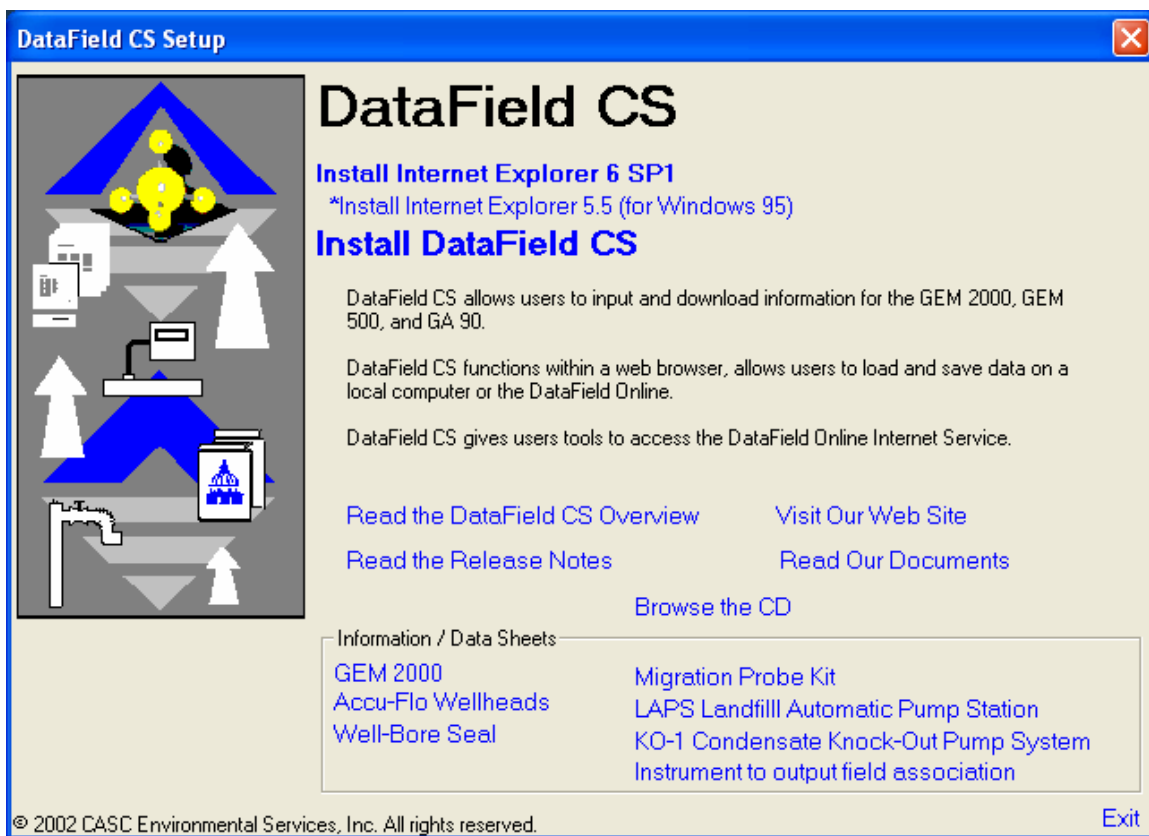
DataField CS is an integrated software program designed to communicate with the GEM™2000, GEM™500 and GA-90 instruments. The software will create files used for storing gas read data, ID data, comments and instrument configuration data. The files created are significantly different from the files created with GEM\_COMM or GA\_COMM software and are not compatible with these versions of software.

DataField CS is browser based (Java enabled) and will operate on Windows98 and higher Windows operating systems. Recommended hardware requirements are:

- Pentium III 500 MHz microprocessor or equal.
- 64 MB RAM.
- 120 MB of free hard disk space.
- CDROM drive.
- Mouse or pointer system.
- Standard keyboard.
- Installed printer.

### 6.1 Installing DataField CS

Be sure your computer is turned on and all software programs have been properly closed. Place the program disk in the CD ROM drive and close the tray. DataField CS will self start and display the DataField CS set-up screen.\*



**Install** the Internet Explorer 6 SP1 by clicking on the corresponding link in the DataField CS set-up screen. If you are using Windows 95, install the Internet Explorer 5.5. Follow the onscreen instructions until the Internet Explorer is installed successfully.

**Reboot** the computer after the installation of the Internet Explorer is completed.

**Re-insert** CD Rom to start autorun again.

**Install** the DataField CS by clicking on the corresponding link in the DataField CS set-up screen. Follow the onscreen instructions.\*

Other useful links on the DataField CS set-up screen:

**Read the DataField CS Overview** link will open a presentation with an overview of DataField CS.

**Read the Release Notes** link has information on the system requirements, application compatibility and other important issues.

**Visit Our Web Site** link will open the CES-LANDTEC web site.

**Read Our Documents** link will open a new window with manuals and user guides for GEM Instruments, as well as several viewers and 3<sup>rd</sup> party tools that can be downloaded.

**Browse the CD** link will open a file browser.

**Information / Data Sheets** set of links provides information on various Landfill instruments.

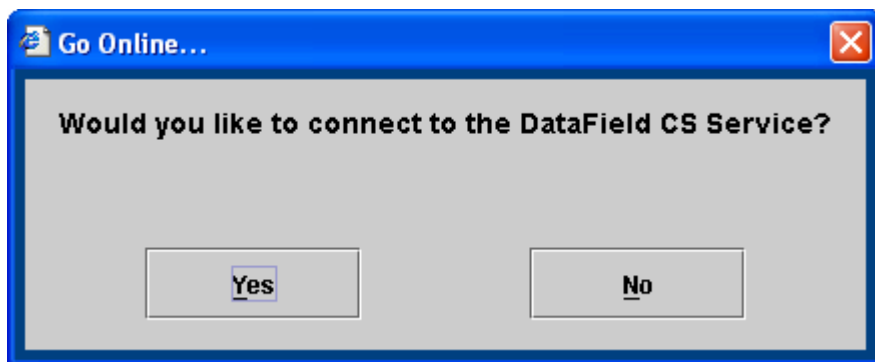
\* If the DataField CS set-up screen hasn't appeared, open a file browser (ex. right-click on the Start button on your desktop and choose open) and navigate to your CD-ROM drive. Double-click on the **Autorun.exe**.

### 6.2 Establishing Communications

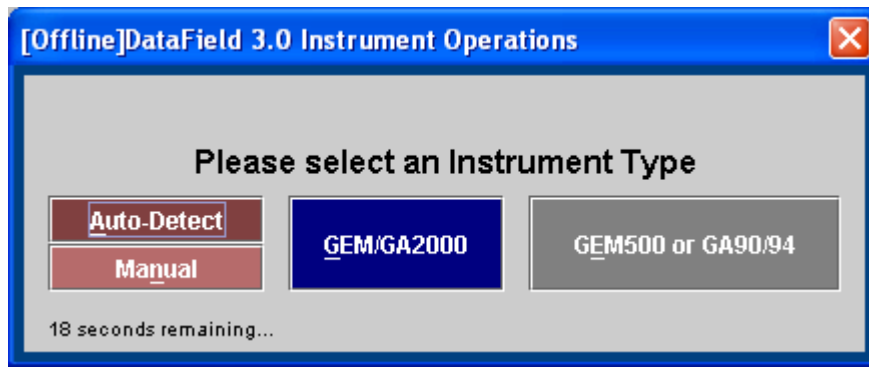
Connect the RS-232 download cable to an open COM port on your computer. Connect the other end of the RS-232 download cable to the GEM™2000 data port. DataField CS has the ability to automatically scan the different COM ports on your computer to find where the instrument is connected.

Turn the instrument on, wait for the self-test function to finish. The Gas Readings screen will display, if not, then turn off the GEM and re-start the instrument. The GEM™2000 must be in the Gas Reading screen in order to establish communications.

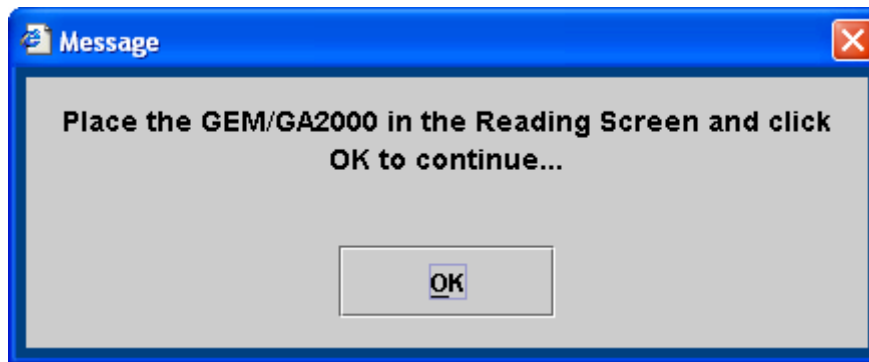
Once the instrument is in the proper communications mode, click on the Start menu then All Programs menu. Scroll to DataField and then DataField CS to initialize the software. The following screen will appear on the computer.



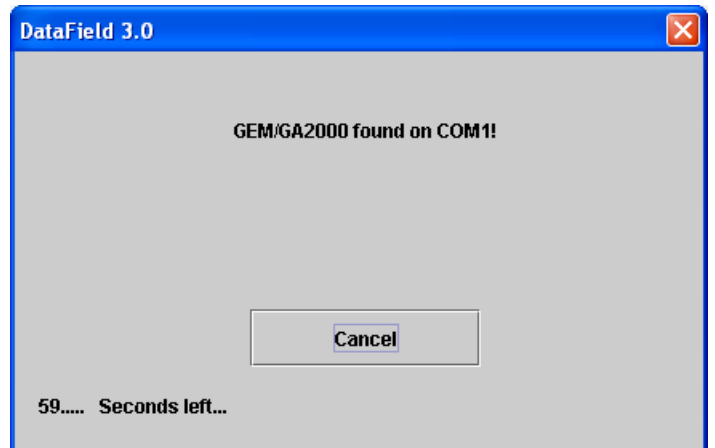
Click Yes to run DataField CS online or No to run it offline.



Click on the GEM/GA2000 button. You can also click on the Auto-Detect button for the DataField CS to automatically detect the instrument.



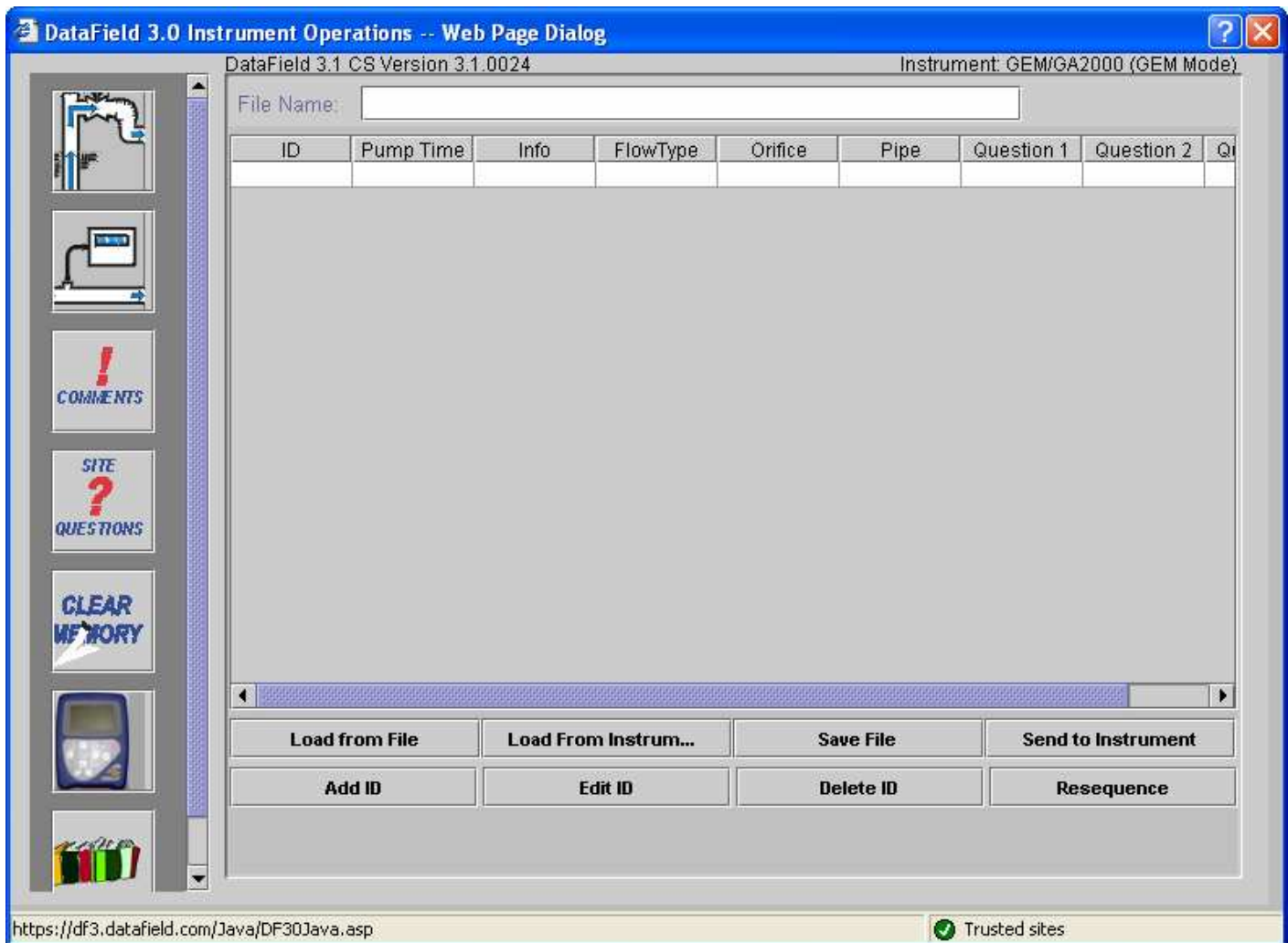
Click OK and DataField CS will automatically search for the instrument. This may take a few minutes. When the instrument is found and the communication is established, the software will display a box that indicates what type of instrument was found. If the software does not find the instrument, it will display a box that indicates that no instrument was found.





## 6.3 Main Screen

Once DataField CS establishes the communication with the instrument, the main software screen will appear.



Seven main categories (buttons) are listed down the left side of the screen: ID Functions, Readings, Comments, Site Questions, Clear Memory, Instrument Settings and Resource Links. Clicking on any one of the buttons will take the user to that functionality of the application.

## 6.4 Close the program

Clicking on the **Close** button in the top right corner of the screen will exit the program. This will close all files and exit the program.

## 6.5 Communications

It is not possible to change instruments and establish communications without re-starting the software.

## 6.6 Functions

Each button has a specific function as listed below:

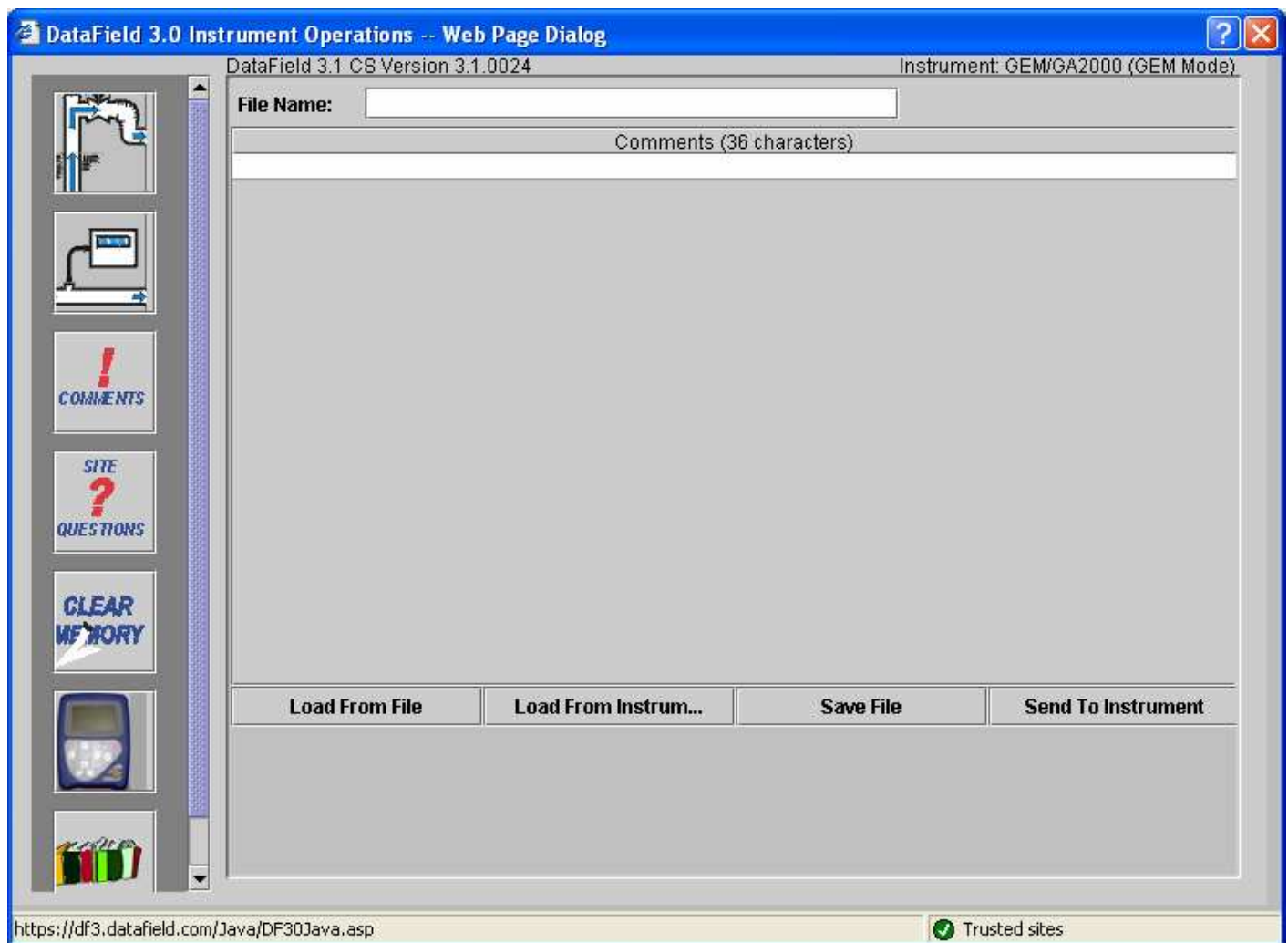
1. **Comments** – Allows entry of comments that may be selected for the IDs. A total of seven comments and one exclusive comment may be selected for each ID.
2. **IDs** – Used for adding new IDs, editing IDs or deleting IDs and entry of ID parameters such as pump run time, flow device, comments and questions for the ID.
3. **Readings** – Allows downloading and viewing data from instrument and uploading of previous data to the instrument.
4. **Site Questions** – DataField CS supports a total of five site questions that are answered by the technician and saved to the ID data.
5. **Clear Memory** – Allows the deletion of selective IDs, readings, comments, site questions or all memory loaded in instrument memory.
6. **Resource Links** – Allows the user to directly access information via the www.

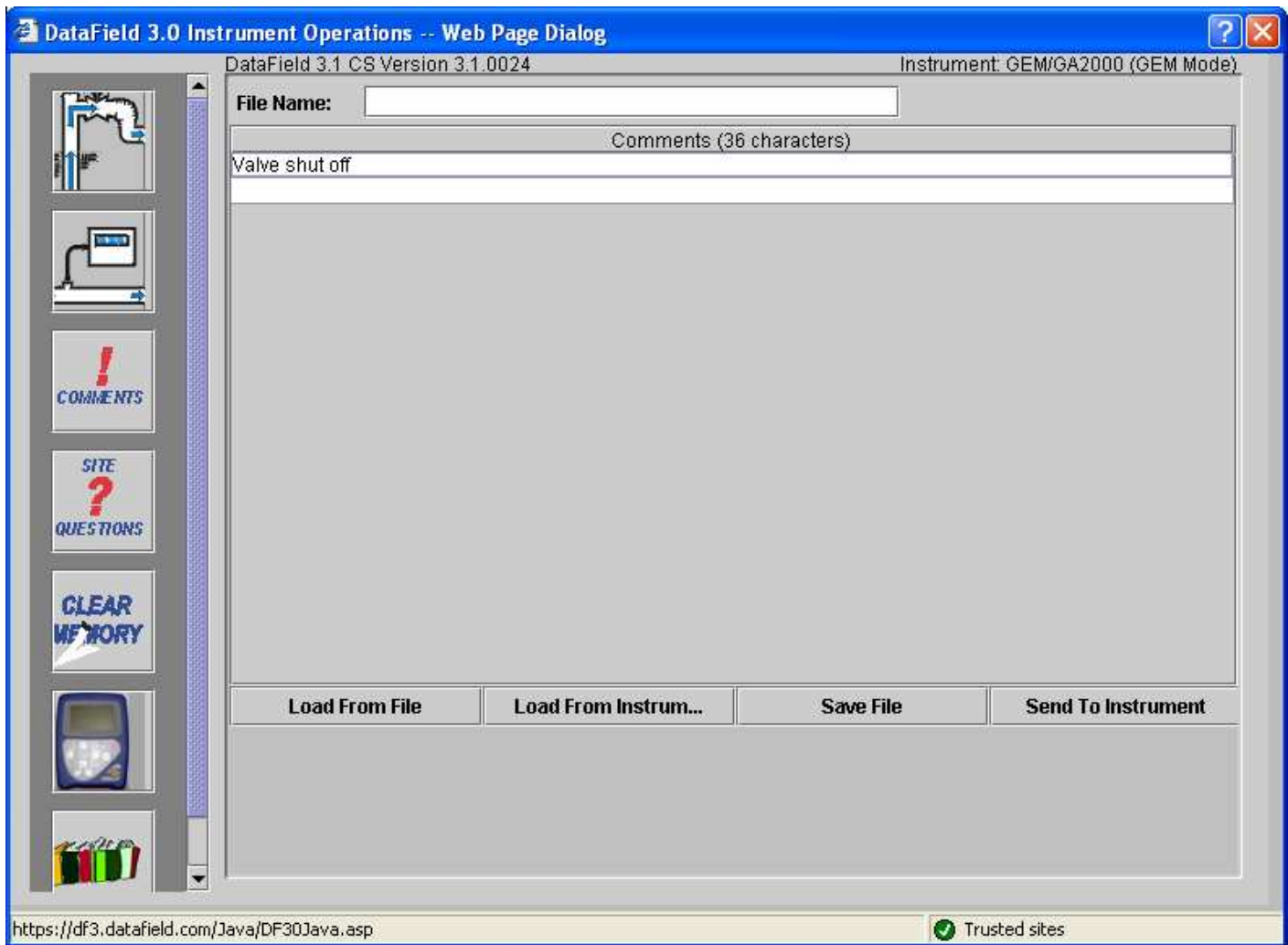
### 6.6.1 Comments



DataField CS allows up to 64 comments to be created for upload to the GEM™2000. Each comment may be up to 36 characters in length and may be alphanumeric or any character on the computer keyboard. **Select Comment** or **Exclusive Comment** must be turned on for comments to be selected for that ID. See section 6.6.2. Click on the **Comments** button to open the

following screen.





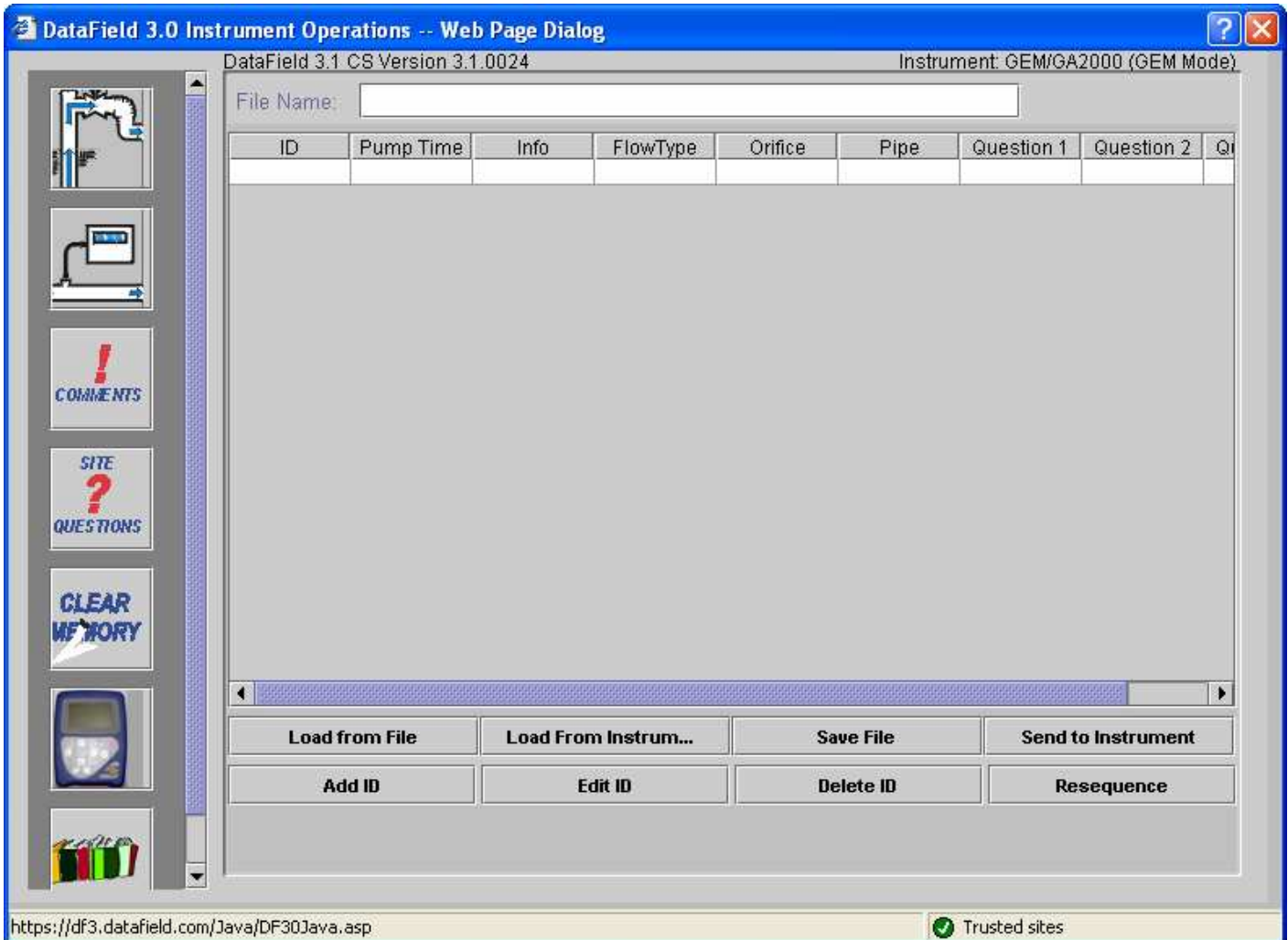
Enter the comment on the comment line and press **Enter** to continue entering comments until all the desired comments have been entered. Click on **Save File** to save the data to disk and then click on **Send to Instrument** to save the comments in the instrument. To delete a comment, click on the comment to highlight the comment and press the **Delete** key on the computer keyboard to remove the highlighted comment. It is always suggested to save the comment file because of the potential size and time required to recreate the comments. Once created, the comment file may be modified and saved under a different file name at any time.

**Note:** Comments must be created and sent to the instrument through the software. They can not be hand input into the instrument in the field.

### 6.6.2 Entering IDs



From the opening screen select the **ID** button. The following screen will open:



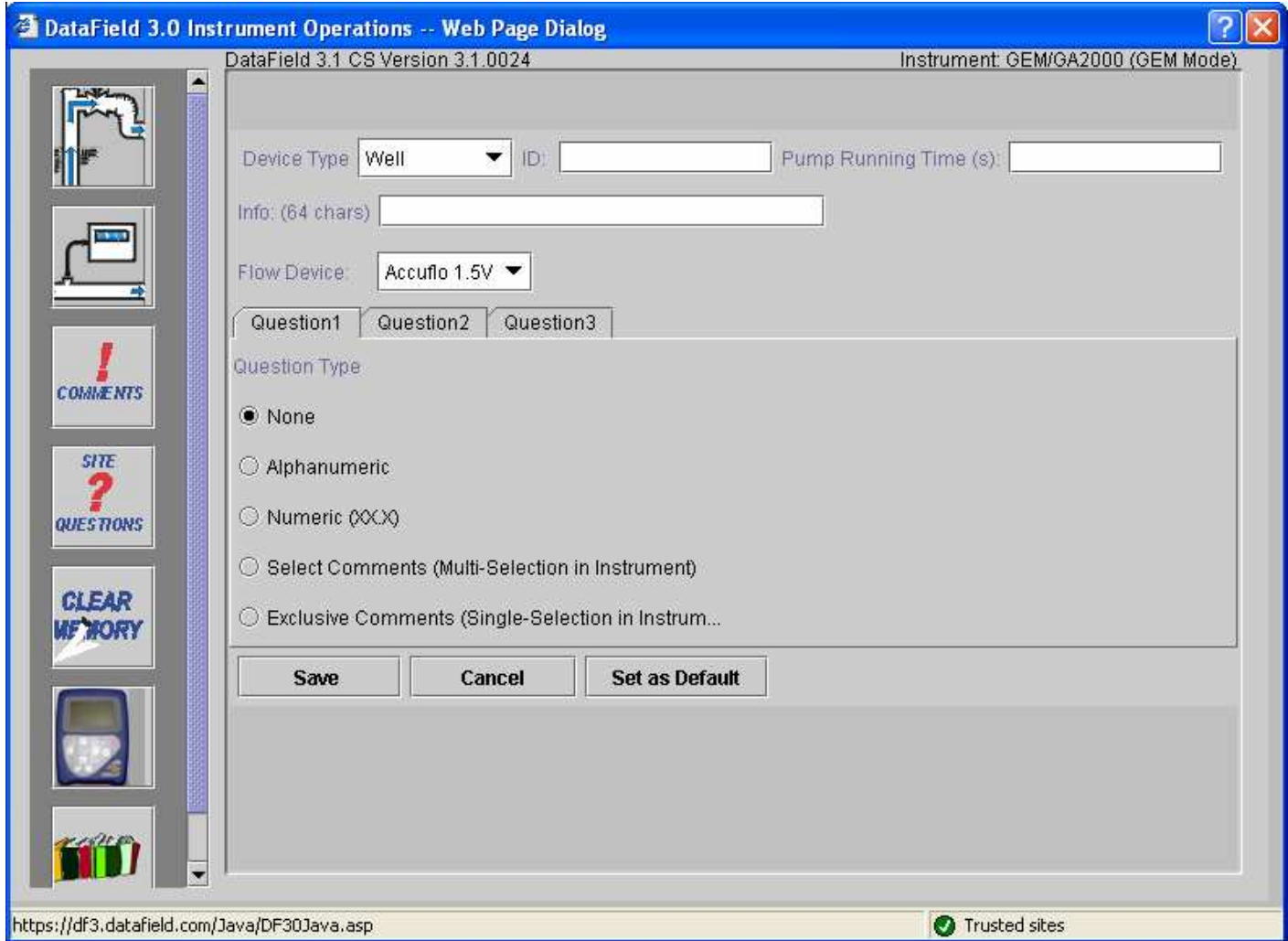
Selecting the **Save File** button will allow you to enter the name for the file you wish to save. The naming of files follows the extended naming convention for Windows.

Selecting the **Load from File** button will allow a previously created file to be loaded from the computer disk drive.

Selecting the **Load from Instrument** button will allow previously loaded IDs in the instrument to be downloaded for modification such as increasing the pump run time or adding additional comments to a specific ID. **CAUTION:** Loading IDs from an instrument can be a dangerous practice and is not recommended if using DF online service. The possibility exists of introducing into a project IDs from another project. When the IDs are downloaded from the instrument and stored online all IDs that are present in the instrument will be stored to the current project **IRRESPECTIVE** of if the IDs belong to the project.

**Add ID** button is used for the creation of a new ID or multiple IDs that may be sent to the instrument or saved to a new file for later use.

To enter a new ID or create a new ID set, click on the **Add ID** button and the following screen will open:



Enter the Well ID in any combination of alpha or numeric characters for a maximum of eight characters. **All eight characters must be used.** Enter the pump run time in seconds (maximum of 999 seconds), pump run time must be entered in order for the pump to be turned on for gas sampling. Enter information about the well, such as its location, previous problems, etc or leave blank. Enter the type of flow device used with the well (Accu-Flo wellhead, Pitot tube, or orifice plate); user input may also be selected. If Pitot tube or orifice plate is selected, the **inside** pipe diameter and **orifice diameter** must be entered. If the pump run time and the flow device are going to be the same for multiple wells, click on **Set as Default** to lock these two values. Three questions may be asked about the well for reply by the technician at the time a sample is taken. These can take the form of alphanumeric, numeric, selected comments or exclusive comments. If none is selected then no questions will be asked for this ID. Note: **If Select Comments or Exclusive Comments is selected, Comments must be created and sent to the instrument.** See section 6.6.1.

## GEM™2000 Operation Manual

Click on **Save** to add this ID to the editor screen seen below. If additional IDs need to be entered, simply click on **Add ID** and enter the data as before.

DataField 3.0 Instrument Operations -- Web Page Dialog

DataField 3.1 CS Version 3.1.0024 Instrument: GEM/GA2000 (GEM Mode)

File Name:

ID	Pump Time	Info	FlowType	Orifice	Pipe	Question 1	Question 2	Question 3
12345678	30	Northeast c...	Accuflo 2H	0	0	Is the leach...	N/A	N/A

COMMENTS

SITE QUESTIONS

CLEAR MEMORY

Load from File Load From Instrum... Save File Send to Instrument

Add ID Edit ID Delete ID Resequence

https://df3.datafield.com/Java/DF30Java.asp Trusted sites

Once all the IDs have been entered, click **Save File** button to save the ID data to a file or **Send to Instrument** button if data is to be uploaded to an instrument for field sampling.

### 6.6.3 Editing IDs

IDs may be edited in a similar manner to entering a new ID. Click on the **ID** button. Click on the **Load from File** button if the IDs to be edited are in a saved file on disk or click on **Load from Instrument** if the IDs to be edited reside in the instrument. Once the IDs have been opened, the **ID Editor** screen will appear as shown below.

DataField 3.1 CS Version 3.1.0024      Retrieving Instrument Type and Mode...

File Name:

ID	Pump Time	Info	FlowType	Orifice	Pipe	Question 1	Question 2	C
demoW001	120	Well for de...	Accuflo 1.5H	0.00	0.00	N/A	N/A	N/A
demoW002	120	Well for de...	Accuflo 1.5V	0.00	0.00	N/A	N/A	N/A
demoW003	120	Well for de...	Accuflo 2H	0.00	0.00	N/A	N/A	N/A
demoW004	120	Well for de...	Accuflo 2V	0.00	0.00	N/A	N/A	N/A
demoW005	120	Well for de...	Accuflo 3H	0.00	0.00	N/A	N/A	N/A
demoW006	120	Well for de...	Accuflo 3V	0.00	0.00	N/A	N/A	N/A
demoW007	120	Well for de...	Orifice Plate	0.75	3.00	N/A	N/A	N/A
demoW008	120	Well for de...	Pitot Tube	0.00	3.00	N/A	N/A	N/A
demoW009	120	Well for de...	User Input	0.00	3.00	N/A	N/A	N/A

COMMENTS

SITE QUESTIONS

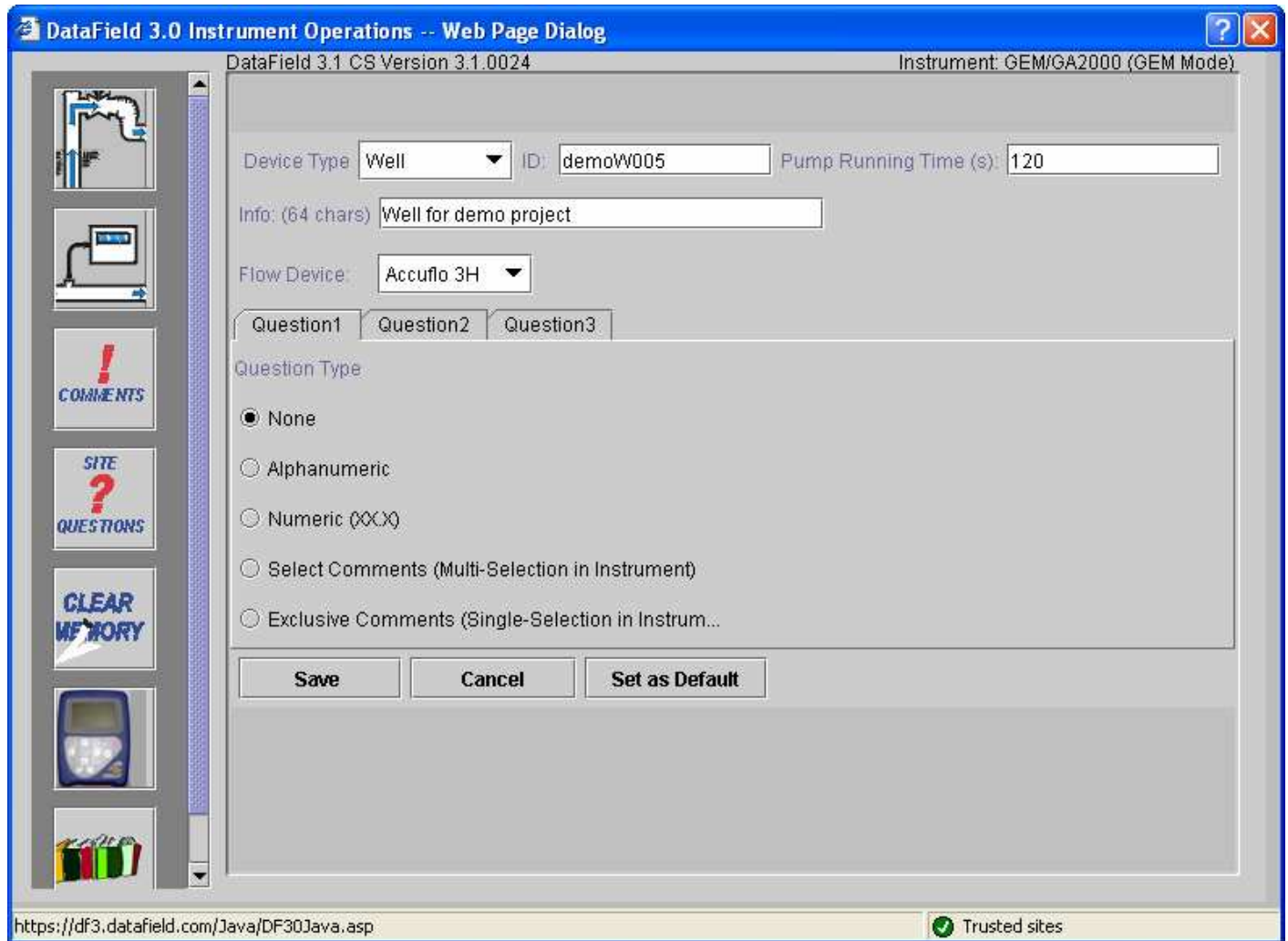
CLEAR MEMORY

Load from File    Load From Instrum...    Save File    Send to Instrument

Add ID    Edit ID    Delete ID    Resequence

https://df3.datafield.com/Java/DF30Java.asp    Trusted sites

To select an ID for editing, click on the ID to highlight the ID, and then click on the **Edit ID** button. The Edit ID screen will open and allow information for the selected ID to be changed. When finished with the changes, click on **Save** to save the edited ID to the ID list.



When editing is completed, click on **Save** to return to the previous screen. Click on **Save File** to save the edited data to disk or click on **Send to Instrument** to append the IDs to the IDs in the instrument.

**Note:** IDs are only appended to the unit. It is strongly recommended to erase/clear IDs from unit prior to sending new IDs to the unit. One obvious exception is in the case of loading IDs for multiple sites in an instrument.



DataField 3.0 Instrument Operations -- Web Page Dialog

DataField 3.1 CS Version 3.1.0024 Retrieving Instrument Type and Mode...

File Name:

ID	Pump Time	Info	FlowType	Orifice	Pipe	Question 1	Question
demoW001	120	Well for demo pr...	Accufflo 1.5H	0.00	0.00	N/A	N/A
demoW002	120	Well for demo pr...	Accufflo 1.5V	0.00	0.00	N/A	N/A
demoW003	120	Well for demo pr...	Accufflo 2H	0.00	0.00	N/A	N/A
demoW004	120	Well for demo pr...	Accufflo 2V	0.00	0.00	N/A	N/A
demoW005	120	Shut this well off	Accufflo 3H	0.00	0.00	N/A	N/A
demoW006	120	Well for demo pr...	Accufflo 3V	0.00	0.00	N/A	N/A
demoW007	120	Well for demo pr...	Orifice Plate	0.75	3.00	N/A	N/A
demoW008	120	Well for demo pr...	Pitot Tube	0.00	3.00	N/A	N/A
demoW009	120	Well for demo pr...	User Input	0.00	3.00	N/A	N/A

COMMENTS

SITE QUESTIONS

CLEAR MEMORY

Load from File Load From Instrum... Save File Send to Instrument

Add ID Edit ID Delete ID Resequence

https://df3.datafield.com/Java/DF30Java.asp Trusted sites

#### 6.6.4 Delete IDs

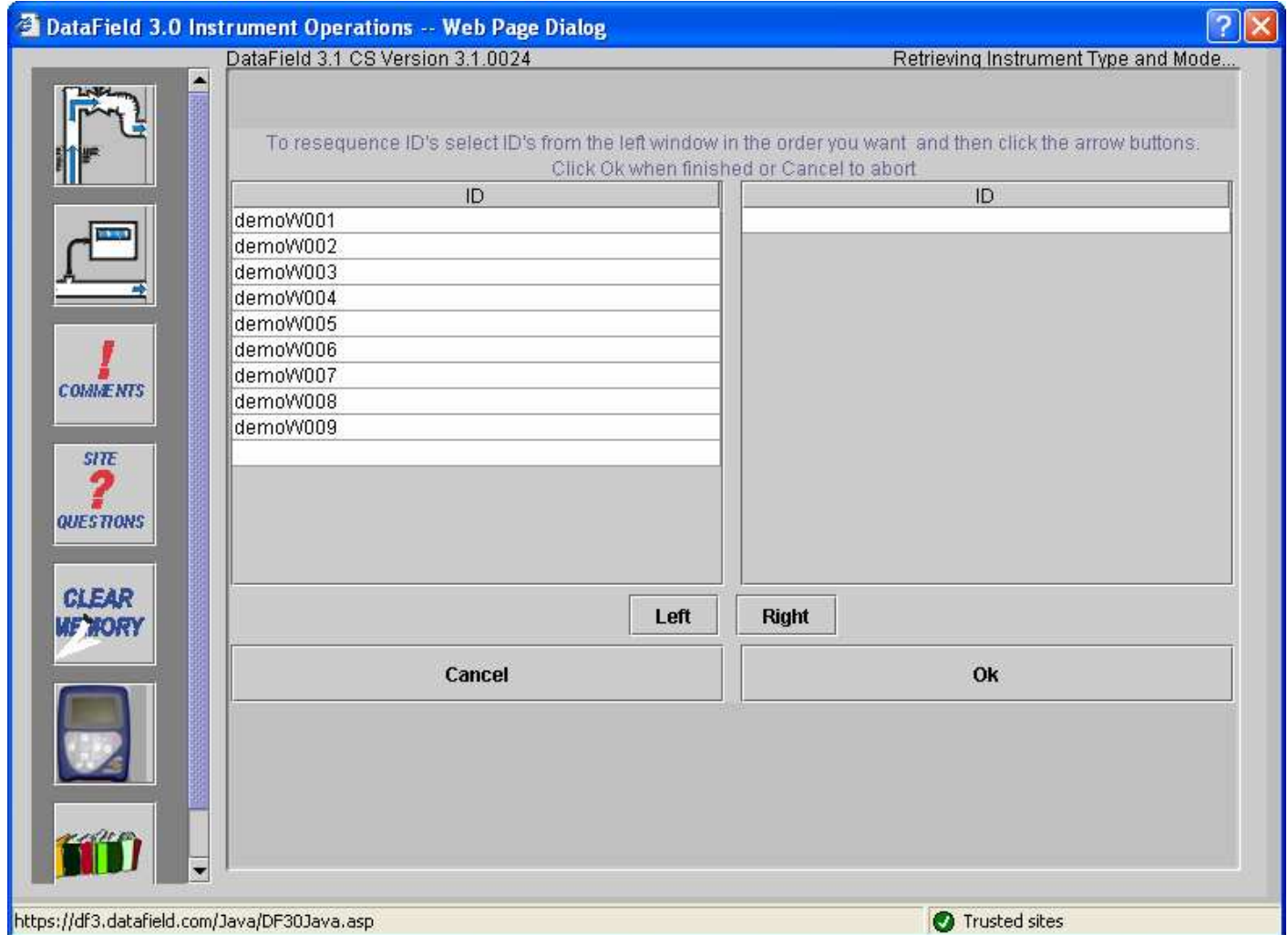
Select an ID to delete and click on it to highlight it. Click on the **Delete ID** button. A prompt will appear to verify the action. Clicking **Yes** will delete the ID. To select multiple IDs use **Ctrl** and **Shift** buttons on your keyboard. When deleting multiple IDs after clicking on the **Delete ID** button a prompt will appear: "Would you like to verify each deletion?" Clicking **No** will delete all the selected IDs. Clicking **Yes** will prompt on the deletion of each ID in the selection. In this case the deletion of some IDs in the selection can be cancelled.

Click on **Save File** to save the updated file to disk or click on **Send to Instrument** to update the instrument for field sampling.

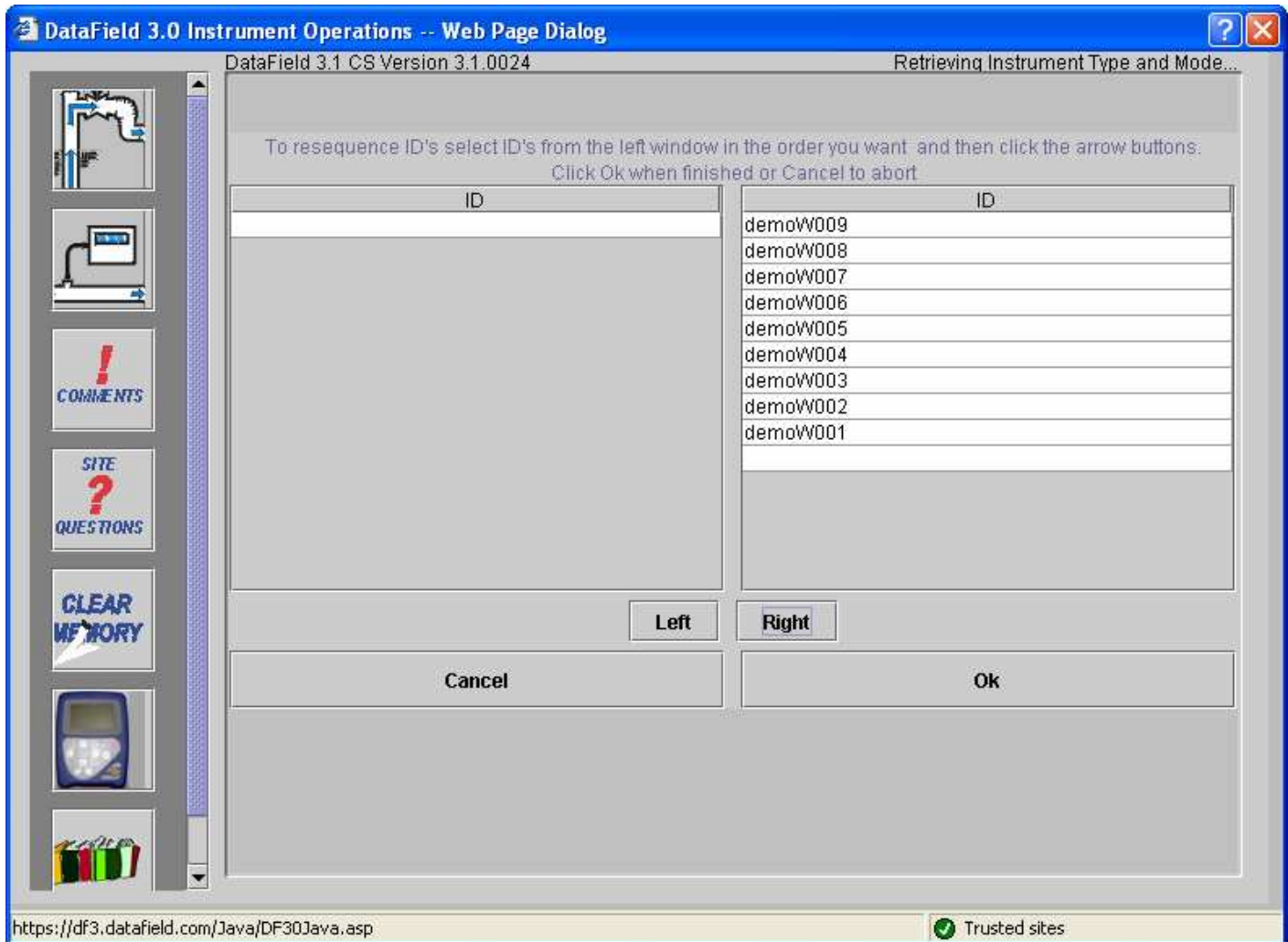
**Note:** We suggest clearing the ID information from the instrument prior to uploading the revised ID list. Otherwise the new ID list will be appended to the existing list. Clearing IDs in the instrument will clear IDs in the both GEM & GA modes of operation.

### 6.6.5 Re-sequencing

With DataField CS it is possible to change the order of the IDs in a file to put them in the same order as they are sampled in the field. This is called **Re-sequencing**. To re-sequence an ID data set, click on the **ID** button to open the ID editor. Load the ID data set from a file or download the data set from the instrument. Click on the **Re-sequence** button to open the screen shown below.



Select the ID from the left side window and click on the **Right** button to move ID to the right window to create the new sequence order. Repeat this process moving all IDs to the right side in the desired order.



Click OK when the desired new sequence is obtained, this will return you to the well ID screen. Click on the **Save File** button to save the new data set to a file on disk or click on **Send to Instrument** to upload the new data to the instrument.

**Note:** It is suggested to clear ID information from the instrument prior to uploading the re-sequenced ID list. Otherwise the new ID list will be appended to the existing list. Clearing IDs in the instrument will clear IDs in the both GEM & GA modes of operation.

### 6.6.6 Readings



The Readings screen provides the capability to download, upload, view, save data to a file and delete individual or multiple readings from a data set. Click on the **Readings** button to open the screen shown below.

Click on **Load from File** to open a file folder of saved data on the disk drive or click on **Load from Instrument** to download data from the instrument. Either action will open the following screen. All readings should be downloaded on a daily basis. While the instrument can hold readings for an extended period of time, it is recommended to download them to a non-volatile memory device (e.g. hard drive, CD, etc.).

DataField 3.1 CS Version 3.1.0024 Instrument: GEM/GA2000 (GEM Mode)

Currently Connected to: "DEMO1"

Device ID	Date/Time	CH4 [%]	CO2 [%]	O2 [%]	Peak CH4 [...]	Peak CO2 [...]	Peak O2 [%]	B
demoW001	01/23/2002...	50.5	36.0	0.0	0.0	0.0	0.0	0.0
demoW002	01/23/2002...	0.0	0.0	4.0	0.0	0.0	0.0	0.0
demoW003	01/23/2002...	56.5	41.6	0.0	0.0	0.0	0.0	0.0
demoW004	01/23/2002...	54.6	44.3	0.4	0.0	0.0	0.0	0.0
demoW005	01/23/2002...	54.6	44.4	0.3	0.0	0.0	0.0	0.0

Buttons: Load From File, Load From Instrument, Technician & Weather Stam..., Store Online, Send To Instrument, Delete Readings

URL: https://df3.datafield.com/Java/DF30Java.asp Trusted sites

Once the file has been opened or data downloaded from the instrument, the readings can be either **stored online** (only with the online version) or **saved to a file** (only with the offline version). When the instrument is in the GA Mode the readings can also be **sent to the instrument**. **Send to Instrument** button will be disabled when the instrument is in the GEM Mode. The screenshot above shows the online version with the instrument in the GEM mode.

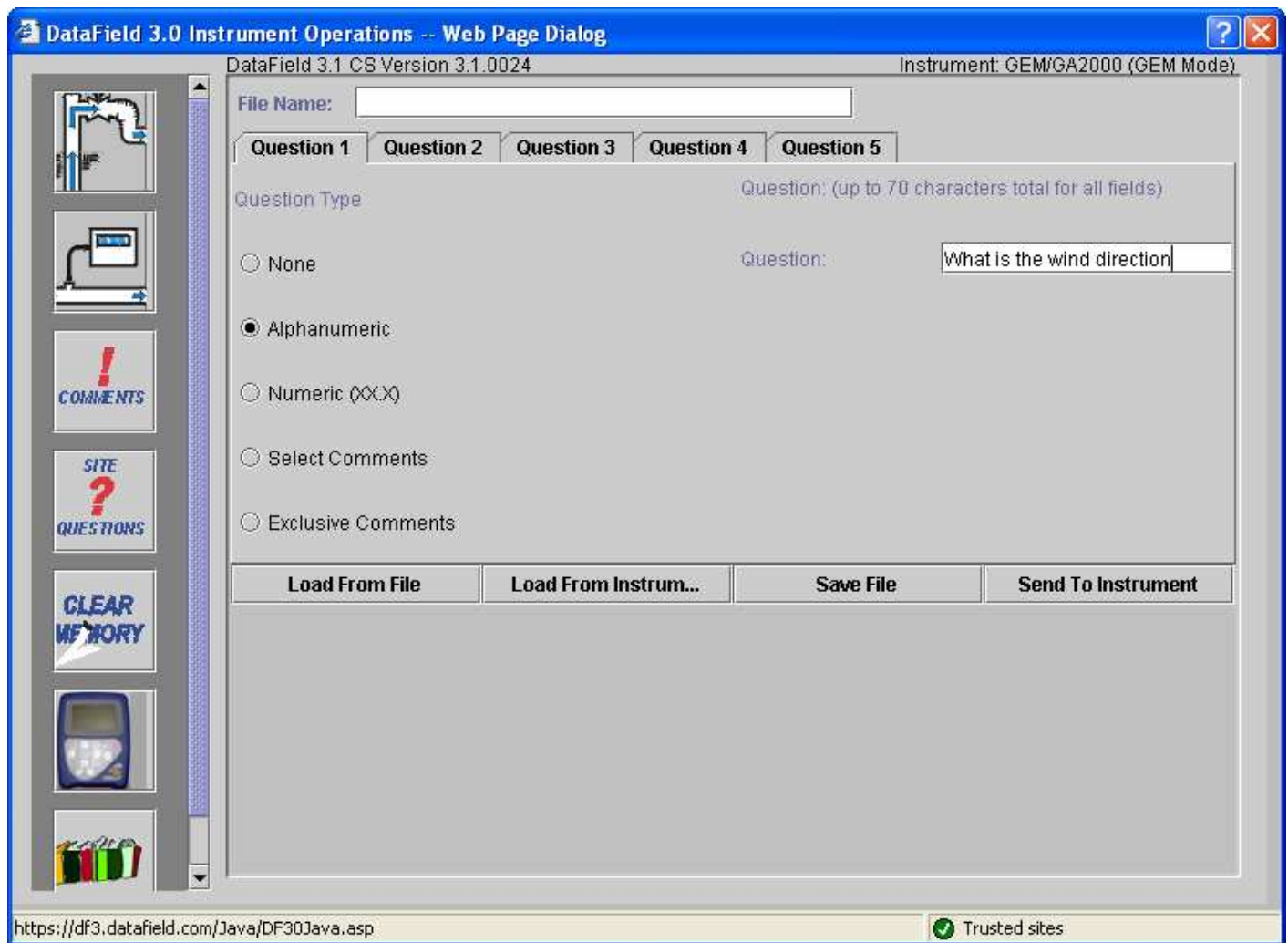
To delete an ID from the data set, click on this ID to highlight it and then click on the **Delete Readings** button. Only one ID can be deleted at a time.

6.6.7 Site Questions

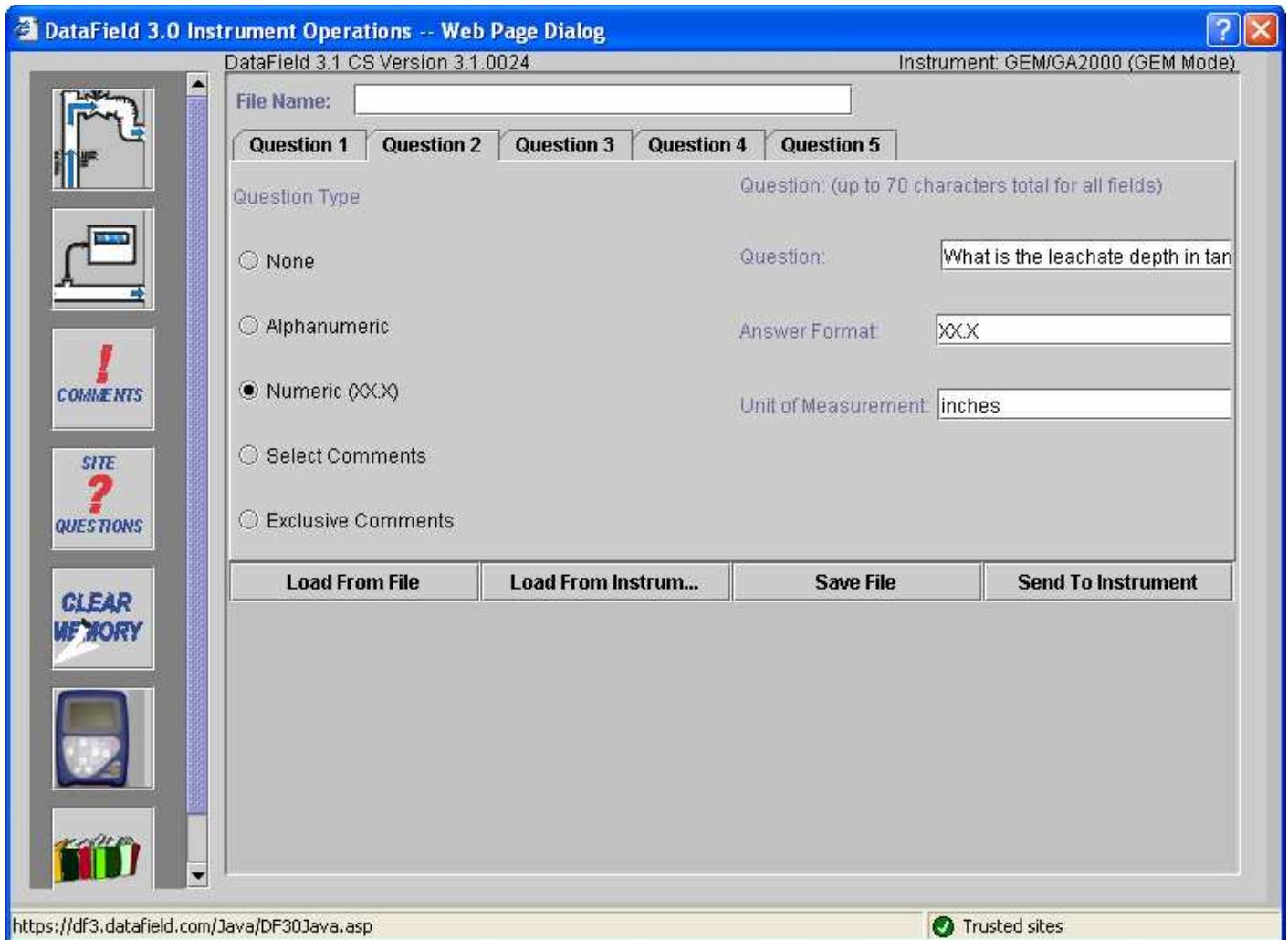


DataField CS supports up to five site questions. Site questions are answered only when **Update Site Data** is selected from the GEM menu screen and appended to all IDs taken thereafter until Update Site Data is selected again. This is a useful feature if conditions change in various locations on the landfill site or for selected wells/probes. Site questions can be either alphanumeric, numeric, select comment (the technician selects the comment from a list of ten answers) or exclusive comments (the technician may select only **ONE** exclusive question from a list of 10 answers). From the opening screen, click on the **Site Questions** button to open the following screen.

**Note:** Site questions must be created and sent to the instrument by the software prior to going into the field. They can not be hand inputted into the instrument in the field.

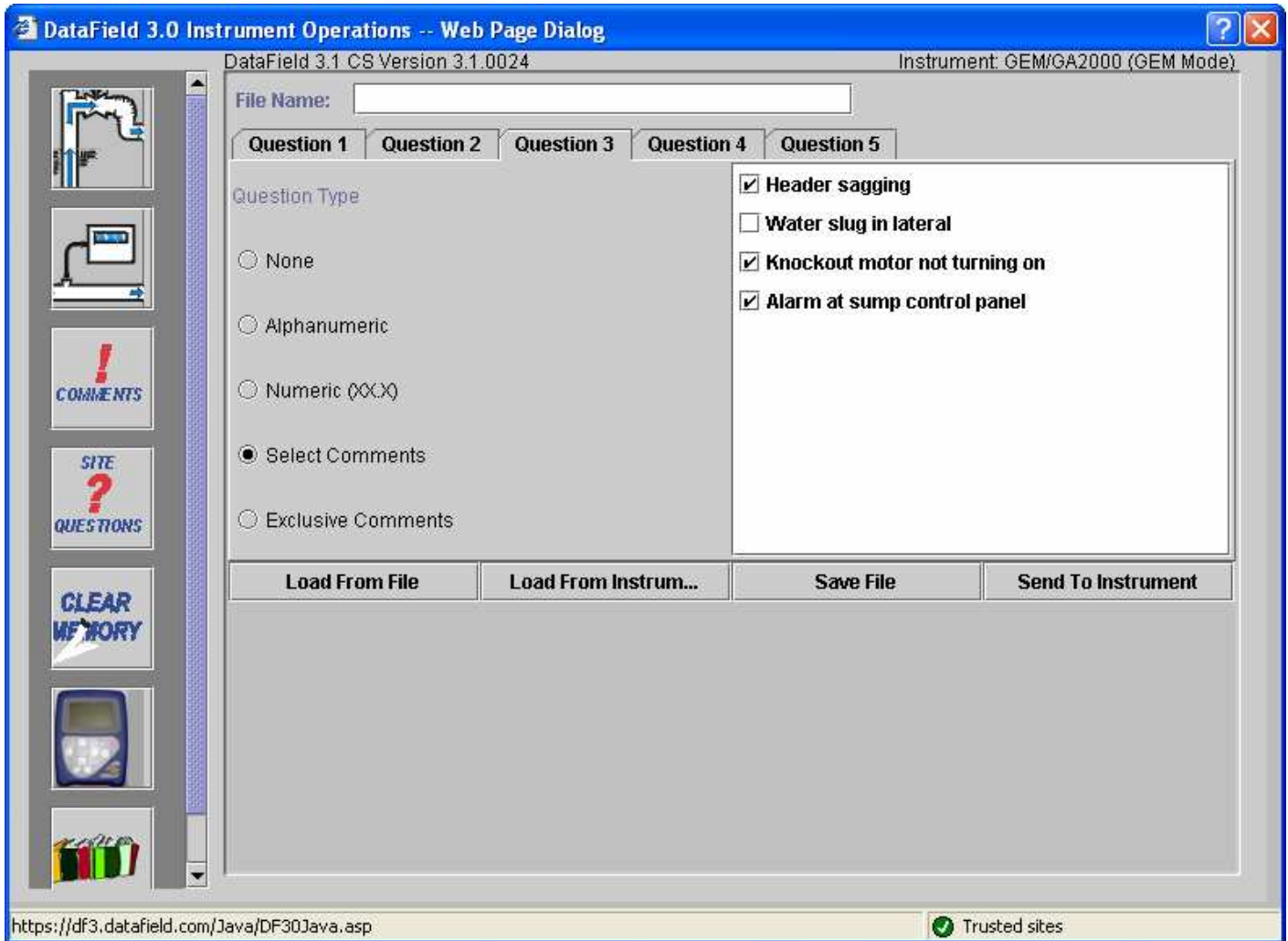


Click on the open spot, to the left of the alphanumeric category in **Question Type** to define Question 1 and type in the question.



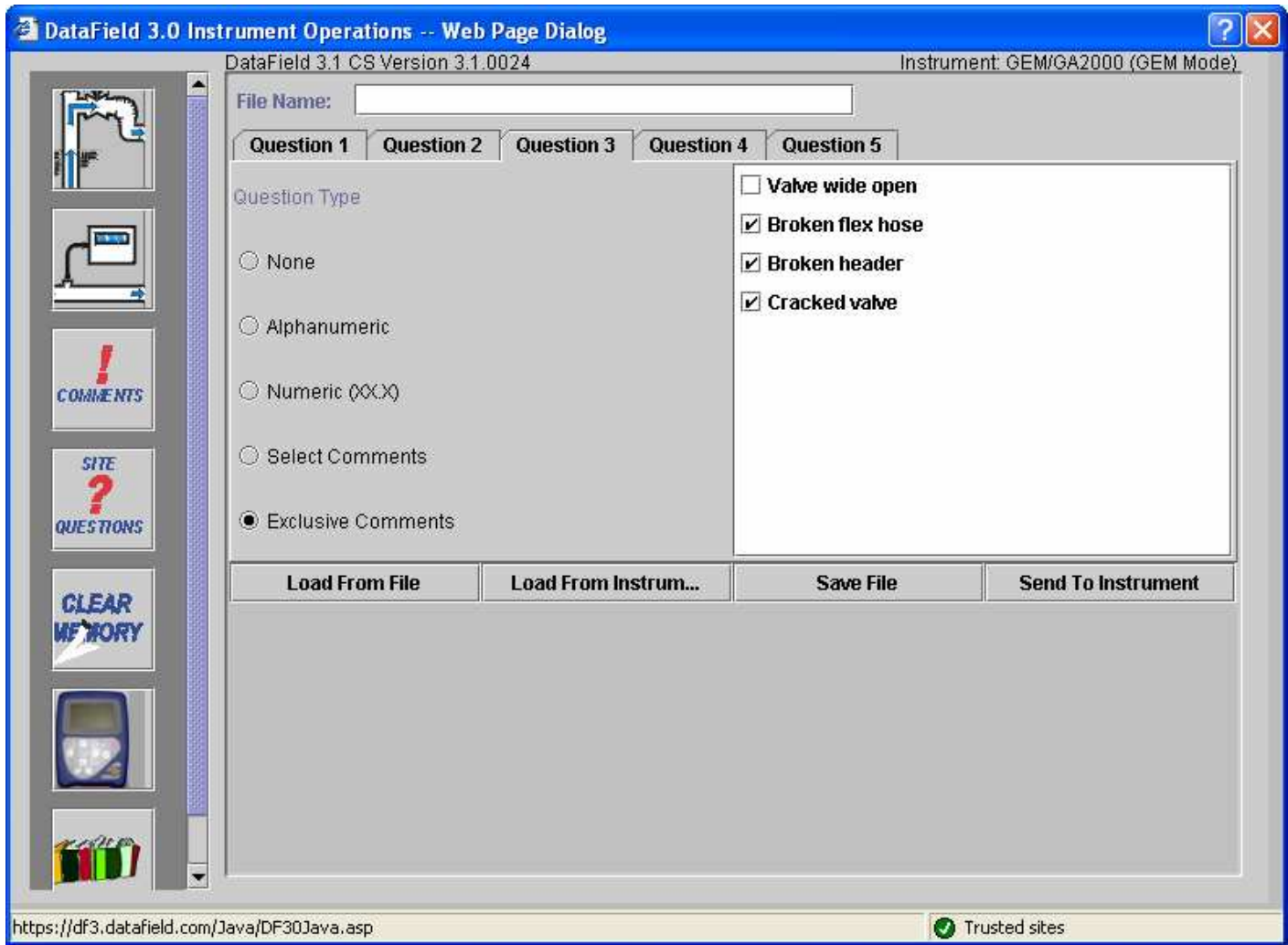
Click on Question 2 and then select Numeric as the Question Type. Note that Answer Format and Unit of Measurement fields appear for this type of question. Answer format refers to the number of digits and decimal places required for the answer. Unit of Measurement refers to inches, feet, yards, etc. for the answer. In this example, XX.X could be equal to 20.5 inches as per the question 'What is the leachate depth in tank?'

Comments may also be used as a site question, however comments must be downloaded from an instrument that has already had comments loaded in it. Connect the GEM™2000 and be sure it is in the read gas screen. Click on Select Comments and the list of comments from the instrument will open in the window for selection. Ten comments may be selected from the list to become **Site Questions**. Click on the box to the left of the comment to select it. The operator may choose any or all of the ten comments when **Update Site Data** is selected on the instrument.





Exclusive comments are treated in a similar manner as select comments in that they also must be downloaded from the instrument. Ten exclusive comments may be selected, however only **ONE** may be chosen by the operator to become an **Exclusive Comment**.



When all the desired questions have been entered, click on **Save File** to retain the information for later use and then click on **Send to Instrument** to update site data in the instrument.

## 6.7 Settings



Clicking on the **Settings** button on the main screen will display the **Instrument Settings**. The Instrument settings provides the capability to set or change optional controls in the instrument, such as time/date, data logging (GA mode only), purge times, etc.

### 6.7.1 Instrument Settings

Set the instrument for RS-232 communications and click on the **Settings** button and the following screen will open. The software will establish communications and download the current instrument settings.

Once the current settings have been obtained, the following screen will open.

DataField 3.1 CS Version 3.1.0024 Instrument: GEM/GA2000 (GEM Mode)

Instrument Status	Alarm Levels	Data Logging	Instrument Options
Instrument	GEM/GA2000 (GEM MODE)		
Software Version	Version 2.21 - 07/05/02		
Serial Number	GM05330		
Next Service Date	1 February 2003		
Days Overdue	214		
Last Factory Calibration	8 August 2002		
Last Field Calibration	Unknown		
Memory Remaining			
Battery Level			

https://df3.datafield.com/Java/DF30Java.asp Trusted sites

There are six different “Menu Cards” under instrument settings. Each card provides different information or instrument settings that may be changed to update the operation of the GEM™2000. The instrument status card will always be shown first, providing calibration and maintenance information in addition to instrument serial number and software version number.

## GEM™2000 Operation Manual

Click on the card tab for **Alarm Levels** to open the alarm levels screen. Both a maximum alarm and a minimum alarm may be set. Note these are global settings and will be the same for all IDs entered in the instrument. Turn off the alarm by clicking off the check mark next to the gas. Click on **Update Alarm Levels** to send the new settings to the instrument.

The screenshot shows a web browser window titled "DataField 3.0 Instrument Operations -- Web Page Dialog". The page content includes:

- Header: DataField 3.1 CS Version 3.1.0024, Instrument: GEM/GA2000 (GEM Mode)
- Navigation tabs: Time, Units of Measurement, Instrument Status, Alarm Levels (selected), Data Logging, Instrument Options
- Alarm Levels configuration table:

		Max	Min
CH4(%)	<input type="checkbox"/>	100	0
CO2(%)	<input type="checkbox"/>	100	0
O2(%)	<input type="checkbox"/>	100	0

Below the table is a button labeled "Update Alarm Levels".

On the left side of the browser window, there is a vertical toolbar with icons and buttons for:

- Comments (with a red exclamation mark icon)
- Site Questions (with a red question mark icon)
- Clear Memory (with a blue "CLEAR MEMORY" button)
- Other instrument-related icons

The browser address bar shows the URL: <https://df3.datafield.com/Java/DF30Java.asp>. A "Trusted sites" icon is visible in the bottom right corner of the browser window.

## GEM™2000 Operation Manual

Click on the **Data Logging** card tab to open the data-logging screen. In this screen enter the Logging ID; this may be any alphanumeric combination of eight characters. Enter the interval between readings in minutes and pump run time in seconds. Click on **Update Logging Data** to send to instrument. Only one logging ID may be loaded to the instrument.

The screenshot shows a web browser window titled "DataField 3.0 Instrument Operations -- Web Page Dialog". The browser address bar displays "https://df3.datafield.com/Java/DF30Java.asp" and a "Trusted sites" icon. The main content area is a Java applet interface for "DataField 3.1 CS Version 3.1.0024" connected to an "Instrument: GEM/GA2000 (GEM Mode)".

The interface features a left-hand navigation menu with icons for: a pump system, a computer monitor, "COMMENTS" (with a red exclamation mark), "SITE QUESTIONS" (with a red question mark), "CLEAR MEMORY" (with a blue paper icon), a handheld device, and a stack of colored folders.

The main panel has a tabbed interface with "Time" and "Units of Measurement" at the top. Below these are four sub-tabs: "Instrument Status", "Alarm Levels", "Data Logging" (which is selected), and "Instrument Options".

Under the "Data Logging" tab, there are three input fields:

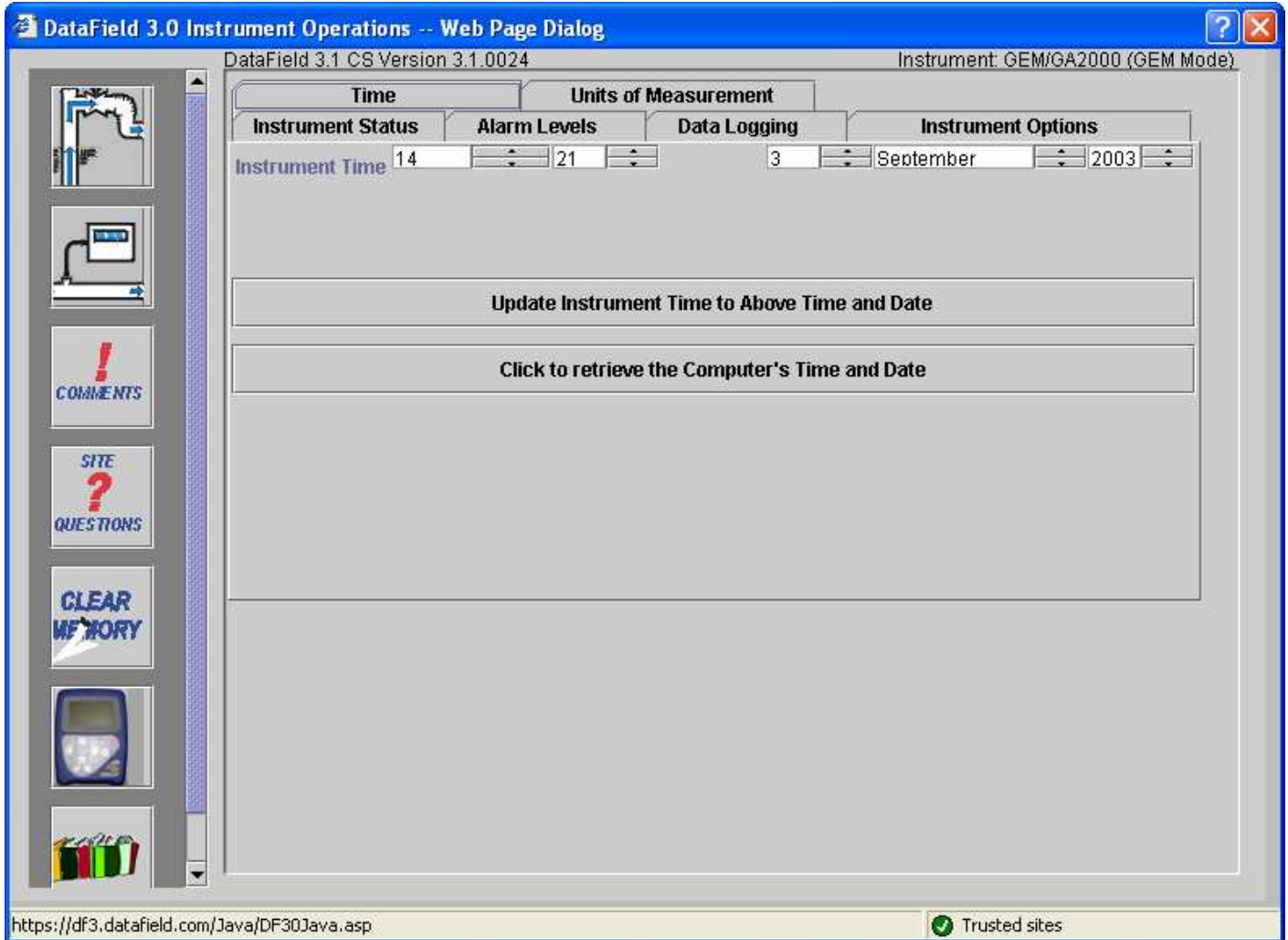
- "Logging ID" with the value "AUTO-LOG"
- "Interval Between Readings (minutes)" with the value "1"
- "Pump Running Time (seconds)" with the value "30"

At the bottom of the configuration area is a button labeled "Update Logging Data".

Click on the **Instrument Options** card tab to open the instrument options screen. The settings in this screen affect different global functions of the instrument. Check the corresponding boxes in order to do the following: automatically purge the instrument during a shut down, automatically zero the instrument, display the percent lower explosive limit on readings screen. **Unchecking the last feature will disable % LEL display in both GA and GEM modes of operation.** The **Low Flow Warning** setting controls the point at which the pump is shut off due to low flow conditions. The default setting for this feature is 50 milliliters per minute but may be set to a lower number or even to zero, if sampling on high vacuum systems. The default value for the **Purge Time** is 30 seconds and may be reset to any length required. Turning off this feature is not recommended. Click on the **Update Instrument Options** button to send the new settings to the instrument.

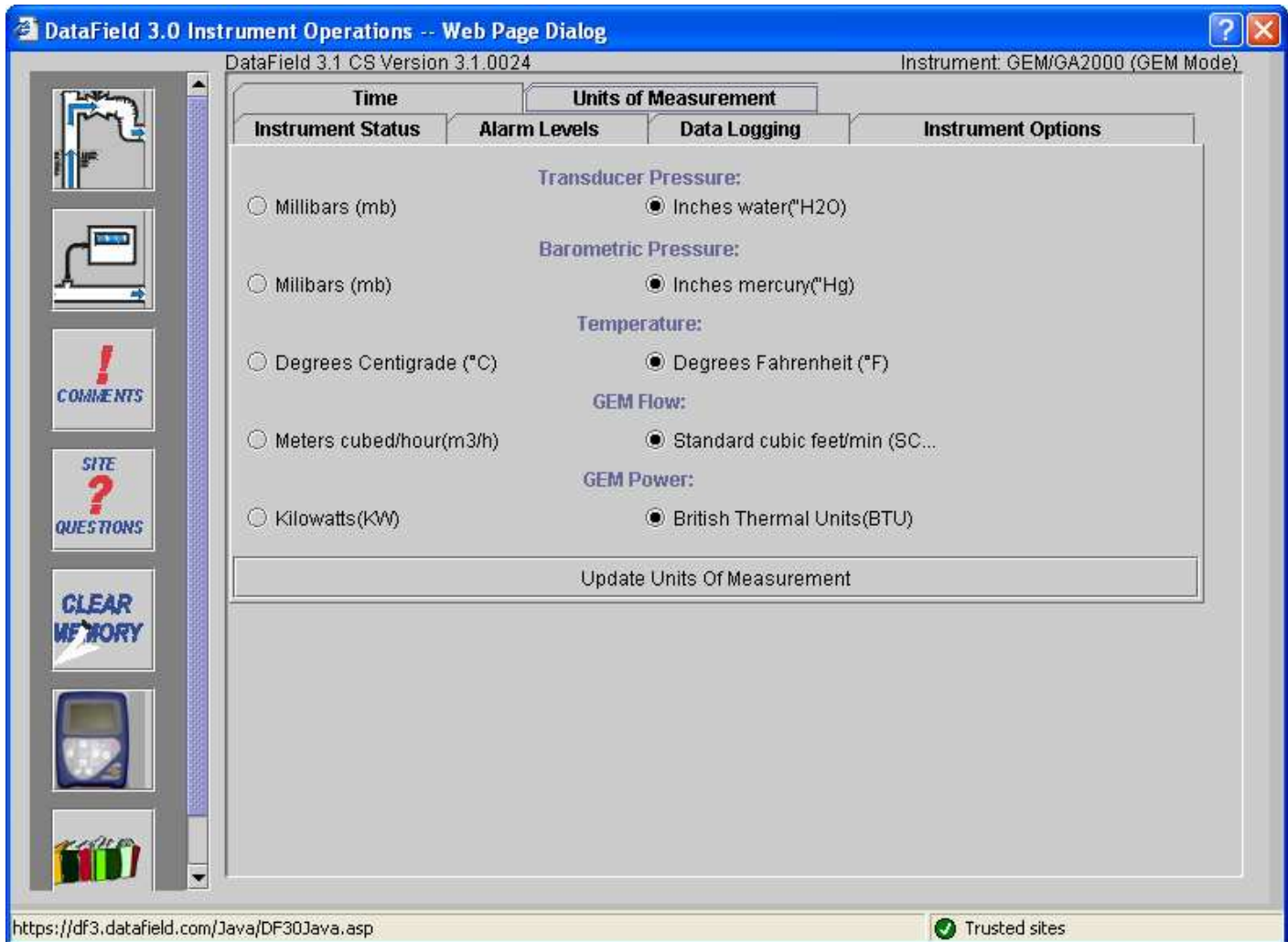
The screenshot shows a web browser window titled "DataField 3.0 Instrument Operations -- Web Page Dialog". The browser address bar shows "https://df3.datafield.com/Java/DF30Java.asp" and a "Trusted sites" icon. The page content includes a navigation sidebar on the left with icons for "COMMENTS", "SITE QUESTIONS", "CLEAR MEMORY", and a device image. The main content area has a title bar "DataField 3.1 CS Version 3.1.0024" and "Instrument: GEM/GA2000 (GEM Mode)". Below the title bar are tabs for "Time", "Units of Measurement", "Instrument Status", "Alarm Levels", "Data Logging", and "Instrument Options". The "Instrument Options" tab is active, showing three checked checkboxes: "Automatically purge the instrument?", "Automatically zero the instrument?", and "Display % lower explosive limit on readings screen?". Below these are two input fields: "Low Flow Warning (ml/minute)" with the value "50" and "Purge Time (seconds)" with the value "30". At the bottom of the main content area is a button labeled "Update Instrument Options".

Click on the Time card tab to open the time and date setting screen. Time and date may be set to the computer time and date settings by clicking on the **Click to Retrieve the Computer's Time and Date** button. Manual setting of the time and date may be accomplished by clicking on the **Update Instrument Time to Above Time and Date**. Any time updates must be done through the software. The instrument time can not be manually updated in the field.



**Units of Measurement** screen allows the units to be changed.

This screen is protected by the password. If you need to change the units of measurement, please contact our technical support team.

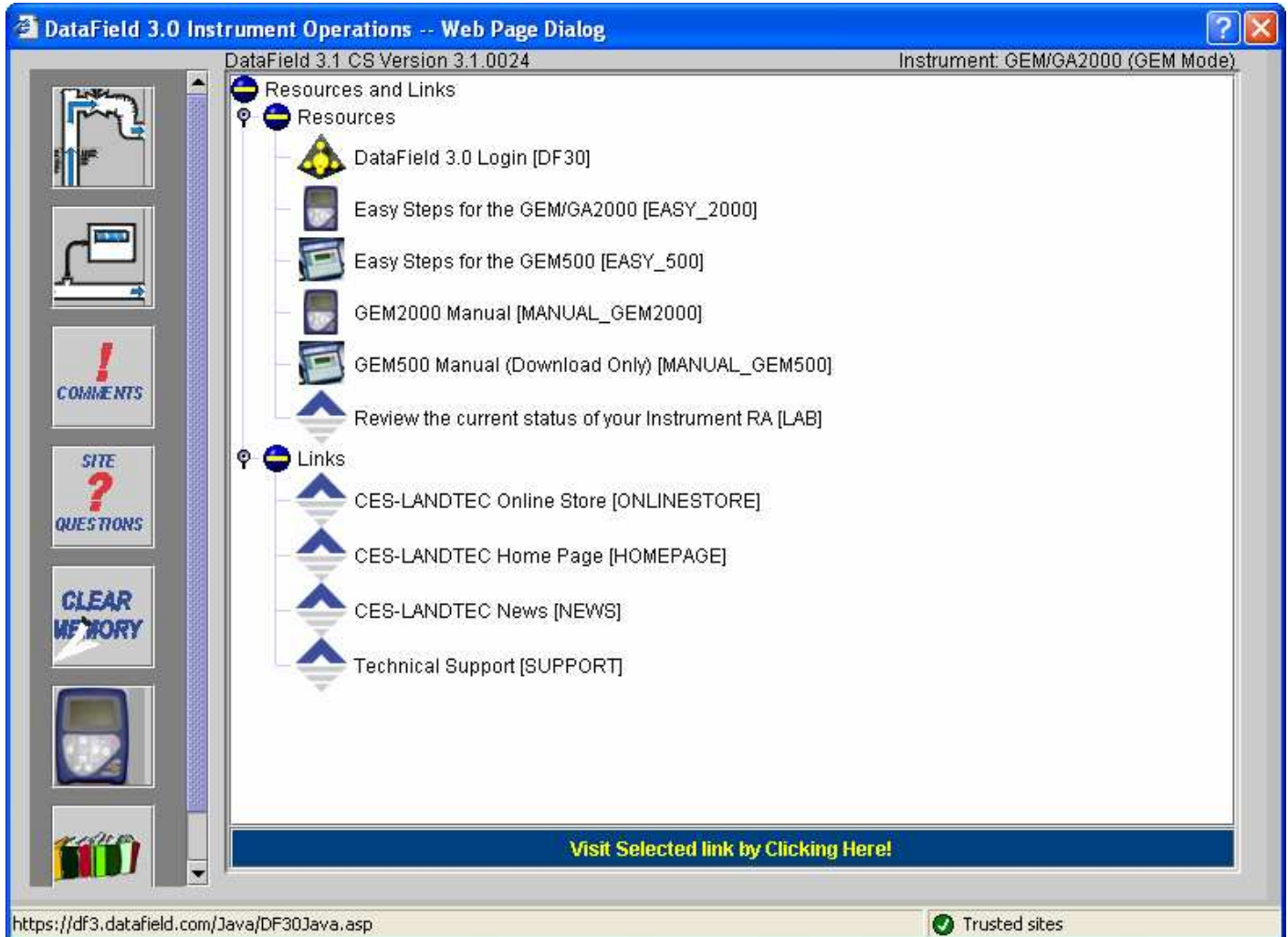


**Note:** EXTREME CAUTION should be taken if changing the Units of Measurement. All data from the instrument should be downloaded and stored in both, the GEM and the GA modes before updating the Units of Measurement. Updating Units of Measurement will erase readings from the instrument. The instrument should be turned off and restarted once the units of measurement have been updated.

### 6.7.2 Resource Links



Clicking on the **Resource Links** button on the main screen will display the **Resources and Links** screen.



By clicking on the supplied link the user is taken directly to the www and the information listed.



## 7 Field Operations

### 7.1 Landfill Gas Generation

A brief overview of the theory of landfill gas generation and Methane recovery follows. Initially, when decomposable refuse is placed into a solid waste landfill, the refuse is entrained with air from the surrounding atmosphere. Through a natural process of bacterial decomposition, the Oxygen from the air is consumed and an anaerobic (Oxygen free) environment is created within the landfill. This anaerobic environment is one of several conditions necessary for the formation of Methane-CH<sub>4</sub>.

If Oxygen is reintroduced into the landfill, those areas are returned to an aerobic (Oxygen present) state and the Methane-producing bacteria population are destroyed. A period of time must pass before the productive capacity is returned to normal. Since there is some Methane of a given quality within the landfill void space, a decline in Methane quality is only gradually apparent depending upon the size of the landfill.

Carbon Dioxide is also produced under either an aerobic or anaerobic condition. Under static conditions, the landfill gas will be composed of roughly half Methane and half Carbon Dioxide with a little Nitrogen.

As air is introduced into the landfill, the Oxygen is initially converted to Carbon Dioxide and residual Nitrogen remains. Measurement of residual Nitrogen is usually a good indicator of the anaerobic state of the landfill; however, it cannot be directly measured. It can, however, be assumed and estimated using a subtraction basis as the balance gas. Hence, the measurement of Carbon Dioxide is an intermediary step. Because Carbon Dioxide levels may fluctuate depending on the changing concentrations of the other constituent gases, Carbon Dioxide levels are not evaluated directly but are considered in light of other data.

In evaluation of residual Nitrogen, allowances must be made if there has been any air leakage into the gas collection system or if there has been serious over pull. If enough air is drawn into the landfill, not all Oxygen is converted into Carbon Dioxide and the Oxygen is apparent in the sample. It is ideal to perform routine analysis of individual wells, as well as an overall well field composite sample, by a gas chromatography. This is not always practical at every landfill.

Under some conditions there may be a small amount of hydrogen in the LFG, (about 1 percent, usually much less). This may affect field monitoring response factors, but otherwise it can be ignored.

### 7.2 Subsurface Fires

If very large quantities of air are introduced into the landfill, either through natural occurrence or overly aggressive operation of the LFG system, a partly unsupported subsurface combustion of the buried refuse may be initiated. Subsurface fire situations are difficult to control or extinguish once started, present health and safety hazards, and can be quite costly. Therefore, prevention by good operation of the collection system and maintenance of the landfill cover is the best course of action. The presence of Carbon Monoxide, Carbon Dioxide, and Hydrogen Sulphide are indicators of poorly supported combustion within the landfill.

### **7.3 Techniques for Controlling Landfill Gas**

There are many techniques for controlling landfill gas extraction. These techniques represent tools, which are used together to control landfill gas. The Accu-Flo wellhead is designed to work with all of these techniques. Below is a discussion of the individual techniques, how to use them, and their limitations. Reliance on only a few of the techniques discussed can lead to misinterpretation of field data and improper operation of the well field. Later the best use of these techniques to optimize landfill gas control will be discussed.

#### **7.3.1 Controlling by Wellhead Valve Position**

Unless the valve handle is calibrated for a given flow rate, this method is unreliable. The position of the valve handle alone does not provide sufficient information about the well to control it. It is useful to note the relative position of the valve, and essential to know which valves are fully open or fully closed.

#### **7.3.2 Controlling by Wellhead Vacuum**

This technique relies on the relationship of well pressure/vacuum to flow for a given well. Reliance upon this method, however, can be misleading. This is because the square root relationship between flow and pressure is difficult to affect while performing day-to-day well field adjustments. As decomposition, moisture, and other conditions change, this method shows itself to be inadequate and imprecise.

#### **7.3.3 Controlling by Gas Composition**

This method determines Methane, Nitrogen (balance gas) and other gas composition parameters at wellheads and at recovery facilities using portable field instruments and, sometimes, analytical laboratory equipment. Complete knowledge of gas composition (i.e., major fixed gases: Methane, Carbon Dioxide, Oxygen and Nitrogen) is desirable. It is also necessary to check other gas parameters, such as Carbon Monoxide, to fully evaluate the condition of the well field. Reliance on this information can lead to improper operation of the well field. Indications of excessive extraction often do not show up right away. This method often leads to a cycle of damage to the Methane producing bacteria population and then to over-correction. This cycling of the well and producing area of the landfill is not a good practice. It leads to further misinterpretation of the condition of the well field and has a disruptive effect on the operation of the well field. The use of analytical laboratory instrumentation such as a gas chromatograph is a valuable supplementary tool to verify gas composition. This normally requires collection of samples at the wellhead and analysis at some fixed location where the equipment is located. The drawbacks of this method as a primary means of obtaining information for well field adjustment are the time expended, cost, and probably most important, responsiveness to the needs of the well field for timely adjustment. The laboratory equipment required is also very costly. Some analysis is recommended for verification of field readings from time to time. It is recommended a monthly sample of the composite gas be taken at the inlet to the flare or gas recovery facility.

#### **7.3.4 Controlling by Flow Rate**

This is a more exacting technique for determining and adjusting gas flow at individual wells. It requires using a fixed or portable flow measurement device at each wellhead to obtain the data needed to calculate volumetric (or mass) flow rates. It is normally convenient to use cubic feet per minute or per day, as a standard unit of measure for volumetric flow. It is important to distinguish between the volumetric quantity

of landfill gas and the volumetric quantity of Methane extracted from each well and the landfill in total. The two variables are somewhat independent of each other and it is the total quantity of Methane extracted we are interested in. It is possible for the total quantity of landfill gas extracted to increase while the total quantity of Methane extracted decreases. To monitor this, the quantity of Methane extracted (LFG flow x percent Methane) or the quantity of BTUs recovered per hour (LFG flow x percent Methane x BTUs per cubic foot of Methane x 60 minutes per hour) can be calculated. It is conventional to measure BTUs per hour as a unit of time. There are approximately 1012 BTUs of heat per cubic foot of pure Methane (like natural gas), although this figure varies a little among reference texts.

Measuring flow is an essential part of monitoring and adjusting a well field. The well should be adjusted until the amount of Methane recovered is maximized for the long term. A greater amount of Methane or energy can usually be recovered over the short term; however, this ultimately leads to diminishing returns. This is seen in stages as increased CO<sub>2</sub> and gas temperature and later as increased Oxygen from well over-pull. In time, the Methane will also decline. This is the result of a portion of the landfill, usually at the surface, being driven aerobic. In this portion of the landfill, the Methane-producing bacteria will have been destroyed (due to the presence of Oxygen). With the Methane-producing capacity of the landfill reduced, the pore space in the area no longer producing may become filled with landfill gas equilibrating (moving in) from an unaffected producing area. This leaves the impression that more gas can be recovered from this area, and may lead to the operator opening the well or increasing flow.

### **7.4 Well field Monitoring**

The frequency of LFG well field monitoring varies depending upon field requirements and conditions. Normal monitoring frequency for a complete field monitoring session with full field readings (suggested normal and abbreviated field readings list follows) will vary from typically once a month to once a week. Well field monitoring should not normally be extended beyond one month. The importance of regular, timely monitoring cannot be overemphasized.

### **7.5 Typical Field Readings**

- Name of person taking readings
- Date/time of each reading
- Methane (CH<sub>4</sub>)
- Oxygen (O<sub>2</sub>)
- Carbon Dioxide (CO<sub>2</sub>)
- Balance Gas (primarily Nitrogen N<sub>2</sub>)
- Wellhead gas temperature (flowing)
- Ambient air temperature
- Static pressure (PS) (from GEM™2000 or magnehelic) or other device (anemometer/velometer)
- Velocity head (P or PT) (from GEM™2000 or pitot tube and magnehelic)
- Wellhead gas flow (from GEM™2000, or pitot tube & magnehelic, or anemometer/velometer)
- Wellhead adjustment valve position (initial and adjusted)
- New wellhead vacuum and flow information after adjustment
- Calculation of each well's LFG and Methane flow and sum total
- Observations/comments

Additionally, Carbon Monoxide (CO) or Hydrogen Sulphide (H<sub>2</sub>S) readings may be taken if problems are suspected. Supplementary monitoring once to several times a week may be performed using an abbreviated form of field readings.

## **7.6 Abbreviated Field Readings**

- Name of person taking readings
- Date/time of each reading
- Methane (CH<sub>4</sub>)
- Oxygen (O<sub>2</sub>)
- Wellhead gas temperature (flowing)
- Ambient air temperature
- Static pressure (PS) (from GEM™2000 or magnehelic)
- Velocity head (P or Pt) (from GEM™2000 or pitot tube and magnehelic)
- Wellhead gas flow (from GEM™2000, or pitot tube and magnehelic, or anemometer/velometer)
- Wellhead adjustment valve position (initial and adjusted)
- New wellhead vacuum and flow information after adjustment
- Observations/comments

Line vacuums and gas quality may be taken at key points along the main gas collection header and at subordinate branches. This helps to identify locations of poor performance, excessive pressure drop, or leakage. Perform systematic monitoring of the well field, taking and logging measurements at each wellhead and major branch junction in the collection system.

During monitoring, examine landfill and gas collection system for maintenance issues. Record needed maintenance or unusual conditions. Examples of unusual occurrences or conditions are unusual settlement, signs of subsurface fires, cracks and fissures, liquid ponding, condensate/leachate weeping from side slopes, surface emissions and hot spots, and liquid surging and blockage in the gas collection system. Field readings should be kept in a chronological log and submitted to management on a timely basis.

## **7.7 Well field Adjustment Criteria**

There are several criteria used in well field adjustment. The primary criterion is Methane quality. Methane quality is an indicator of the healthy anaerobic state of the landfill and thus proper operation of the LFG collection system. However, a decline in the healthy productive state of the landfill is usually not immediately apparent from Methane quality. Due to this, several criteria must be considered at once.

Conditions within the landfill favor Methane production. Following are well field adjustment criteria and typical conditions for consideration:

- Methane quality (ranging from 26 percent upwards)
- pH
- Temperature
- General overall quality
- Moisture conditions
- Waste stream characteristics
- Placement chronology
- Insulation characteristics
- Oxygen quality (ranging below 1 percent, preferably less than ½ percent)
- Landfill cover porosity and depth in the proximity of the well
- Landfill construction factors including:
  - Type of fill
  - Size and shape of refuse mass

- Depth of fill
- Compaction
- Leachate control methods
- Seasonal, climatic, geographical, and recent weather, or other considerations, including seasonally arid or wet conditions, precipitation, drainage, groundwater
- Surrounding topography and geologic conditions
- Proximity of the well to side slopes (within 150 to 200 feet and less may require conservative operation of the well)
- Nitrogen (typically 8 to 12 percent and less)
- Temperature (between ambient and about 130 °F)
- LFG and Methane flow from the wellhead
- Design of the gas collection system
- Landfill perimeter gas migration and surface emission control, or energy recovery objectives
- Diurnal fluctuation (day to night) of atmospheric pressure

### **7.8 Establishing Target Flows**

The goal is to establish a target flow which will likely produce the best possible Methane quality and minimum Oxygen levels while maximizing the recovery of landfill gas. Typically, small adjustments are made in flow to achieve and maintain quality objectives. The well must not be allowed to over pull. High well temperatures, (130° to 140°F and greater), are an indication of aerobic activity and, thus, well over-pull. These effects may not be immediately apparent.

Well adjustment should be made in as small an increment as possible, preferably an increment of ten percent of the existing flow or less. There may be obvious conditions when this is not appropriate, such as when first opening up a well or when serious over-pull is recognized. Every effort should be made to make adjustments and operations as smooth as possible. Dramatic adjustments, or operating while switching between a high flow mode and a well shutoff mode, should be avoided.

### **7.9 Well field Optimization**

Every effort should be made to continuously locate and correct or eliminate conditions (e.g., gas condensate, surging and blockage, settlement, etc.), which inhibit efficient operation of the gas collection system. This allows well monitoring and adjustment to be significantly more effective.

### **7.10 Migration Control—Dealing with Poor Methane Quality**

If Methane and Oxygen quality objectives cannot be maintained at a given well, such as a perimeter migration control well, then an attempt should be made to stabilize the well as closely as is practical, avoiding significant or rapid down trending of Methane or up trending of Oxygen.

It is not uncommon for perimeter migration control wells to be operated at less than 40 percent Methane or greater than one-percent Oxygen. It should be recognized that these wells are likely in a zone where some aerobic action is being induced, and that there is some risk of introducing or enhancing the spread of a subsurface fire. Sometimes a judicious compromise is necessary to achieve critical migration control objectives or because existing conditions do not allow otherwise. Such situations should be monitored closely.

### ***7.11 Well field Adjustment—Purpose and Objectives***

The objective of well field adjustment is to achieve a steady state of operation of the gas collection system by stabilizing the rate and quality of extracted LFG in order to achieve one or several goals. Typical reasons for recovery of LFG and close control of the well field are:

- Achieve and maintain effective subsurface gas migration control.
- Achieve and maintain effective surface gas emissions control.
- Assist with proper operation of control and recovery equipment.
- Avoid well “over-pull” and maintain of a healthy anaerobic state within the landfill.
- Optimize LFG recovery for energy recovery purposes.
- Control nuisance landfill gas odors.
- Prevent or control subsurface LFG fires.
- Protect structures on and near the landfill.
- Meet environmental and regulatory compliance requirements.

Well field adjustment is partly subjective and can be confusing because it involves judgment calls based on simultaneous evaluation of several variables, as well a general knowledge of site specific field conditions and historical trends. Well field evaluation and adjustment consist of a collection of techniques, which may be used, in combination, to achieve a steady state of well field operation.

## 8 Troubleshooting

### Problem

Unit does not turn on or operation is erratic

“Flow Fail” is displayed and an audible alarm is heard

Readings taken are not what was expected

Unit displays\*\*\*\*\* or >>>>>

Oxygen reading is high on all wells

Unit will not download readings or an error occurs while downloading.

Methane and Carbon Dioxide readings drift

Oxygen readings drift

Black screen displayed when unit turned On

Nothing happens when the Gas Pod is installed

Temperature does not update when temperature probe is installed

### Corrective Action/Reason

Battery charge is too low-recharge batteries.

Unit is too hot - cool down unit and try again.

Contact Factory Service.

The inlet is blocked.

Remove blockage and retry.

The particulate filter or water trap filter needs replacing.

Unit may be out of calibration. Calibrate unit with known gas concentration.

Water trap or particulate filters are clogged. Replace filter(s).

These symbols are substituted when the measured reading is out of range of the instruments capabilities in some fields or when a value needs to be entered manually such as temperature.

Check that the water trap housing is screwed on tight.

Check or replace O-rings on the water trap and instrument inlet.

Check the wellhead inset for cracks, replace O-ring on insert.

Field calibrate Oxygen channel.

Verify that the communications software is the right version for the instrument being used.

Check that the proper serial port is selected in the software.

Contact Factory Service.

Perform a field calibration and check well again. Verify cal gas is flowing when regulator is turned on.

Verify all connections are tight and filters are not clogged.

Contact Factory Service.

Perform a field calibration - zero and span.

Contact Factory Service.

Charge unit over night and try again.

Unit too hot - cool down and try again.

Try adjusting contrast level.

Contact Factory Service.

Remove and re-seat the Gas Pod.

Contact Factory Service.

Check the probe fitting is fully seated.

Check the probe plug is screwed together tightly.

Contact Factory Service.

## 9 Technical Specifications

### 9.1 Physical

Weight	4.4 lbs.
Size	L 2.48" x W 7.48" x D 9.92".
Case material	Anti-static ABS.
Keys	Membrane panel.
Display	Liquid Crystal Display 40 x 16 characters. Fibre optic woven backlight for low light conditions.
Filters	User replaceable integral fibre filter at inlet port and an external PTFE water trap filter.

### 9.2 General

Certifications	UL Certified to Class 1, Zone 1, AEx Ib d Ila T4
Temperature measurement	With optional probe 14°F to 167 °F.
Temperature accuracy	±0.4°F (± probe accuracy).
Visual and audible alarm	User selectable CO <sub>2</sub> , CH <sub>4</sub> and O <sub>2</sub> Min/Max levels via DataField CS software.
Communications	RS232 protocol via download lead with variable baud rate.
Relative pressure	±250 mbar from calibration pressure

### 9.3 Power supply

Battery type	Rechargeable Nickel Metal Hydride battery pack containing six 4AH cells. <b>Not user replaceable.</b> Lithium Manganese battery for data retention.
Battery life	Typical use 10 hours from fully charged condition.
Battery charger	Separate intelligent 2A battery charger powered from AC voltage supply (110-230V).
Charge time	Approximately 2 hours from complete discharge.
Alternative power	Can be powered externally for fixed-in-place applications only. Contact CES-LANDTEC for further information.
Battery lifetime	Up to 1,000 charge/discharge cycles.

### 9.4 Gas Ranges

Detection principle	CO <sub>2</sub> and CH <sub>4</sub> by dual wavelength infrared cell with reference channel. O <sub>2</sub> by internal electrochemical cell.			
Oxygen cell lifetime	Approximately 18 months in air.			
Typical Accuracy 0 - Full Scale	<b>Gas</b>	<b>0-5% volume</b>	<b>5-15% volume</b>	<b>15%-FS</b>
	CH <sub>4</sub>	±0.3%	±1%	±3% (100%)
	CO <sub>2</sub>	±0.3%	±1%	±3% (60%)
	O <sub>2</sub>	±1%	±1%	±1% (21%)
Response time, T90	CH <sub>4</sub>	≤20 seconds		
	CO <sub>2</sub>	≤20 seconds		
	O <sub>2</sub>	≤20 seconds		
Range	CH <sub>4</sub>	0-70% to specification, 0-100% reading.		
	CO <sub>2</sub>	0-40% to specification, 0-100% reading.		
	O <sub>2</sub>	0-25%		



**9.5 Pump**

Typical flow	300 cc/min.
Flow fail point	50 cc/min approximately.
Flow with 200 mbar vacuum	250 cc/min approximately.
Vacuum	70 inches H <sub>2</sub> O.

**9.6 Operating Conditions**

Operating temp range	32°F to 104 °F.
Relative humidity	0-95% non-condensing.
Atmospheric pressure range	700-1200 mbar. Displayed in Inches of Mercury (5.9 – 35.4“Hg). Not corrected for sea level.
Atmospheric pressure accuracy	±5 mbar approximately.
Case seal	IP65.

**9.7 Optional Gas Pods**

Typical Accuracy (Subject to User calibration).	<b>Gas</b>	<b>0-Full Scale</b>
	CO	±10% FS
	H <sub>2</sub> S	±10% FS
	SO <sub>2</sub>	±10% FS
	NO <sub>2</sub>	±10% FS
	CL <sub>2</sub>	±10% FS
	H <sub>2</sub>	±10% FS
	HCN	±10% FS
Response time, T90	CO	≤60 seconds
	H <sub>2</sub> S	≤60 seconds
	SO <sub>2</sub>	≤60 seconds
	NO <sub>2</sub>	≤60 seconds
	CL <sub>2</sub>	≤60 seconds
	H <sub>2</sub>	≤60 seconds
	HCN	≤60 seconds
	Range	CO
H <sub>2</sub> S		0-50 or 0-200ppm
SO <sub>2</sub>		0-20 or 0-100ppm
NO <sub>2</sub>		0-20ppm
CL <sub>2</sub>		0-20ppm
H <sub>2</sub>		0-1000ppm
HCN		0-100ppm



Soil Gas

Vapor Intrusion

Property Redevelopment

Ambient Air Monitoring

Indoor Air Quality

Waste-to-Energy



Air Toxics

## Guide to Air Sampling

Canisters and Bags



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**Eurofins Air Toxics, Inc.**  
**Guide to Whole Air Sampling – Canisters and Bags**

**Revision 6/27/14**

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## Section 1.0 Introduction

Eurofins Air Toxics Inc. presents this guide as a resource for individuals engaged in air sampling. Air sampling can be more involved than water or soil sampling due to the reactivity of chemical compounds in the gas matrix and sample interaction with the equipment and media used. Ensuring that air samples are collected properly is an important step in acquiring meaningful analytical results. This guide is not a substitute for experience and cannot sufficiently address the multitude of field conditions. Note that this guide is intended for projects involving whole air sampling of volatile organic compounds (VOCs) in canisters and Tedlar® bags. Eurofins Air Toxics provides the “Guide to Sorbent-Based Sampling - Volatiles and Semi-Volatiles” for other types of sampling.

### 1.1 Whole Air Sampling of VOCs

There are three general ways to collect compounds in a gas phase sample. A sampler may collect the gas sample in a container, actively pump the vapor through a sorbent tube, solution or filter, or rely on passive sample collection onto a sorbent bed. This guide focuses on collecting a sample in the most common air sampling containers, Summa canisters and bags. The sample may be collected in the container either passively, relying on an evacuated canister to drive the sample collection, or actively using a pump to fill the container. The container is subsequently sealed and transported to the laboratory for analysis. The sample is referred to as a “whole air sample” and the compounds remain in the gas matrix inside the container.

As a general rule, whole air sampling is appropriate when target compounds are chemically stable and have vapor pressures greater than 0.1 torr at 25°C and 760mm Hg (EPA standard ambient conditions). Performance of a given compound in a whole air sample is dependent upon its chemical properties, the matrix of the sample, and the degree of inertness of the sample container.

### 1.2 Choosing Between Canisters and Bags

Table 1.2 compares the features and performance of Summa canisters and bags. Summa canisters or similarly treated canisters are rugged containers designed to provide superior inertness and extended sample storage times. Evacuated canisters also do not require a sampling pump for sample collection. By contrast, bags require a sample pump, but can be purchased inexpensively in bulk, require little preparation or cleaning, and take up little space prior to use. Unlike canisters, bags are typically not appropriate for ppbv-level VOC measurements due to their background artifacts and short hold-times. Over time, low molecular weight gases can diffuse through the bag material while chemicals with lower vapor pressures can condense on the bag surface thereby compromising analyte recoveries. Call your Project Manager at 800-985-5955 if you have questions regarding the appropriate sampling media.

**Table 1.2 Comparison of Canisters to Bags**

	Canisters	Bags
<b>Type of Sampling</b>	Passive (vacuum)	Active (pump required)
<b>Media Hold Time</b>	Up to 30 days recommended	Indefinite
<b>Hold Time to Analysis</b>	Up to 30 days	Up to 3 days
<b>Surface Inertness</b>	Excellent	Fair
<b>Cleanliness</b>	Batch or 100% certified to ppbv/pptv levels	Some VOCs present in the ppbv range
<b>Sampling Application</b>	Ambient air, soil/landfill gas	Soil/landfill gas, stationary sources, SVE systems
<b>Rule of Thumb</b>	“ppbv device”	“ppmv device”
<b>Advantages</b>	Inertness, hold time, ruggedness, no pump	Purchase/shipping cost, availability, convenience

## Section 2.0 Canisters and Associated Media

*This section provides a description of air sampling canisters, practical considerations for sampling, and step-by-step instructions for collecting grab and integrated samples. Photographs illustrate the correct way to assemble the various sampling components. Tables provide detailed information on many operational factors that ultimately influence the quality of the data obtained from a canister sample.*

### 2.1 Introduction to Canisters

An air sampling canister is a container for collecting a whole air sample. A canister may be spherical or cylindrical and is constructed of specially treated stainless steel. The canister is prepared for sampling by evacuating the contents to a vacuum of approximately 29.9 inches of Mercury (in Hg). Opening the stainless steel bellows valve allows the air sample to enter the canister. Flow controllers can be utilized to restrict the flow and allow for collection at a desired flow rate or over a desired range. When the sample has been collected, the valve is closed and the canister is returned to the laboratory. Canisters range in volume from less than 1 liter (L) to 6 L. In general, 6 L canisters are used to collect ambient air samples and samples requiring time integration greater than 2 hours. One liter canisters are typically used for taking high concentration (i.e., greater than 5 ppbv) samples not requiring time integration such as soil vapor.



#### 2.1.1 Summa Canister

A Summa canister is a stainless steel container that has had the internal surfaces specially passivated using a “Summa” process. This process combines an electropolishing step with a chemical deactivation step to produce a surface that is nearly chemically inert. A Summa surface has the appearance of a mirror: bright, shiny and smooth. The degree of chemical inertness of a whole air sample container is crucial to minimizing reactions with the sample

and maximizing recovery of target compounds from the container. Eurofins Air Toxics maintains a large inventory of Summa canisters in 1 and 6 L volumes.

#### 2.1.2 Canister Certification

Eurofins Air Toxics provides two types of canister cleaning certification, batch and 100%, depending upon the requirements of the project. The batch certification process is most appropriate for routine ambient air applications and high concentration applications such as soil vapor and landfill gas monitoring. The batch certification process begins by cleaning a set of canisters using a combination of dilution, heat and high vacuum. The cleaning batch is certified by analyzing a percentage of canisters for approximately 60 VOCs using GC/MS. The batch meets cleaning requirements if the target compound concentrations are below 0.2 ppbv. Alternatively, the 100% certification (i.e., individual certification) process is typically required for ambient and indoor air applications driven by risk assessment or litigation requiring pptv (parts per trillion by volume) sensitivity. If 100% certification is required, canisters are individually certified for a client-specific list of target compounds using GC/MS. When the 100% certified canisters are shipped, the analytical documentation demonstrating that they are free of the target compounds down to the project reporting limits is emailed to the client. When sampling with certified media, it is important to note that all media is certified as a train and must be sampled as such (i.e., a particular flow controller goes with a particular canister and is labeled as such).



Specify whether your project requires batch or 100% canister certification.

#### 2.1.3 Canister Hold Time

**Media Hold Time:** Unlike water and soil environmental samples, which are collected in single-use, disposable vials and jars, air samples are collected in reusable summa canisters. Eurofins Air Toxics requires that canisters be returned within 15 days of receipt to effectively manage our inventory and to insure canisters meet performance requirements in the field. Evacuated canisters have a finite timeframe before the canisters naturally lose

vacuum during storage. Using canisters beyond 15 days increases the risk of having unacceptable initial vacuum at the start of sampling.

**Sample Hold Time:** EPA Method TO-15 cites a sample hold time of up to 30 days for most VOCs. Several non-routine compounds, such as bis(chloromethyl)ether, degrade quickly and demonstrate low recovery even after 7 days. Reactive sulfur compounds such as hydrogen disulfide and methyl, ethyl, and butyl mercaptan are not amenable to storage in stainless steel summa canister, and either fused silica lined (FSL) canisters or Tedlar bags are required for sample collection.

## 2.2 Associated Canister Hardware

Associated hardware used with the canister includes the valve, brass cap, particulate filter and vacuum gauge. (Flow controllers are covered in detail in section 3.2.)

### 2.2.1 Valve

An industry standard 1/4" stainless steel bellows valve is mounted at the top of the canister. The valve maintains the vacuum in the canister prior to sampling and seals the canister once the sample has been collected. No more than a half turn by hand is required to open the valve. Do not over-tighten the valve after sampling or it may become damaged. A damaged valve can leak, possibly compromising the sample. Some canisters have a metal cage near the top to protect the valve.

To protect the valve and provide secure connections in the field, a replaceable fitting is attached to all canisters. As threads wear and require replacement, new fittings can be installed at the laboratory prior to shipping to the field. You will need a 1/2" wrench to secure the fitting while connecting or removing the required equipment to the canister.

### 2.2.2 Brass Cap

Each canister comes with a brass cap (i.e., Swagelok 1/4" plug) secured to the inlet of the valve assembly. The cap serves two purposes. First, it ensures that there is no loss of vacuum due to a leaky valve or a valve that is accidentally opened during handling. Second, it prevents dust and other particulate matter from damaging the valve. The cap is removed prior to sampling and replaced following sample collection.



Always replace the brass cap following canister sampling.

### 2.2.3 Particulate Filter

Particulate filters should always be used when sampling with a canister. Separate filters are provided to clients taking a grab sample, and filters are built into the flow controllers for clients taking integrated samples. The 2 micron filter is a fritted stainless steel disk that has been pressed into a conventional Swagelok adapter. This device has a relatively high pressure drop across the fritted disk and restricts the flow into the canister even when sampling without a flow controller. Table 2.2.3 lists the typical fill time for a grab sample using a 2 micron particulate filter.



**Table 2.2.3 Grab Sample Fill Times for Canisters**

CANISTER VOLUME	2 micron filter
6 L	<5 minutes
1 L	<1 minute

#### **2.2.4 Fittings**

All fittings on the sampling hardware are 1/4" Swagelok, and a 9/16" wrench is used to assemble the hardware. A 1/2" wrench is also required to tighten fittings onto a union connector. Compression fittings should be used for all connections. Never use tube-in-tube connections. It is critical to avoid leaks in the sampling train. Leaks of ambient air through fittings between pieces of the sampling train will dilute the sample and cause the canister to fill at a faster rate than desired. Eurofins Air Toxics can provide the necessary fittings and ferrules if requested.

#### **2.2.5 Vacuum Gauge**

A vacuum gauge is used to measure the initial vacuum of the canister before sampling, and the final vacuum upon completion. A gauge can also be used to monitor the fill rate of the canister when collecting an integrated sample. Eurofins Air Toxics provides 2 types of gauges. For grab sampling, a test gauge checks initial and final vacuums only and is not to be sampled through. For integrated sampling a gauge is built into the flow controller and may be used for monitoring initial and final vacuums, as well as monitoring the fill rate of the canister. Both gauges are considered to be rough gauges, intended to obtain a relative measure of vacuum change. Accuracy of these field gauges are generally on the order of +/- 5 in Hg. Individuals with work plans that outline specific gauge reading requirements are strongly encouraged to purchase and maintain their own gauges in the field. In special cases, a laboratory-grade, NIST-traceable vacuum gauge can be provided upon request.



The vacuum gauges that are routinely provided are intended as a rough gauge measurement device (+/-5 in Hg accuracy).

## Section 3.0 Sampling with Canisters

There are two basic modes of canister sampling: grab and integrated. A grab sample is taken over a short interval (i.e., 1-5 minutes) to provide a point-in-time sample concentration, while an integrated sample is taken over a specified duration or utilizing a specified flow rate. In both modes the canister vacuum is used to draw the sample into the canister. This is commonly referred to as passive canister sampling. Sections 3.1 and 3.2 detail procedures for grab and integrated sampling, and section 3.3 provides procedures specific to soil vapor collection.

Regardless of the type of canister samples collected, the following rules apply:

- DO NOT use canister to collect explosive substances, radiological or biological agents, corrosives, extremely toxic substances or other hazardous materials. It is illegal to ship such substances and you will be liable for damages.
- ALWAYS use a filter when sampling. NEVER allow liquids (including water) or corrosive vapors to enter canister.
- DO NOT attach labels to the surface of the canister or write on the canister; you will be liable for cleaning charges.
- DO NOT over tighten the valve, and remember to replace the brass cap.
- IF the canister is returned in unsatisfactory condition, you will be liable for damages.
- DO NOT make modifications to the equipment connections and/or use Teflon tape unless approved by the laboratory.
- AND, if you have any questions or need any support, our experienced project management team is just a phone call away at 800-985-5955.



Use a 9/16" and 1/2" wrench to tighten Swagelok connections on the canister sampling train.

### 3.1 Grab Sampling Using Canisters

The most common hardware configuration used to take a grab sample is to simply attach a particulate filter to the canister inlet. A particulate filter is shown in section 2.2.3 and is used to prevent particulate matter from fouling the valve and entering the canister.



#### 3.1.1 Step-By-Step Procedures for Canister Grab Sampling

These procedures are for a typical ambient air sampling application; actual field conditions and procedures may vary.

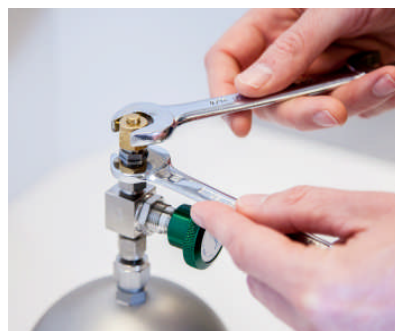
##### Before you get to the field:

1. Verify contents of the shipped package (e.g., chain-of-custody, canister, particulate filter, and gauge – if requested).
  2. Make sure you include a 9/16" and 1/2" wrench in your field tool kit.
  3. Verify the gauge is working properly.
  4. Verify the initial vacuum of canister as described in the following section:
- **Verify Initial Vacuum of the Canister:** Prior to shipment, each canister is checked for mechanical integrity. However, it is still important to check the vacuum of the canister prior to use. Eurofins Air Toxics recommends doing this before going to the field if possible. The initial vacuum of the canister should be greater than 25 in Hg. If the canister vacuum is less than 25 in Hg, ambient air may have leaked into the canister during storage or transport and the sample may be compromised. Contact your Project Manager if you have any questions on whether to proceed with sample collection. If



sampling at altitude, there are special considerations for gauge readings and sampling (see Section 5.2). The procedure to verify the initial vacuum of a canister is simple but unforgiving.

1. Confirm that valve is closed (knob should already be tightened clockwise).
2. Remove the brass cap.
3. Attach gauge.
4. Attach brass cap to side of gauge tee fitting to ensure a closed train.
5. Open and close valve quickly (a few seconds).
6. Read vacuum on the gauge.
7. Record gauge reading on “Initial Vacuum” column of chain-of-custody.
8. Verify that canister valve is closed and remove gauge.
9. Replace the brass cap.



#### When ready to sample:

1. Confirm that valve is closed (knob should already be tightened clockwise).
2. Remove brass cap.
3. Attach particulate filter to canister.
4. Open valve 1/2 turn (6 L canister normally takes less than 5 minutes to fill).
5. Close valve by hand tightening knob clockwise.
6. Verify and record final vacuum of canister (repeat steps used to verify initial vacuum). For grab samples, the ending vacuum is typically close to ambient pressure (0 in Hg).
7. Replace brass cap.
8. Fill out canister sample tag (make sure the sample ID and date of collection recorded on the sample tag matches what is recorded on the COC exactly).
9. Return canister in box provided.
10. Return sample media in packaging provided.

11. Fill out chain-of-custody and relinquish samples properly (it is important to note the canister serial numbers on the chain-of-custody).
12. Place chain-of-custody in box and retain pink copy.
13. Tape box shut and affix custody seal (if applicable) across flap.
14. Ship accordingly to meet method holding times.



Return all equipment used or unused to the laboratory. Unreturned canisters and associated hardware will result in additional charges as outlined in the media agreement.

### 3.2 Integrated Sampling with Canisters and Flow Controllers

As an alternative to an “instantaneous” grab sample, an air sample collected at a controlled rate is referred to as an integrated sample. Flow controllers or flow restrictors are devices which provide sample collection at a desired flow rate and/or sampling interval. By using a flow controller at a specified flow rate, air samples can provide information on average compound concentrations over a defined period. For example, an 8- or 10-hour integrated sample can be used to determine indoor air quality in the workplace. Similarly, a 24-hour integrated sample may be collected to determine residential exposure to indoor or outdoor air sources. In addition to using a flow controller for time-integrated sample collection, a flow controller may be required for soil gas collection to restrict the vacuum applied to the soil and pore water and to collect a representative sample with minimal intrusion of ambient air.

Eurofins Air Toxics provides two general types of flow controllers: mass flow controllers and critical orifice devices. Both devices are driven by differential pressure between ambient conditions and vacuum in the canister.

### 3.2.1 Mass Flow Controller

A mass flow controller employs a diaphragm that actively compensates to maintain a constant mass flow rate over the desired time period. As the differential pressure decreases, the flow rate decreases and the diaphragm responds by opening up to allow more air to pass through to maintain a stable flow rate. Mass flow controllers are calibrated in the laboratory to provide flow rates suitable for durations up to 24 hours. Durations greater than 24 hours are possible, however, performance of the flow controller is less reliable due to the low flow rates required.



### 3.2.2 Critical Orifice Devices

Eurofins Air Toxics has two types of critical orifice controllers – “capillary column” and “frit pressed”. Both types restrict the flow rate and the canister fill rate decreases as the canister fills to ambient pressure.



These controllers are suitable for applications not requiring constant flow rate over the sampling period such as soil vapor collection or at sites in which temporal variability of VOCs is not expected. Critical orifice devices can cover intervals from 0.5 to 12 hours and flow rate from 10 to 250

ml/min. The “capillary column” device (also known as the Blue Body Flow Controller) restricts air flow by forcing the sample to enter a capillary column of minute radius. The flow rate is a function of the length of inert capillary column. The frit pressed device has a critical orifice machined to meet a set flow rate.



### 3.2.3 Sampling Interval and Flow Controller Setting

When you request canisters and flow controllers from Eurofins Air Toxics, you will be asked for the flow rate (soil vapor) or sampling interval (ambient air), and the flow controllers will be pre-set prior to shipment. The flow rate is set at standard atmospheric conditions (approximately sea level and 25°C). If samples will be collected at elevation or at ambient temperatures significantly different than 25°C, the canister will fill faster or slower depending on sample conditions. If you specify unusual sample conditions at the time of project set-up, we can set the flow controller accordingly. (See Section 5.2 for a discussion of collecting a sample at elevation.) Mass flow controllers should not be utilized for source or process samples in which the collection point is under vacuum or pressure. Please discuss these specific non-standard field conditions with your Project Manager at the time of project set-up.

**Table 3.2.3 Flow Rates for Selected Sampling Intervals (mL/min)**

Sampling Interval (hrs)	4 min.	0.5	1	2	4	8	12	24
6 L Canister	NA	167	83.3	41.7	20.8	11.5	7.6	3.8
1 L Canister	167	26.6	13.3	6.7	-	-	-	-

Note: Target fill volumes for 6 L and 1 L canisters are 5,000 mL and 800 mL, respectively.

### 3.2.4 Final Canister Vacuum and Flow Controller Performance

For time-integrated sample collection using a mass flow controller, the final vacuum of a canister should ideally be approximately 5 in Hg or greater. The flow rate will remain constant as the canister fills and will start to decrease as the canister vacuum approaches

5 in Hg. At this point, the differential pressure between the canister and ambient air is not sufficient to maintain the set flow rate. Because of normal fluctuations in the flow rate due to changes in field temperature and pressure, the final vacuum typically ranges between 3 and 10 in Hg.

- **If the residual canister vacuum is greater than 10 in Hg** (i.e., more vacuum), the actual flow rate is lower than the set point and less sample volume is collected. When the canister is pressurized prior to analysis, the pressurization dilution will be greater than normal. This will result in elevated reporting limits.
- **If the residual canister vacuum is near ambient pressure** for a time-integrated sample, the canister filled faster than calibrated. Once the vacuum decreases below 5 in Hg, the flow rate begins to decrease from its set point. This scenario indicates that the sample is weighted toward the first portion of the sampling interval. The sampler cannot be certain the desired sampling interval was achieved before the canister arrived at ambient conditions. Although the actual sampling interval is uncertain, the canister still contains a sample from the site.

**Table 3.2.4 Relationship between Final Canister Vacuum, Volume Sampled, and Dilution Factor (6 L Canister)**

Final Vacuum (in Hg)	0	2.5	5	7.5	10	12.5	15	17.5	20
Volume Sampled (L)	6	5.5	5.4	5	4	3.5	3	2.5	2
Dilution Factor*	1.34	1.46	1.61	1.79	2.01	2.30	2.68	3.22	4.02

\*Canister pressurized to 5 psig for analysis

$$\text{Final Reporting Limit} = \text{Method Reporting Limit} \times \text{Dilution Factor (Canister Pressurization)} \times \text{Dilution Factor (Sample Analysis)}$$

$$\text{Dilution Factor (Canister Pressurization)} = \frac{\text{Final Pressure}}{\text{Receipt Pressure}} = \frac{14.7 \text{ psig} + \text{Final Pressure (psig)}}{14.7 \text{ psig}} \left[ \frac{1 - \text{Receipt Vacuum (in Hg)}}{29.9 \text{ in Hg}} \right]$$

### 3.2.5 Considerations for Integrated Sampling with Canisters

Collecting an integrated air sample is more involved than collecting a grab sample. Sampling considerations include verifying that the sampling train is properly configured, monitoring the integrated sampling progress, and avoiding contamination.

- **Avoid Leaks in the Sampling Train:** A leak in any one of these connections means that some air will be pulled in through the leak and not through the flow controller. (Follow the leak check step #4 in 3.2.6).
- **Verify Initial Vacuum of Canister:** See Section 3.1.1 for instructions on verifying initial canister vacuum. A separate gauge is not necessary as both the mass flow controllers and critical orifice flow controllers have built-in rough gauges.
- **Monitor Integrated Sampling Progress:** When feasible, it is a good practice to monitor the progress of the integrated sampling during the sampling interval. The volume of air sampled is a linear function of the canister vacuum. For example, when using a 24-hour mass flow controller, at a quarter of the way (6 hours) into a 24-hour sampling interval, the canister should be a quarter filled (1.25 L) and the gauge should read approximately 6 in Hg lower than



the starting vacuum (~22 in Hg). More vacuum indicates that the canister is filling too slowly; less vacuum means the canister is filling too quickly. If the canister is filling too slowly, a valid sample can still be collected (see Section 3.2.4). If the canister is filling too quickly because of a leak or incorrect flow controller setting, corrective action can be taken. Ensuring all connections are tight may eliminate a leak. It is possible to take an intermittent sample; the time interval need not be continuous.

- **Avoid Contamination:** Flow controllers should be cleaned between uses. This is done by returning them to the laboratory.
- **Caution When Sampling in Extreme Temperatures:** Field temperatures can affect the performance of the mass flow controllers. Laboratory studies have shown that flow rates can increase slightly with decreasing temperatures. A flow rate increase of approximately 10% is expected when sampling at field temperatures of 5 to 10°C.

### 3.2.6 Step-by-Step Procedures for Integrated Sampling

These procedures are for a typical ambient air sampling application; actual field conditions and procedures may vary.

#### Before you get to the field:

1. Verify contents of the shipped package (e.g., chain-of-custody, canister, and flow controller)
2. Make sure you include a 9/16" and 1/2" wrench in your field tool kit.
3. Verify the gauge is working properly
4. Verify the initial vacuum of canister (section 3.1.1)

#### When ready to sample:

1. Confirm that valve is closed (knob should already be tightened clockwise).
2. Remove brass cap from canister.

3. Attach flow controller to canister. The flow controller is securely attached if the flow controller body does not rotate.
4. Place the brass cap at the end of the flow controller creating an air tight train, and quickly open and close the canister valve in order to check for leaks. If the needle on the gauge drops, your train is not airtight. In this case, try refitting your connections and/or tightening them until the needle holds steady.
5. Once the sample train is airtight remove the brass cap from the flow controller and open the canister valve a ½ turn.
6. Monitor integrated sampling progress periodically.
7. Verify and record final vacuum of canister (simply read built-in gauge).
8. When sampling is complete, close valve by hand tightening knob clockwise.
9. Detach flow controller and replace brass cap on canister.
10. Fill out canister sample tag (make sure the sample ID and date of collection recorded on the sample tag matches what is recorded on the COC exactly).
11. Return canisters and associated media in boxes provided. **Failure to return all of the provided equipment will result in a replacement charge as outlined in the media agreement.**
12. Fill out chain-of-custody and relinquish samples properly (it is important to note the canister serial numbers on the chain-of-custody).
13. Place chain-of-custody in box and retain pink copy.
14. Tape box shut and affix custody seal at each opening (if applicable).
15. Ship accordingly to meet method holding times.

### 3.3 Soil Gas Sample Collection

Canisters can be used for the collection of soil vapor by attaching the sampling train to the soil gas probe. Typically, a critical orifice flow controller is used to minimize the applied vacuum in order to minimize partitioning of VOCs from the soil or pore water to the soil vapor. Additionally, lower flow rates help to minimize the intrusion of ambient air into the soil vapor probe. In general, time-integration is not required for soil gas samples; however, there may be exceptions to this rule of thumb. For example, some regulatory guidance documents recommend concurrent indoor air and sub-slab soil vapor collection over a

24-hour period. This means that a mass flow controller calibrated for a 24-hour sample would be required for the sub-slab as well as the indoor air sample.

### 3.3.1 Canister to probe connection – Tubing

Collection of a soil gas sample requires the use of tubing to connect the soil gas probe to the sample train. Teflon FEP tubing is recommended based on its low background and its inertness. Alternative tubing can be used if shown to meet data quality objectives. Please note that Low Density Polyethylene or flexible Tygon tubing is not recommended due to VOC adsorption during sample collection. Teflon tubing is provided by the laboratory upon request at the time of order. A charge based on the length will be assessed. It is important to store the tubing away from VOC sources during storage and transport to the site to minimize contamination.

### 3.3.2 Canister to probe connection –Fittings

To connect the tubing to the canister sampling train, a Swagelok fitting and a pink ferrule are used. The position of the ferrule is key to ensure the fitting is securely connected to the canister. See the figure below for the correct positioning and connection. The pink ferrule is flexible and cannot be over-tightened.



### 3.3.3 Leak Check Compounds Considerations

To determine whether ambient air is introduced into soil gas sample, a leak check may be used. Leak check compounds may be liquid or gaseous tracers. Liquid compounds are challenging to use effectively in the field and can be introduced into the sample due to improper handling in the field, erroneously indicating a leak in the sampling train. Liquid tracers such as isopropanol should never be directly applied to connections in the sampling train. Rather, the liquid is carefully applied to a cloth and placed near the connection or on the ground next to the probe. Great care must be used in the field to insure the liquid tracer is not handled during sampling train assembly or disassembly. Even a trace amount of a liquid tracer on a glove used to replace a canister brass cap can contaminate the sample. Liquid leak check compounds can interfere with the analytical runs, and even small leaks may result in analytical dilution and raised reporting limits when measuring ppbv target compound levels.

Gaseous tracers such as helium are typically used with shroud placed over the sampling equipment and/or borehole. To quantify the leak, the concentration of the tracer gas in the shroud should be measured.



Specify the leak check compound planned for your soil gas sampling event and record on the COC.

### 3.3.4 Step-by-Step Procedures for Soil Vapor Sampling

These procedures are for a typical soil vapor sampling application; actual field conditions and procedures may vary. Please consult your specific regulatory guidance for details.

#### Before you get to the field:

1. Verify contents of the shipped package (e.g., chain-of-custody, canister, tubing, fittings, and flow controller).
2. Make sure you include a 9/16" and 1/2" wrench in your field tool kit.
3. Verify the gauge is working properly.
4. Verify the initial vacuum of canister.

#### Prior to vapor collection:

- **Purge tubing adequately.** A long length of tubing has significant volume of "dead air" inside. Without purging, this air will enter the canister and dilute the sample. Consider using a handheld PID/FID to confirm that you have purged the tubing and are drawing sample air through the tubing. A standard rule of thumb is to utilize 3 purge volumes prior to sample collection. However, under certain circumstances, purge volumes of 1 to 10 may be appropriate. Please review your regulatory guidance and your site specific conditions in determining the appropriate purge volumes.
- **Don't sample water.** If moisture is visible in the sample tubing, the soil gas sample may be compromised. Soil gas probes should be at an appropriate depth to avoid reaching the water table. Additionally, subsurface vapor should not be collected immediately after measurable precipitation.

#### When ready to sample:

1. Confirm that valve is closed (knob should already be tightened clockwise).
2. Remove brass cap from canister.
3. Attach flow controller to canister if needed. The flow controller is securely attached if the flow controller body does not rotate. (Note: The frit-press flow controller and 1 L canister may be pre-assembled by the laboratory.)
4. Place the brass cap at the end of the flow controller creating an air tight train, and quickly open and close the canister valve in order to check for leaks. If the needle on the

gauge drops, your train is not airtight. In this case, try refitting your connections and/or tightening them until the needle holds steady.

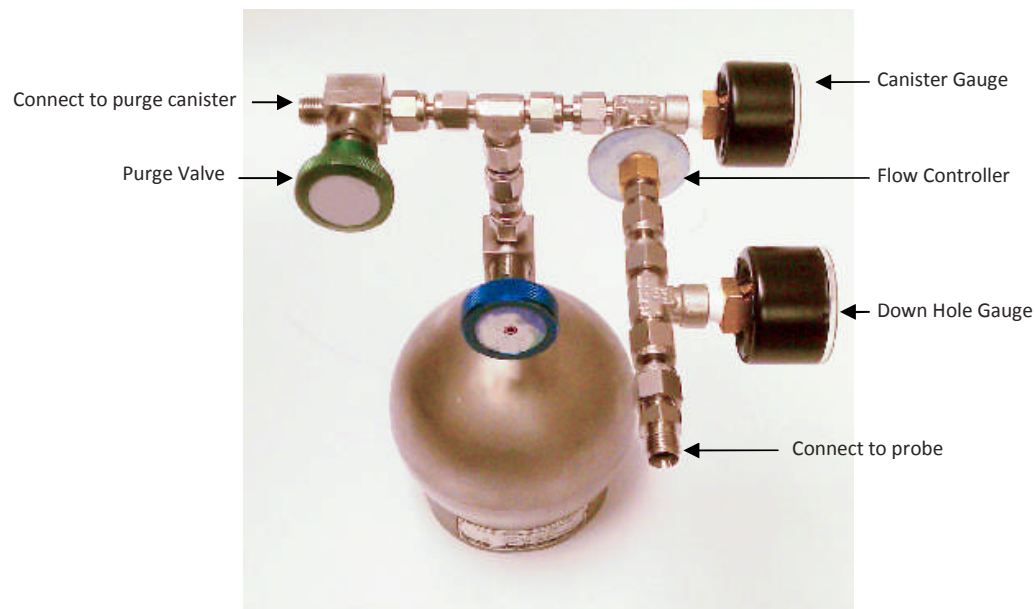
5. Once the sample train is airtight remove the brass cap from the flow controller and attach the probe tubing to the flow controller using the pink ferrule and Swagelok nut. (See 3.3.2 for proper positioning of the ferrule.)
6. Once the probe line has been purged and appropriate leak check measures have been implemented, open the canister valve a ½ turn.
7. Verify and record final vacuum of canister (simply read built-in gauge).
8. When canister fills to the desired end vacuum, close valve by hand tightening knob clockwise.

*Please note: Some projects require residual vacuum of approximately 5 in Hg at the end of sample collection even if time-integrated samples are not required. The residual vacuum serves to provide a check of the integrity of the canister during transport to the laboratory to insure no leaks occurred during shipment. A field vacuum reading similar to the lab receipt vacuum reading demonstrated that no leak occurred.*

9. Detach tubing and flow controller and replace brass cap on the canister.
10. Fill out canister sample tag (make sure the sample ID and date of collection recorded on the sample tag matches what is recorded on the COC exactly).
11. Return canisters and associated media in boxes provided. **Failure to return all of the provided equipment will result in a replacement charge as outlined in the media agreement.**
12. Fill out chain-of-custody and relinquish samples properly (it is important to note the canister serial numbers on the chain-of-custody).
13. Place chain-of-custody in box and retain pink copy
14. Tape box shut and affix custody seal at each opening (if applicable)
15. Ship accordingly to meet method holding times

### 3.4.4 Collecting Soil Gas Samples with Sampling Manifolds

If required, Eurofins Air Toxics can provide a sampling manifold to assist with leak checking the sampling train, purging the sampling line, and monitoring the vacuum applied to the soil gas bore hole during sample collection. The manifold is shown below:



The ‘Down Hole Gauge’, located prior to the flow restrictor, is a vacuum gauge that monitors the vacuum applied to the soil gas probe. Because this is not a flow meter but a measure of pressure/vacuum, the gauge should read at zero if there is sufficient flow from the soil. If the gauge begins to read a vacuum, then the flow is being restricted. Low flow, high vacuum conditions can be encountered when sampling in low permeability soil. The ‘Canister Gauge’, in line after the flow controller and prior to the purge canister, is a vacuum gauge that indicates to the sampler whether or not the canister is filling properly at the expected rate. This setup enables the sampler to evaluate the lithologic conditions at the site and determine if a valid soil gas sample is being taken. Finally, when duplicate

samples are required, the manifold can be used as a duplicate sampling “T” by simply replacing the purge canister with another sample canister.

There are several options to use as a purge vacuum source to attach to the purge valve connection – a Summa canister, sampling pump or sampling syringe. The below instructions assume a Summa canister will be used as a purge volume source since other sources are generally provided by the client.

#### When ready to sample:

##### Leak Check Test

1. Confirm that canister valves are closed (knob should already be tightened clockwise).
2. Remove brass caps from both the sample canister and the purge canister. (Unless using certified media, there is no difference between the two).
3. Attach manifold center fitting to sample canister.
4. Attach purge canister to the Purge Valve end of the manifold by attaching provided Teflon tubing and compression fittings.
5. Confirm that there is a brass cap secured at the inlet of the manifold creating an air tight train, make sure the manifold valve above the purge canister is open, and quickly open and close the purge canister valve in order to check for leaks. If the needle on the gauge drops, your train is not airtight. In this case, try refitting your connections and/or tightening them until the needle holds steady.

##### Purging

6. Once the sample train is airtight remove the brass cap from the manifold inlet, connect the tubing from the sample port using a compression fitting and open the purge canister valve, 1/2 turn.
7. Monitor integrated sampling progress periodically. \*Please note, because the purge canister is inline after the flow restrictor the line will not purge faster than at a rate of 167 ml/min.

8. Once the desired purge volume is met close both the manifold valve and the purge canister valve by hand tightening the knobs clockwise.
9. If sampling at multiple locations, the purge canister can be disconnected from the manifold and used to begin purging the next sample location without compromising the sample train.

### ***Sampling***

10. The line is now ready to be sampled. Open the sample canister valve and monitor sampling progress periodically.
11. When the sampling is complete close the valve and replace the brass cap on the canister; record final vacuum of canister (simply read built-in gauge).
12. Fill out canister sample tag (make sure the sample ID and date of collection recorded on the sample tag matches what is recorded on the COC exactly).
13. Return canisters in boxes provided and all parts of the soil gas manifold. **Unreturned media will result in a replacement charged assessed as described in the media agreement.**
14. Fill out chain-of-custody and relinquish samples properly (it is important to note the canister serial numbers on the chain-of-custody).
15. Place chain-of-custody in box and retain pink copy.
16. Ship accordingly to meet method holding times.



## Section 4.0 Sampling with Bags

*This section provides a description of the types of air sampling bags, selecting the right bag for your application, practical considerations for sampling, and step-by-step instructions for collecting a grab sample. Photographs illustrate the correct way to assemble the various sampling components.*

### 4.1 Introduction to Bags

Air sampling bags are containers used to collect whole air samples for landfill gas, soil gas and stationary source applications. Bags can be constructed from various materials which can differ in terms of stability characteristics and cleanliness. In general, air sampling bags are best suited for projects involving analysis of compounds in the ppmv range. They can be used to collect sulfur compounds, but only if the fittings are non-metallic (e.g., polypropylene, Teflon<sup>®</sup>, or Nylon).

Air sampling bags are equipped with a valve that allows for filling. Sample collection requires a pressurized sampling port, a low flow rate pump or a lung sampler. The bag expands as the vapor sample is pulled in. When the target volume of the sample is collected, the valve is closed and the bag is returned to the laboratory. Bag materials should be selected based on the specific application. Common air sampling bags include Tedlar film and FlexFoil. Eurofins Air Toxics maintains a limited inventory of air sampling bags in 1 L, 3 L and 5 L volumes.

#### 4.1.1 Tedlar<sup>®</sup> Film

Tedlar<sup>®</sup> is a trade name for a polyvinyl fluoride film developed by DuPont Corporation in the 1960's. This patented fluoropolymer has been used in a wide variety of applications including protective surfacing for signs, exterior wall panels and aircraft interiors. Tedlar<sup>®</sup> film is tough yet flexible and retains its impressive mechanical properties over a wide range

of temperatures (from well below freezing to over 200°F). Tedlar<sup>®</sup> exhibits low permeability to gases, good chemical inertness, good weathering resistance and low off-gassing.

Tedlar<sup>®</sup> bags may be used to collect samples containing common solvents, hydrocarbons, chlorinated solvents, sulfur compounds, atmospheric and biogenic gases and many other classes of compounds. Compounds with low vapor pressures such as Naphthalene are not appropriate for Tedlar bags as recovery is very low even under short sample storage times. Low molecular compounds such as Helium and Hydrogen can diffuse through the Tedlar bag material resulting in poor storage stability.



#### 4.1.2 Tedlar<sup>®</sup> Bag Suppliers and Re-use

Compounds commonly detected from analyzing new Tedlar<sup>®</sup> bags include methylene chloride, toluene, acetone, ethanol, 2-propanol, phenol, and dimethylacetamide. While levels of these common artifacts are typically in the ppbv range, the cleanliness of bags can vary significantly between vendors, and purchasing bags directly from an unknown vendor should be avoided. Once the Tedlar<sup>®</sup> bag is used for sample collection, the surface has been exposed to moisture and possible VOCs. It may irreversibly adsorb many VOCs at the low ppbv level. A series of purges with certified gas may not remove the VOCs from the surface. Consider your data quality objectives to determine whether re-using Tedlar<sup>®</sup> bags is appropriate.

#### 4.1.3 Hold Time for a Tedlar<sup>®</sup> Bag

The media hold time for a Tedlar<sup>®</sup> bag is indefinite if stored out of sunlight in a cool, dry location.

The sample hold time to analysis varies by method and compound. See Table 4.1.3 for recommended sample storage times for commonly requested parameters.

**Table 4.1.3 Recommended Maximum Sample Storage Times for Tedlar® Bags**

Analytical Method	Chemical Class	Storage Time
ASTM D5504	Suite of sulfur compounds including Reactive Sulfur compounds (Hydrogen sulfide, Methyl mercaptan)	24 hours
ASTM D1946 ASTM D1945	Atmospheric and natural gases: CO, CO <sub>2</sub> , CH <sub>4</sub> , C <sub>2</sub> -C <sub>5</sub> hydrocarbons (He and H <sub>2</sub> not recommended)	Up to 3 days
Modified TO-14A, TO-15, TO-3, TO-12	Volatile Organic Compounds (VOCs)	Up to 3 days

#### 4.1.4 FlexFoil Bags

FlexFoil bags are made from an opaque and flexible material with 4-ply construction resulting in high physical strength to minimize rupture and leakage and low permeability to provide good stability for low molecular weight compounds. FlexFoil bags are ideal for target compounds such as Hydrogen and Helium and can be used for the suite of atmospheric and natural gas components. While the reactive sulfur compounds, Hydrogen Sulfide and Methyl Mercaptan, show good stability over 24 hours in FlexFoil bags, other sulfur compounds demonstrate low recovery. Table 4.1.4 summarizes the compounds and the hold times amenable to FlexFoil bags.

**Table 4.1.4 Recommended Maximum Sample Storage Times for FlexFoil Bags**

Analytical Method	Chemical Class	Storage Time
ASTM D5504	Hydrogen sulfide, Methyl mercaptan only Not recommended for full sulfur list.	24 hours
ASTM D1946 ASTM D1945	Atmospheric and natural gases Full List	Up to 3 days

#### 4.2 Air Bag Sampling

Using a bag to collect an air sample normally involves “active” sampling, unlike an evacuated canister that can be filled “passively” by simply opening the valve. There are two methods commonly used to fill a bag: a pump or a lung sampler.

- Sampling with a Pump:** The most common method for filling a bag is to use a small pump with low flow rates (50-200 mL/min) and tubing to fill the bag. Eurofins Air Toxics, Inc. does not provide pumps but pumps may be rented from equipment providers or purchased from manufacturers such as SKC or Gilian.
- Sampling with a Lung Sampler:** A “lung sampler” may be used to fill a bag. Although a little more complicated than simply using a pump, the main advantage to using a lung sampler to fill a bag is that it avoids potential pump contamination.



A bag with attached tubing is placed in a small airtight chamber (even a 5-gallon bucket can work) with the tubing protruding from the chamber. The sealed chamber is then evacuated via a pump, causing the bag to expand and draw the sample into the bag through the protruding tube. The sample air never touches the wetted surfaces of the pump. Eurofins Air Toxics does not provide lung samplers, but they can be rented from equipment suppliers or purchased by manufacturers such as SKC Inc.

#### 4.2.1 Considerations for Bag Sampling

Some considerations for collecting a bag sample:

- **Fill the bag no more than 2/3 full:** Allow for possible expansion due to an increase in temperature or decrease in atmospheric pressure (e.g., the cargo hold of a plane)
- **Keep the Tedlar® bag out of sunlight:** Tedlar® film is transparent to ultraviolet light (although opaque versions are available) and the sample should be kept out of sunlight to avoid any photochemical reactions
- **Protect the bag:** Store and ship the bag samples in a protective box at room temperature. An ice chest may be used, but DO NOT CHILL
- **Fill out the bag label:** It is much easier to write the sample information on the label before the bag is inflated. Make sure to use a ball-point pen, never a Sharpee or other marker which can emit VOCs.
- **Provide a “back-up” bag:** Consider filling two bags per location in the rare occasion that a defective bag deflates before analysis. The “hold” sample does not need to be documented on the Chain-of-Custody and should have an identical sample ID to the original sample indicating that it is the “hold” sample
- **Avoid Contamination:** Care should be taken to avoid contamination introduced by the pump or tubing. Begin sampling at locations with the lowest compound concentrations (e.g., sample the SVE effluent before the influent). Decontaminate the pump between uses by purging with certified air for an extended period; better yet, use a lung sampler. Use the shortest length possible of Teflon® tubing or other inert tubing. DO NOT REUSE TUBING. If long lengths of tubing are used, consider purging the tubing with several

volumes worth before sampling. If you are concerned about sampling for trace compounds, you shouldn't be using a Tedlar® bag (see Section 1.2)

- **Don't Sample Dangerous Compounds in a Bag:** Do not ship any explosive substances, radiological or biological agents, corrosives or extremely hazardous materials to Eurofins Air Toxics. Bag rupture during transit to the laboratory is possible and the sampler assumes full liability.

#### 4.2.2 Step-by-Step Procedures for Bag Sampling (Pump)

Note: These procedures are for a typical stationary source (e.g., SVE system) sampling application; actual field conditions and procedures may vary.

##### Before you get to the field:

1. Verify contents of the shipped package (e.g., chain-of-custody, bag, and tubing/fittings – if requested).
2. Verify pump cleanliness and operation (Eurofins Air Toxics does not provide pumps).

##### When ready to sample:

3. Purge sample port.
4. Attach new Teflon® tubing from sample port or probe to low flow rate pump.
5. Purge tubing.
6. Fill out bag sample tag.
7. Attach additional new Teflon® tubing from the pump outlet to the bag valve.
8. Open bag valve.
9. Collect sample (FILL NO MORE THAN 2/3 FULL).
10. Close bag valve by hand tightening valve clockwise.
11. Return filled bags in a rigid shipping container (DO NOT CHILL).
12. Fill out chain-of-custody and relinquish samples properly.
13. Place chain-of-custody in box and retain pink copy.

14. Tape box shut and affix custody seal (if applicable) across flap.
15. Ship first overnight or priority overnight to meet method holding times.



Expedite delivery of air sampling bags to the laboratory for analysis.

## Section 5.0 Special Sampling Considerations

*This section provides recommendations for the collection of field QC samples such as field duplicates. Considerations for sampling at altitude, sampling SVE ports and using sample cylinders are presented.*

### 5.1 Field QC

To measure accuracy and precision of the field activities, project plans often include field duplicates, field blanks, ambient blanks, trip blanks and/or equipment blanks.

#### 5.1.1 Field Duplicate

A field duplicate is a second sample collected in the field simultaneously with the primary sample at one sampling location. The results of the duplicate sample may be compared (e.g., calculate relative percent difference) with the primary sample to provide information on consistency and reproducibility of field sampling procedures. Due to the nature of the gas phase, duplicate samples should be collected from a common inlet. The configuration for collecting a field duplicate includes stainless steel or Teflon® tubing connected to a Swagelok “T”. If integrated samples are being collected and the sample duration is to be maintained, the sample train should be assembled as follows: each canister should have a flow controller attached, then the duplicate sampling T should be attached to the flow controllers. If the collection flow rate from the sample port is to be maintained then the

duplicate sampling T should be connected to the canisters; then the flow controller is connected to the inlet of the sampling T.

Alternatively, if the project objective is to assess spatial or temporal variability, then field duplicates may be deployed in close proximity (ambient air sampling) or samples may be collected in succession (soil vapor).

#### 5.1.2 Field Blank

A field blank is a sample collected in the field from a certified air source. Analysis of the field blank can provide information on the decontamination procedures used in the field. Clean stainless steel or Teflon® tubing and a certified regulator should be used. It is imperative that individually certified canisters (the sample canister and the source canister/cylinder, if applicable) be used to collect a field blank.

#### 5.1.3 Ambient Blank

An ambient blank is an ambient air sample collected in the field. It is usually used in conjunction with soil gas or stationary source (e.g., SVE system) sampling. Analysis of the ambient blank can provide information on the ambient levels of site contaminants. It is recommended that an individually certified canister be used to collect an ambient blank.

#### 5.1.4 Trip Blank

When sampling for contaminants in water, the laboratory prepares a trip blank by filling a VOA vial with clean, de-ionized water. The trip blank is sent to the field in a cooler with new sample vials. After sampling, the filled sample vials are placed back in the cooler next to the trip blank and returned to the laboratory. Analysis of the trip blank provides information on decontamination and sample handling procedures in the field as well as the cleanliness of the cooler and packaging.

When sampling for compounds in air, a trip blank provides little, if any, of the information above. A trip blank canister can be individually certified, evacuated, and sent to the field in a box with the sample canisters. Since the valve is closed and the brass cap tightened, it is questionable if the trip blank canister contents are ever “exposed” to sampling conditions. The trip blank VOC concentrations essentially provide information regarding the cleanliness and performance of the trip blank canister. Results cannot necessarily be applied to the associated field sample canisters accompanying the trip blank. **Eurofins Air Toxics does not recommend collecting a trip blank for air sampling.**

## 5.2 Considerations for Sampling at Altitude

Sampling at altitudes significantly above sea level is similar to sampling a stationary source under vacuum in that target fill volumes may be difficult to achieve. The figure to the right illustrates the relationship between increasing altitude and decreasing atmospheric pressure. Ambient conditions in Denver at 5,000 ft altitude are quite different from ambient conditions at sea level. Canister sampling is driven by the differential pressure between ambient conditions and the vacuum in the canister.

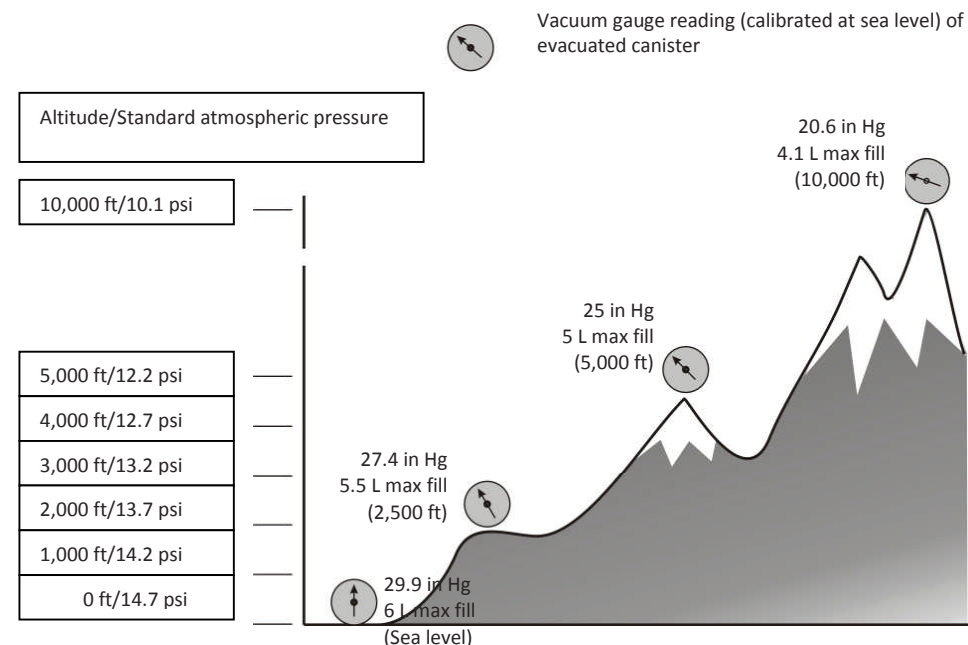
There is less atmospheric pressure in Denver and 5 L is the maximum fill volume of standard air assuming the canister is allowed to reach ambient conditions (i.e., final gauge reading of 0 in Hg). Theoretically, if you sample high enough (e.g., in space), no sample would enter the canister because there is no pressure difference between the evacuated canister and ambient conditions. To fill a canister to 6 L in Denver, you would need to use an air pump.

Sampling at altitude also affects gauge readings. The gauges supplied by Eurofins Air Toxics, Inc. (see Section 2.2.4) measure canister vacuum relative to atmospheric pressure and are calibrated at approximately sea level. Before sampling at altitude, the gauges should be equilibrated (see Section 3.1). But even after equilibrating the gauge, verifying the initial vacuum of a canister at altitude is misleading. In Denver at 5,000 ft, expect the gauge to read 25, not 29.9 in Hg. You do not have a bad canister (i.e., leaking or not evacuated properly). The canister is ready for sampling and the gauge is working properly.



**Rule of Thumb:** For every 1,000 ft of elevation, the gauge will be off by 1 in Hg and the fill volume will be reduced by 1/5 L.

If you have questions about sampling at altitude, please call your Project Manager at 800-985-5955.



## 5.3 Considerations for SVE/LFG Collection System Sampling

There are some additional sampling considerations for collecting grab samples (canister or bag) from a Soil Vapor Extraction (SVE) system or landfill gas (LFG) collection system. The general challenge with these samples arises from the need to employ a length of tubing to direct the landfill gas or process air to the canister or bag. Tubing introduces the potential for contamination and diluting the sample.

- **Use inert tubing.** Teflon® tubing is recommended. Tubing with an outer diameter of ¼” works best with the fittings on the particulate filter. (See Section 3.3.1).
- **Do not reuse tubing.**
- **Purge tubing adequately.** A long length of tubing has significant volume of “dead air” inside. Without purging, this air will enter the canister and dilute the sample. Consider using a handheld PID/FID to confirm that you have purged the tubing and are drawing sample air through the tubing.
- **Avoid leaks in the sampling train.** Leaks of ambient air through fittings between pieces of the sampling train (e.g., tubing to particulate filter) will dilute the sample.
- Always use compression fittings for all connections; never use tube in tube connections.
- **Purge the sample port.** A sample port on an SVE system or LFG collection system can accumulate solids or liquids depending upon the location of the port in the process and the orientation of the port. An influent sample port located upstream of a filter or moisture knock-out can be laden with particulates or saturated with water vapor. Heavy particulate matter can clog the particulate filter and foul the canister valve. It is important to prevent liquids from entering the canister. A sample port oriented downward may have liquid standing in the valve. Purge the sample port adequately before connecting the sampling train.
- **Consider the effects of sampling a process under vacuum or pressure.** When collecting a grab sample from a stationary source such as an SVE system or LFG collection system, some sample ports may be under vacuum or pressure relative to ambient conditions. When the sample port is under vacuum, such as the header pipe from the extraction well network, it may be difficult to fill the canister with the desired volume of sample. A vacuum pump may be used to collect a canister grab sample from a sample port under considerable vacuum. See the related discussion on sampling at altitude in Section 5.2. When the sample port is under pressure, such as the effluent stack downstream of the blower and treatment system, you may inadvertently pressurize the canister. Only a DOT-approved sample cylinder should be used to transport pressurized air samples (see Section 5.4). Under no circumstances should a Summa canister be pressurized more than 15 psig. Bleed off excess pressure by opening the valve temporarily while monitoring the canister with a pressure gauge.

## 5.4 Considerations for Sample Cylinder Sampling

Sample cylinders, also known as “sample bombs”, are DOT-approved, high pressure, thick-walled, stainless steel cylinders with a valve at each end. They were intended for collecting a pressurized sample for petroleum gas applications. Sample cylinders differ from sample canisters in that they do not have a Summa-passivated interior surface and are not evacuated prior to shipment. Sample cylinders are not suitable for analysis of hydrocarbons at ppbv levels. Sample cylinders can be used for analysis of natural gas by ASTM D-1945 and calculation of BTU by ASTM D-3588. Eurofins Air Toxics assumes that clients requesting a sample cylinder have a pressurized process and sample port with a built-in gauge and 1/4” Swagelok fitting to attach to the sample cylinder. Eurofins Air Toxics has a limited inventory of 500 mL sample cylinders that are particularly suited for landfill gas collection systems (i.e., LFG to energy applications). This section provides step-by-step procedures for sampling with a sample cylinder.



Inform the lab during project set up if hazardous samples (e.g. high Hydrogen Sulfide concentrations) will be collected to verify the lab can safely handle the samples.

### Step-by-Step Procedures for Sample Cylinder Sampling

These procedures are for a typical stationary source sampling application and actual field conditions; procedures may vary. Follow all precautions in the site Health and Safety Plan when dealing with a pressurized sample port and sample cylinder. Follow required DOT guidelines for packaging and shipping.

1. Verify contents of the shipped package (e.g., chain-of-custody, sample cylinder, particulate filter).
2. Verify that gauge on sample port is working properly.
3. Purge sample port.

4. Remove brass caps on either end of cylinder.
5. Attach particulate filter to upstream valve.
6. Attach filter/cylinder assembly directly to the sample port.
7. Open both valves 1/2 turn.
8. Allow sample air to flow through sample cylinder (approximately 10 L for a 500 mL cylinder).
9. Close downstream valve of sample cylinder by hand tightening knob clockwise.
10. Allow sample cylinder to pressurize to process pressure (max 100 psig).
11. Close upstream valve of sample cylinder and sample port.
12. Detach filter/cylinder assembly from sample port and remove particulate filter.
13. Replace brass caps.
14. Fill out sample cylinder sample tag.
15. Fill out chain-of-custody and relinquish samples properly.
16. Include the chain-of-custody with the samples and retain pink copy.
17. Pack, label, and ship according to DOT regulations.



Follow DOT regulations for packaging and shipping hazardous samples.



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## Chapter 3. Common Sampling Procedures

### 3.1. Purpose

This chapter presents specific sampling procedures and items common to the sampling events covered in Chapters 4 – 12. Section 1.5 and Figure 1-1 of this handbook illustrate the relationships among these chapters. Additional references include facility standard operating procedures (SOPs) and special requirements contained in regulatory programs and site permits.

### 3.2. Preparations for Field Sampling

The success of a field sampling program depends on the level of preparation prior to entering the field. Implementation of the SAP begins with preparing for the field sampling operation. The following preliminary steps are vital to the success of the project:

- **Preliminary Off-Site Evaluation.** Prior to implementing the SAP, the Program Manager and Health and Safety Supervisor should review any Historical Overview and Site Description sections of the SAP. This review may result in the decision for an on-site evaluation to assess the sampling procedures, relevant safety equipment, and PPE.
- **Equipment Verification.** The SAP should specify an equipment list, including sampling equipment, sample containers, and PPE. This list should be reviewed in detail by the entire sampling team and the Health and Safety Supervisor to verify that necessary items are included and appropriate for the site being sampled.
- **Inventory.** The Equipment Technician (however named) shall gather all the specified equipment and containers into one place and verify that it is on hand. Reagents, supplies, and quality control materials shall be checked and verified as appropriate. The designated technician shall notify the Program Manager that equipment preparations are complete.
- **Sign-Over of Materials.** The designated individual shall check the equipment inventory, and sign for custody if required.
- **Staffing and Scheduling.** The Program Manager shall consider the impact of specified sampling requirements on staff and schedule.
- **Screening or Field Measurements.** Sample screening or field testing for pH, dissolved oxygen (DO), sulfite, conductivity, disinfection chemicals, and temperature require additional field time. The need for additional personnel is based on time demands, training requirements and degree of difficulty. Significant field testing requirements may justify the procurement of a field laboratory and a trained field chemist to relieve other team members of this responsibility.
- **Preservation.** Preservation, either chemical or thermal, is required for most water samples. Thermal preservation usually requires icing the samples after collection and storing samples at  $\leq 6^{\circ}$  Celsius (C). For chemical preservation, two practices exist for adding preservative: 1) addition of the chemicals to the samples in the field, and 2) addition of the chemicals to the sampling containers prior to sending the containers to the field. Adding the reagents to the sample containers at the time the samples are collected requires the sampler to maintain records of addition and quality of the reagents and to follow proper chemical handling techniques. In some cases it may be advisable to have the laboratory add the reagents to specially labeled sample containers before they are sent to the field. This may reduce the fieldwork required and the possibility of field error resulting from contaminating the preservatives. Addition of the correct amount of preservative can be estimated for samples collected on a routine basis having little to no outside environmental or process effects.

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**WARNING:** When using containers filled with preservative, use caution when filling the bottles to ensure the preservative is not released to the environment and the correct amount of preservative has been added to adequately fix the sample.

- **Time.** Many samples have short holding times prior to analysis. Review the holding time requirements and coordinate the schedule with the laboratory so the samples are analyzed within the required holding times. Holding times are dictated by the regulatory program and data may be invalidated if holding times are not met.

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**Note:** Refer to Appendix B of this handbook for specific information on hold times, preservation, and containers.

### 3.2.1. Preparing for a Sampling Event

Preparing for a sampling event requires planning and a thorough knowledge of the regulatory program. The key elements for such preparation include:

- **Objectives.** The objectives should be thoroughly understood by all sampling personnel prior to sample collection. Knowledge of the compliance scope, boundaries, geography, and area roads and bridges will facilitate sampling.
- **Map of Study Area.** A map of the study area is essential for sampling. The map should be detailed enough so that sample locations and landmarks are clearly identifiable.
- **Permits and Regulations.** The person collecting samples should have a working knowledge of applicable permits, required monitoring, and other specified conditions. Regulations that potentially impact the sampling area, such as right of entry, should be reviewed by the sample collector.
- **Waste Sources.** When the objective of a project is to determine the nature, extent, or impact of a waste source upon an environmental medium, knowledge of waste source(s) within the area, as well as those sources upstream or upgradient that may impact the area, is essential. This knowledge entails knowing waste source discharge points or areas, type of waste, volume of discharge,

and constituent concentration. When this information is not readily available, it may be necessary to collect background information.

- **Environmental Medium Characteristics.** If the study is of a waterway, the physical characteristics of the waterway should be known prior to sample collection. These important physical characteristics include whether the receiving waterway resembles a lake, reservoir, pond, small stream, or a river. Average and maximum recorded flow, width and depth, type of benthic substrate, and type of predominant aquatic vegetation also should be noted.
- If the study area is limited to land, it is important to have knowledge of the terrain, soils classification, geology, terrestrial vegetation, industrial and residential development, predominant land use, and wildlife.
- **Sampling Information.** A sampler must know the types of samples to be collected, (e.g., water, wastewater, soil, or solid waste). The sampler also must know whether the samples are to be collected nocturnally or during the daytime, and where within the environmental medium the samples are to be collected (including both horizontal and vertical collections) as well as the preferred method of collection.
- **Laboratory Arrangements.** Arrangements must be made with the analytical laboratory to ensure that the laboratory is expecting the samples when they arrive and has a description of the types of samples (e.g., liquid, semi-solid, solid, or biological), an approximation of the number of samples for each sample type, and the analyses requested on each sample type. Arrangements must be made for the appropriate number of sample containers and preservatives where required. Regulations on transportation of samples from the point of collection to the laboratory must be considered, and the COC record must be traceable, as detailed in the SAP.

- **Equipment.** Prior to going to the sampling location, the sampling gear should be examined to ensure that it is appropriate for the task and in good working order. Verify that any preventative maintenance has been completed according to the SOPs. Label, mark, and otherwise identify all equipment, instruments, reference materials, and associated supplies for measurement processes to indicate calibration or standardization status. Expiration dates of reagents and solutions should be checked and verified as to usability. If a boat is required, an appropriate boat, motor, and life jackets must be available, and preliminary boat launch locations should be known before going to the sampling site. All equipment should be examined prior to starting the sampling event.

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**Note:** When in use, sampling equipment should be anchored to prevent loss in the event the rope or equipment slips through the hands of the sample collector.

- **Safety.** The safety of sampling personnel is paramount. During wading operations, a rope should be attached to the sampler and extended to an anchored person on shore. In boating operations, at least two people should be present, one to collect the samples and another to operate the boat motor. Boat personnel are required to wear life preservers and take care to avoid overloading the craft. When collecting samples, beware of snakes, stinging insects, ticks, or other animals that may cause injury to the sample collectors.
- **Personnel Transportation and Lodging.** The Program Manager must consider arrangements for transporting sampling personnel and equipment to the sampling site, and for lodging when the sampling extends beyond a working day.

### 3.2.2. Preliminary On-Site Evaluation

When sampling for the first time at a new location, a preliminary on-site evaluation should be conducted prior to the sampling event to ensure that all aspects of the sampling process are addressed.

Upon arrival at the site, the Program Manager (or designee) and the Health and Safety Supervisor shall check with facility personnel to determine whether there have been any recent changes at the sampling locations that would influence the SAP or modify the expected hazards.

### 3.2.3. Preliminary Site Safety Evaluation

After a preliminary hazard analysis, sampling locations should be inspected to develop the Safety Plan or HASP as appropriate to the scope of the project. PPE information specified may not be completely reliable, and additional air monitoring may be required. When air monitoring activities are needed, focus first on identifying conditions that present an acute health hazard, and then evaluate exposure to chemicals such as carcinogens that could create long-term health problems.

If samples are to be collected in a confined spot, testing the air within the space for oxygen content should be a priority. Tests for explosive levels of flammable vapors should be conducted next, followed by testing for the presence of hazardous concentrations of specific toxic agents (depending upon the nature of the space and its contents or previous contents).

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**Note:** Real-time instrumentation is available for making these measurements. Air samples should be collected to evaluate the levels of other chemicals in the air that may require respiratory protection. Some organic chemicals such as gasoline vapors can be monitored with standard field instruments. However, monitoring for carcinogens will normally require the use of a field gas chromatograph or the collection of test samples for laboratory analysis.

In general, the air monitoring program to evaluate worker exposures to toxic chemicals should be designed by an industrial hygienist familiar with the facility and potential hazards to which the field sampling team will be exposed.

Review physical hazards that may be present at the site, such as unstable footing near river embankments, water safety practices, first aid supplies, equipment safety practices, and other physical hazards.

### 3.2.4. Explosive Safety Evaluation

The possibility of encountering explosive hazards must be considered in all sampling plans. When the presence of energetic materials is suspected from the history of a site, appropriate precautions can be incorporated during the planning stages.

Consideration should also be given to situations that can lead to the formation of unstable materials from constituents that are not originally energetic compounds. Formation of peroxides in ethers and metal picrates are two examples that have been known to create safety hazards.

### 3.2.5. Preliminary Sampling Evaluation

Sampling locations should be inspected to ensure the information in the SAP is correct. All equipment should be checked prior to mobilization and the day before the sampling event to ensure proper equipment operation, parts, and records are available for the sampling operation. If needed, preventative maintenance should be performed.

Reagents, supplies, reference materials, and consumable materials should be verified as to expiration dates, quality, and applicability to the assigned equipment.

Locate all the sample locations during the on-site evaluation to determine site accessibility with the designated equipment, sample location, and possible background contamination for the contaminants of interest. Electromagnetic interferences, volatile air pollutants from locations off site, weather, and climate may affect the sampling event and should be planned for, as much as practical, to avoid delays in sampling.

### 3.3. The Sampling Event

A typical sampling event should include the following sequential activities:

- Complete all preparation and preliminary evaluation activities as needed
- Arrive at the sampling site with appropriate equipment, supplies, materials, and sample containers
- Set up equipment, work areas, and safety areas, as described in the SAP

- Collect samples at the locations specified in the SAP or reference procedure
- Immediately following sample collection, ensure that each sample container is labeled as described in the SAP. The sample label must be traceable to the sample number, date/time sampled, sampler's name, preservative, and site name, location or unique project identifier.
- Document the exact location of the collected sample(s) in the field logbook or field notebook (FLB/FN). Also, record in the FLB/FN other observations of environmental conditions that could affect or contribute to knowledge of the sampling area and the environment where the sample is collected. Prevailing weather conditions at the time of sampling should also be recorded.
- Preserve or ice samples as appropriate and record preservation method
- Perform field tests or field screening measurements and record all observations in the FLB/FN
- Complete the COC record and other field records
- Pack and seal the shipping container with collected samples, and transport the shipping container with the COC record and any laboratory required forms to the laboratory. Retain copies of all transmitted forms.
- Return all forms and copies of relevant FLB/FN pages to the Program Manager or designee
- Clean sampling equipment for the next sampling event or storage
- Breakdown all work area and safety areas as required and return the site to the condition found at the start of the sampling event
- Dispose of all waste materials using appropriate procedures.

### 3.4. Sampling Procedures

The SAP refers to detailed sampling procedures or includes the details of the sampling operation. A standard SOP format should be used to incor-

porate the following items for each type of sampling operation:

- Sampling locations, sample numbers or identifiers
- Type, volume, and number of sample containers to be filled at each sampling location and the records to be maintained
- Contaminants to be measured and special handling procedures to ensure proper collection
- Safety, health, and hazard cautions
- Sampling equipment (construction material, type, etc.) and records to be maintained for status, maintenance, and corrective action
- Step-by-step sample collection procedures (grab, composite, continuous for specified period, etc.)
- Sampling frequency for repeated sampling at the same sample location
- Special sampling requirements (e.g., the collection of initial runoff samples after a rain for contamination)
- Sample handling procedures for each sample container (e.g., screened, filtered, sequence for filling groundwater sample containers, etc.)
- Preservatives required for each sample container and contaminant
- Reagents, supplies and support services quality, verification and validation criteria to ensure materials are used properly
- Equipment decontamination procedures to be used between sample locations and between sampling events
- Recordkeeping requirements, documentation handling, and retention requirements
- Sample, equipment, and materials storage requirements
- Provisions for storage or disposal of wastes generated during field sampling.

#### 3.4.1. Sampling Strategies

See Appendix A for sampler and sampling recommendations and strategies for waste materials. Sampling strategies for drinking water, wastewater,

groundwater and TSCA materials are permit or compliance dependent. The Scope or Purpose section of the sampling procedures should describe the rationale for the sampling strategy to ensure that all personnel involved with the project have an understanding of the sampling event.

#### 3.4.2. Sampling Procedure Checklist

Following is a checklist of the minimum steps to address in SOP format.

- **Sampling Approach**
  - Objective
  - Design of sampling plan
  - Statistics
- **Material to be Sampled**
  - Physical state
  - Volume
  - Hazardous properties
  - Composition
- **Site**
  - Accessibility
  - Waste generation and handling
  - Transitory events, startup, shutdown
  - Maintenance
  - Climate
  - Hazards
- **Equipment**
  - Maintenance
  - Preparation and cleaning
  - Operation
  - Calibration and standardization
- **Sample Handling, Transportation, Storage and Preservation**
  - COC
  - Seals
  - Forms
  - Containers
  - Preservatives, reagents, and supplies
- **QA/QC**
  - Controls on process
  - Audits
  - Training
  - Samples, blanks, duplicates, and spikes
- **Health and Safety**
  - Personnel protection

- Safety procedures
- Emergency procedures
- **Laboratory**
  - Document transfer
  - Sample arrival schedule, transfer
  - Sample preservation, handling and storage
  - Analytical methods and QC
  - Reporting format and schedule.

### 3.5. Sample Documentation and COC Procedures

Thorough documentation of a sample's custody is required to support sample validity. The documentation must verify that the samples are representative, were collected in accordance with the requirements of the SAP, and are not vulnerable to tampering before being received by the laboratory. The COC begins when the sample is taken and ends when the sample is disposed of. Sample documentation and COC procedures include the following.

- A completed sample collection label attached to all sample containers
- Records of sampling operations written in FLB/FN or related forms as designated for the operation in the SAP. Records include sample type, sample matrix, sampling method, field test methods, and QC procedures. A table may be used to present this information.
- Identification of every sample container on a COC record and all custody transfers documented
- Custody of the samples with all discrepancies in the field operations resolved or duly recorded.

The following should be used to generate the required sample documentation.

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**Note:** EPA's "Field Operations and Records Management System II Lite (FORMS II Lite™)" software is an electronic COC and may also be used to simplify and accelerate the sample documentation process.

#### 3.5.1. Pre-Assigned Sample Numbers

Each sample consists of all of the material collected for analysis at one place, at one time, and of one

matrix, except for composite samples, which may contain components collected at different locations or time.

The Program Manager shall establish a system for assigning a unique sample number to each sample collected in the field. The numbering system will be defined in the SAP, in case additional samples are generated in the field. The number for each sample will be used to identify the sample in the FLB/FN, on the sample container, and on the COC record. The number may be used on other forms and reports presenting measurements, test data, or evaluations.

The sample numbers of field QC samples like a field duplicate should be transparent to the laboratory. The sample numbers should not reveal whether a sample is a blank sample or two field samples are duplicate/split pairs to avoid potential biasing of analytical results.

The sample number provides a common identifying code for all of the analytical results for a single sample. This is particularly useful when the results are entered into a computer database, which should include:

- Sample number
- Sample container number
- COC record number
- Matrix
- Location
- Sample type
- Sample date and time
- Sampler's name
- Parameter
- Analytical result
- QC data
- Compliance limit and
- Data qualifier code (optional).

Results from analysis of trip blanks, field blanks, equipment decontamination blanks, split samples and MS/matrix spike duplicate (MSD) samples may be entered into a computer database. In some testing programs, these results are used to

generate the data qualifier code for the analytical results from test and duplicate samples.

It is recommended that the information associated with each sample number consists of elements describing the sample type, matrix, location, and the time and date of sample collection as required.

---

**Note:** If the sampling and analytical data are to be added to an existing database, sample numbers should be consistent with database requirements.

### 3.5.2. Sample Container Labeling

Sample labels are an important part of proper documentation to reduce the possibility of confusing sample containers, and to provide the necessary handling information. Sample containers should be pre-labeled as much as practical before sample collection. The labels may be protected from the sample matrix with a clear tape covering. For volatile samples, check with the laboratory to ensure that any labels being used do not interfere with their auto-samplers. Sample labels should include sample number, date and time sampled, location, sample type, preservative and the sampler's initials or signature.

Sample numbers may be unique to the sample location, to the sample type or to the container. In some labeling processes, a unique sample number is written on the container label, and all information recorded on the accompanying form(s) is traceable to the unique sample number.

Some number schemes uniquely number each sample container. All data reported for the sample includes the sample container number for traceability to the container measured. This is useful when sample containers are cleaned and lot controlled, and traceability from container preparation, preservation, sampling, and testing is required.

A designated Field Sample Custodian or sampler should label the sample containers when they are filled. Preprinted, adhesive, multiple part labels formatted as shown in Figure 3-1 may be used. Each part includes the unique sample container number that may be pre-numbered to avoid duplication.

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**Note:** Because 40-mL volatile organic analysis (VOA) vials may be stuck in an autosampler, the field sampling team leader needs to contact the laboratory to make sure if applying a clear tape over a sample label of 40-mL VOA vials is acceptable. Use waterproof ink to make label entries. FLB/FN notations should provide an explanation if a pencil was used to fill out the sample container label due to field weather conditions. Because waterproof ink may contain target VOAs such as xylene, toluene, or alcohols as a solvent, great care is needed to prevent VOA samples from contamination by the solvent of waterproof ink or permanent marker.

**Figure 3-1. Multiple Part Container Label**

<b>PROJECT NAME</b>	
Sample #: XXXXX	
Container #: XXXXX	
Sample #: _____	
Date: _____	Time: _____
Location: _____	
Cont. Size: _____	
Cont. Type: _____	
Matrix: _____	
Type of Sample: _____	
Preservative: _____	
Signature: _____	

### 3.5.3. FLB/FN

The FLB/FN is the written record of all field data, observations, field equipment calibrations, and sample collection activities. Potential for future legal actions dictates that the FLB/FN be site-specific and that they be hardbound (e.g., ledger, composition book, diary, etc.). All pages (front and back) shall be serially numbered so removal will be apparent. Samplers shall adhere to the following guidelines when using FLB/FN.

- The FLB/FN shall be assigned to the QA/QC Coordinator or designee. Additional log books may be assigned by the Program Manager or designee to the Field Chemist and the Health and Safety Supervisor. The QA/QC Coordinator or designee shall note in each FLB the individual to whom it was assigned. The FLBs may be controlled by the QA/QC Coordinator or the Program Manager.

- Each FLB shall be annotated with the sampling program name or number.
- Key personnel and telephone numbers shall be listed on the first page.
- Entries shall be written in waterproof blue or black ballpoint pen. Avoid felt tip pens. *Do not use pencil.*
- Start a new page at the beginning of each day.
- Entries should be chronological – a time notation should introduce each entry.
- Sketch or obtain a map of the area or facility. Include sketches of layout, structural features, and points of interest or contamination. Include a north arrow and a rough scale. If possible, obtain a site map (reduced if necessary) and permanently place it in the FLB/FN.
- Language should be objective, factual, and free of personal feelings or other inappropriate terminology. Speculation or personal observations may be included if they are clearly identified as such.
- Do not erase or scratch out errors. Draw a single line through the error, then insert corrected material. The person who made the error shall initial and date the correction as well as clearly state the reason for the error.
- Entries or corrections made by individuals other than the person to whom the FLB/FN was assigned shall be signed and dated by the individual making the entry or correction. An explanation for the correction should be noted.
- The last entry for each day should include a short summary of the day's activities, weather conditions and the time the site was left. As appropriate, the last entry for each week should be a summary of the week's activities. Weekly summaries should be thorough and descriptive.
- The FLB/FN shall be signed at the end of each day. Signatures shall be written on a single diagonal line drawn across the blank portion of the page following the day's last entry.
- All FLBs/FNs shall be returned to the individual designated for review and final storage when sampling is completed as described in the SAP.
- FLB/FN entries will contain a variety of information. Information to be entered at the start of each day of sampling includes the following:
  - Date of the sampling event
  - Time sampling started and approximate time for set up of equipment
  - Weather conditions
  - Level of PPE being used
  - Names of field sampling team members and others present during the sampling.
- Fully document all deviations from the SAP or changes in sampling procedures. Problems, delays, or any unusual occurrences such as improper equipment or breakdowns should be included, along with resolutions and recommendations. Summarize the content and conclusions of all relevant meetings, discussions, and telephone conversations in which you are involved. Include the names and affiliations of all personnel involved. Thoroughly document all directives and/or guidance from EPA or other government personnel. Directives that give personnel specific authority to make critical decisions must be documented in the FLB/FN.
- Whenever a sample is collected or a measurement is made, a detailed description of the location must be recorded. The source from which the sample is collected should be clearly identified to maintain traceability and allow another person to locate the exact sampling location. The ability to relocate the sample site ensures duplication of future sampling events. Measurements from permanent features (e.g., center line of road, numbered utility pole, etc.) to the sample point must be made and entered into the FLB/FN. Coordinates on a map, or an accurate site sketch with distance measurements to known locations are other options to ensure the exact location of each sample is recorded.



- Describe the site thoroughly so another person will be able to locate the exact sample location. Note signs of contamination such as oily discharges, discolored surfaces, unusual odors, dead or distressed vegetation including types of plants, if possible. Photographs may be taken to provide evidence of visual observations, record site conditions, and assist with locating the sample site in the future. Photographs taken of sample locations should be noted along with the picture number. Log the record in the FLB/FN to identify which sampling site is depicted in the photograph.

---

**Note:** A series of photographs can be identified by taking the first photograph of an informational sign with the sampling program name, number, and the project number on it.

- Each time a sample container is filled and labeled, a copy from the multiple part form of the sample container label or reference number label with all information recorded shall be put into the FLB/FN.
- All equipment used to make measurements must be identified by type, manufacturer, and serial number, along with the date of calibration. Details of field calibration procedures and results shall also be included in the FLB/FN.
- Note decontamination or disposal procedures for all equipment, samples, protective clothing, and personnel decontamination procedures.
- For each delivery or shipment of samples to a laboratory, record the following information in the FLB/FN:
  - Custody procedures and serial numbers
  - Packing and shipping procedures (record air bill numbers)
  - Name, address, telephone number, and contact of the laboratory performing the analysis.

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**Note:** The laboratory address should be the sample receipt address, which may not be the same as the mail receipt address.

### 3.5.4. Field Notes/Field Sampling Forms

Field notes or field sampling forms are used in addition to or in lieu of field log notes. When field notes are used in lieu of an FLB, the record keeping practices presented in Section 3.5.3 should be followed. The field form provides a place for the sampler to record the information required for the project. Field forms are specially designed for any given project and may be completed one per sample or one per sampling event. The forms include blank lines for recording the information necessary for the project to ensure the proper information is recorded. All blanks must be completed on a field form to ensure proper documentation. The sampler completes the field form for all samples collected including QC samples. An example of a field form for a well sampling activity is presented in Figure 3-2 below.

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**Note:** A review of the regulatory program's specific requirements must be conducted to ensure that all documentation requirements are met. Some programs do not allow the use of loose field forms as the sole documentation vehicle and require hardbound logbooks.

The field form lists the sample number, location, matrix, the type and number of sample containers filled (including QC samples), any chemical preservatives added and checked for each sample container, sampling procedure reference, deviations to the procedures and all field measurements and observations.

The Field Sample Custodian indicates acceptance of the information on the field form by signing and dating the form. In cases where multiple part forms are used for the sample label, for each sample container filled, one part of the multiple part adhesive sample container label is placed on the field form at the appropriate location. The completed field forms are returned to the Program Manager as soon as possible and by the means indicated in the SAP. Deviations or problems encountered during the sampling event must be communicated promptly in writing to the Program Manager or designee. This may be completed by sending the field form by facsimile or other means to communicate the deviations, as

well as allow for continuation of the project and ensure sample holding times are not jeopardized.

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**Note:** The field form becomes part of the permanent project records, but is not usually sent to the laboratory.

### 3.5.5. Chain of Custody (COC)

An overriding consideration for environmental measurement data is the ability to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Documentation of security, field handling criteria, shipment, laboratory receipt, and laboratory custody until disposal, provides evidence of proper processing. The degree of custody documentation is dependent on the regulatory program, data use, and needs. Many state programs for sampling wastewater and drinking water do not require “legal custody,” but recommend legal custody whenever data is known to be used for evidence. A review of data use and risk of legal proceedings will dictate the type of custody procedure to be employed. Documentation consists of a COC record that is completed by the Sample Custodian.

#### 3.5.5.1. Field Custody Procedures

The Field Sample Custodian or sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. A sample is considered to be “in custody” for legal proceedings if it is:

- In a person’s actual possession
- In view after being in physical possession
- Locked up so that no one can tamper with it after having been in physical custody
- In a secured area, restricted to authorized personnel only.

If any one of these is not in place at all times, the COC is broken.

The Program Manager or designee shall review all field activities to determine whether proper custody procedures were followed during the fieldwork and whether additional samples are required. The sampler or Sample Custodian shall notify the Program Manager of any breach or irregularity of COC procedures described in the SAP.



### 3.5.5.2. COC Records

From time of collection through final sample disposal, there are many transfers of custody during the course of a sampling program. All sample containers must be accompanied by a COC record to document these transfers. A separate COC record shall be prepared by the Field Sample Custodian or sampler for each sampling event. In some programs, a COC record accompanies each shipping container and includes a pre-numbered COC record. This record lists the sample containers that are in the shipping container, and serves as the packing list for the container. The serial number on the form becomes the identifying number for the shipping package.

Figures 4-3 provides an examples of a sample COC record. The example has been used for a wide variety of regulatory programs and meets legal COC requirements. It tracks the samples from sample collection to disposal. All sampling, preservative, and test information is included. The SAP will indicate the individual responsible for completing each section. The following information relates to the numbered blocks:

#### COC Record—Figure 3-3.

- (1) The **company/command** name and **code** for the source of the funding.
- (2) The **contact name** for the Program Manager or designee indicated in the SAP.
- (3) The **job order number (J.O. #)** is entered to trace the information to the specific job.
- (4) The **signature** of the Program Manager or designee authorizing the funds.
- (5) The **permit number (No.)**, if applicable, for the samples collected. The number is issued by the regulatory agency for specific compliance reporting.
- (6) The **sample ID/location** based on permit designations or actual site location name.
- (7) The **sample taken date and time** are recorded for grabs on the start line only and for


composites on the start date and time and stop date and time.

- (8) The code for **sample type** such as grab, composite flowing and composite time (see Section 18).
- (9) The initials for the **person sampled by**.
- (10) The code for **sample matrix** such as liquid, solid, and gas (see Section 18).
- (11) The code for **preservative** (see Section 18).
- (12) The **# of samples** and **container** type are entered as “4-P” for four plastic containers (See Section 18).
- (13) The **analysis** to be performed - may reference descriptions in the SAP.
- (14) The field reading for **pH** for the sample containers indicated.
- (15) The field reading for **temperature** with the unit of measure for the sample containers indicated. The SAP may indicate the temperature to be recorded in the outfall temperature and not the sample temperature.
- (16) The field reading for **other** required measurements may be entered with the unit of measure. The SOP and name of the test must be indicated on the custody form.
- (17) After the samples are preserved, the **preservation is verified**. The verification is noted per the SAP. This verification may be temperature, pH, or if all is correct an indication is made as “OK.”
- (18) This section of the custody form contains **common codes** to be used by the sampler when completing the custody record. When situations arise that do not match the code designations, alternates may be added for the one time use on the custody form.
- (19) The expected **turnaround** for sample request is placed in this area. The reason is presented to determine if the turnaround time is regulatory, project specific, or based on holding time requirements.

- (20) **Special instructions** or comments may be entered in this space.
- (21) The **regulation applied** to the project is checked.
- (22) The **sample collection/charge, possible sample hazard** and other **comments** relate to the command in charge of sampling, special sample hazards, or to other sample comments. Reference may be made to code or specific sections of the SAP.
- (23) The **delivery order number** is entered.
- (24) The **contract lab** and **contract number (No.)** are entered for testing work performed by a designated contract laboratory.
- (25) The **sample disposal** method and the date completed.
- (26) The signature and **company/command** of the person relinquishing custody (**relinquished by**).
- (27) The signature of the person custody is **received (rec'd) by**.
- (28) The **date/time** custody is transferred.

Figure 3-3. COC Record

### CHAIN-OF-CUSTODY RECORD & ANALYSIS REQUEST FORM



**PWC ENVIRONMENTAL LABORATORY**  
 CODE 990 BLDG 2:140  
 9142 MARYLAND A VENUE  
 NORFOLK, VA 23511-3095  
 PH: (004)4450951 FAX: (004)4450952

**ENVIRONMENTAL**

#### CLIENT INFORMATION

COMPANY/COMMAND: 1 CODE: \_\_\_\_\_

CONTACT: 2 EXT: \_\_\_\_\_ FAX: \_\_\_\_\_

PHONE: \_\_\_\_\_

J.O. #: 3

SIGNATURE: 4

PERMIT NO.: 5

LAB USE ONLY LINE ITEM #	SAMPLE NO	SAMPLE ID/LOCATION	SAMPLE TAKEN	ON DATE	AT TIME	TYPE	SAMPLED BY	MATRIX	PRESERVATIVE	# OF SAMPLES / CONTAINERS	ANALYSIS	FIELD READINGS		PRESERVATION	
												pH	TEMPERATURE	OTHER	VERIFIED BY
	<u>6</u>		START	<u>7</u>		<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>
			STOP												
			START												
			STOP												
			START												
			STOP												
			START												
			STOP												
			START												
			STOP												
			START												
			STOP												

**TURNAROUND: 19** (FOR RUSH TURNAROUND STATE REASON BELOW)

**SPECIAL INSTRUCTIONS: 20**

**SAMPLE DISPOSAL: 25** ( ) RETURN TO CLIENT ( ) DISPOSAL BY LAB

**REGULATION APPLIED:**

RCRA ( ) HSD ( )

SDWA ( ) TSCA ( )

CWA ( ) PHOTO ( )

CAA ( ) OTHER ( )

**CONTAINER:** A. AMBER (glass) B. BAG C. CARTRIDGE D. CAPTIONED LID E. HEAVY THINSEAL

**MATRIX:** L - LIQUID S - SOLID GS - GEL SS - SEMI SOLID SW - SWIPE P - PLASTIC ST - STAIN T - TISSUE V - VIAL

**TURNAROUND:** 1 - COOL TO 4C 2 - HQ3, pH=2 3 - HQ3A, pH=2 4 - HQ3H, pH=12 5 - HOL, pH=2 6 - DUBS, HQ3203, 4C 7 - FIELD FILTER 8 - NONE

**SAMPLING/COLLECTION CHANGE: 22**

POSSIBLE SAMPLE HAZARDS: \_\_\_\_\_

COMMENTS: \_\_\_\_\_

**D.O. NUMBER: 23**

**CONTRACT LAB: 24**

**CONTRACT NO.(S): \_\_\_\_\_**

RELINQUISHED BY: 26 COMPANY/COMMAND: \_\_\_\_\_ REC'D BY: \_\_\_\_\_ DATE/TIME: 28

RELINQUISHED BY: \_\_\_\_\_ COMPANY/COMMAND: \_\_\_\_\_ REC'D BY: \_\_\_\_\_ DATE/TIME: \_\_\_\_\_

RELINQUISHED BY: \_\_\_\_\_ COMPANY/COMMAND: \_\_\_\_\_ REC'D BY: \_\_\_\_\_ DATE/TIME: \_\_\_\_\_

1. CUSTOMER IS RESPONSIBLE FOR ALL CHARGES NECESSARY FOR THE PROCESSING AND ANALYSIS OF SAMPLE(S).  
 ALL RUSH SAMPLES ARE SUBJECT TO SURCHARGE  
 2. SAMPLES RECEIVED AFTER 3:00PM MON. - THURS. AND 2:00PM ON FRIDAY WILL BE REPROCESSED THE NEXT BUSINESS DAY (7:30 AM - 4:00 PM).

The COC record identifies which pairs of sample containers were collected for the same analysis, and identifies the sample containers that were filled with sample for use as the MS/MSD QC samples. Based on the needs and data use, the COC record may not list any information as to the exact sample location or whether a sample is a field duplicate, field blank, trip blank or an equipment decontamination blank. This information is kept as blind information from the laboratory to ensure objective reporting. When this process is used, records must be maintained that trace the sample collected in the field with the sample as identified to the laboratory. Compliance data for drinking water or wastewater testing do not require blind submissions. The QC sample information is provided to the laboratory to ensure prompt notification when the QC data does not meet the SAP specifications.

Whenever samples are split with a second laboratory or government agency, a separate COC record may be prepared for the second set of samples. The additional set of COC records must be noted. Copies of the original may be sent with the split samples noted, or a separate form may be prepared by copying the appropriate information for the samples onto the additional form. In all cases, the use and need of the additional form should be noted.

Upon completion of the packing of each shipping container, the Field Sample Custodian shall confirm the completeness of the COC record by signing the COC record. If a multiple-part form is used:

- The original copy is put into the shipping container
- The first copy is sent immediately (preferably by fax) to the Program Manager or designee
- The second copy is kept with the FLB/FN or copy of the field form.

If a single part form is used, photo copies should be made for the Program Manager and the FLB.

After the COC record is completed and all samples are packaged and shipped to the appropriate locations, the person relinquishing the samples to

the laboratory or agency shall request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this is noted in the "received by" space.

Field COC terminates upon laboratory receipt of the samples. The laboratory should complete the "received by" sections and if appropriate, the "preservative checks" sections on the COC record and return the original signed record to the Program Manager. If there are any discrepancies between the COC record, the contents of the shipping container, and the SAP or contract requirements provided to the laboratory, the samples in question shall be segregated from normal sample storage, and the laboratory shall immediately notify the Program Manager. In some cases, the laboratory checks the sample submittal and recordkeeping to ensure adherence to the SAP. This added check is often used in drinking water and wastewater testing programs for compliance monitoring. Recordkeeping and information checks should be performed by the laboratory to ensure the samples received meet the requirements of the SAP.

#### **3.5.5.3. Custody Seals (Optional)**

Custody seals are narrow strips of adhesive paper used to indicate whether a shipping container has been opened during shipment. The seals are placed along the edges of the most exterior container in which samples are enclosed. It is not always necessary to place seals on individual sample containers in the shipping container.

Paper custody seals should be signed and applied before the shipping container is shipped to the laboratory. The preferred procedure includes use of a custody seal attached to the front-right and back-left of the container. Custody seals are covered with clear plastic tape. Another way to use custody seals, is to put all sample containers with packing and ice in a large garbage bag and seal the garbage bag with a signed custody seal.

#### **3.5.5.4. Custody Transfer**

Transfer of custody and shipment procedures are as follows.

- Each sample shipping container shall be accompanied by a properly completed COC record. The original of the record shall be included in the container. The Field Sample Custodian shall keep a copy of the completed form as part of permanent documentation and will send a copy of the COC record to the Program Manager.
- When transferring possession of samples, individuals relinquishing and receiving shall sign, date, and note the time of the transfer. This record documents custody transfer from the Field Sample Custodian to another person, to a mobile laboratory, to the permanent laboratory, or to a secure storage area.
- If the sample container is sent by common carrier, a bill of lading shall be used. Bill of lading receipts shall be sent to the Program Manager for permanent retention. If sent by mail, the package shall be registered with return receipt requested. Commercial carriers and the U.S Postal Service are not required to sign off on the COC record as long as it is sealed inside the package with the sample container and the custody seals remain intact (if used).
- Authorizes the payment for the analyses
- Alerts the laboratory to any anticipated hazards associated with the samples and custody procedures to be followed while the samples are in the possession of the laboratory
- Specifies the reporting requirements and content for the final report from the laboratory
- Instructs the laboratory as to the disposition of the samples after the completion of the analyses.

### 3.6. Sample Packaging, Handling, and Transportation

The Field Sample Custodian is responsible for the proper field storage, security, packing, and shipping of the samples from the field to the laboratory or designated holding location. The packaging, labeling, and shipment of samples by common carrier are regulated by the DOT and the International Civil Aviation Organization (ICAO)/International Air Transport Association (IATA), when appropriate. Instructions for classification, labeling, and packaging of hazardous materials are contained in DOT regulations (49 CFR 172 and 173, and subsequent Parts). Overnight couriers generally accept materials shipped under these regulations. However, some couriers have additional restrictions for hazardous shipments. EPA also regulates the shipment of hazardous waste and hazardous material by requiring labeling on certain packages.

The procedure for determining whether a sample is hazardous under DOT regulations is complex, as is the determination of the proper shipping name, packaging requirements, and labeling requirements for DOT hazardous materials. A summary of specific requirements are addressed below. Should questions arise, assistance is available from the DOT (1-202-366-4000) and Federal Aviation Administration (FAA) (1-866-835-5322) hotlines.

Samples obtained at sites are classified for shipping purposes as either environmental (non-hazardous) samples or hazardous samples. If a material is being shipped for testing to determine its hazards, a tentative hazard class assignment

#### 3.5.6. Request for Analysis

The Request for Analysis form is often incorporated into the COC record since the chain must accompany the samples. In more complex sampling programs, an additional form may be used to request testing.

When contracting for laboratory services and prior to submitting the samples, the laboratory should be contacted and the following information presented. The Request for Analysis form can be used as a preliminary contact mechanism to ensure that the scope of work is understood. This form:

- Specifies the analyses, procedures, and QC data to be performed on each sample container and the compliance protocols to be followed
- Specifies the laboratory accreditation/certification required to be maintained during the period of the contract



should be made based on knowledge of the material. Samples requiring special packaging or labeling are those containing chemicals that are listed as hazardous materials in:

- 49 CFR 172.101
- CERCLA RQ Hazardous Substances
- DOT CLASS 9 listed in 49 CFR 172.101 Appendix A, Poison DOT Class 6.1 and Flammable Liquids.

Environmental (non-hazardous) samples are those that are not classified as Hazardous Materials under DOT regulations, are packaged in quantities less than the CERCLA RQ, *and* for which a Hazardous Waste Manifest is not required by EPA. These samples require careful packing, but no special shipping procedures. In general, samples of groundwater, surface water (other than leachate or lagoons), and soil may be shipped as environmental samples (non-hazardous) to an analytical laboratory for testing if each of the sample containers contains less than 1 pound of soil or 1 gallon of water, and the entire shipping package weighs less than 66 pounds. Eventual analysis for a hazardous constituent does not necessarily classify a sample as a DOT hazardous material, nor does the classification of a material as a hazardous waste under EPA regulations. DOT regulations forbid the shipping of non-hazardous materials as hazardous. However, if any doubt exists as to whether the sample might be classified as a hazardous material, the sample should be treated as hazardous.

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**Note:** For details on the shipping of non-hazardous waste, refer to *ASTM D6911-03: Standard Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis*. This standard provides guidance in determining the most appropriate procedures for packaging and shipping environmental samples.

The storage and disposal of hazardous waste is regulated by the EPA. Hazardous waste, as specified in 40 CFR 262, is not exempted from EPA manifesting requirements. However, EPA RCRA regulations exempt samples collected for analysis or treatability testing from the RCRA requirements that otherwise apply to hazardous waste (including the requirement for a Hazardous

Waste Manifest). The definitions for these exemptions are:

- **Samples for Analysis.** 40 CFR 261.4(d): Samples of solid waste, water, soil, or air, which are collected for the sole purpose of testing to determine their characteristics or composition, when samples are being sent to the laboratory for testing or are being returned to the collector after testing.
- **Samples for Treatability Testing.** 40 CFR 261.4(e): Samples collected for the purpose of conducting treatability studies when they are being transported to the testing facility provided they meet criteria for the quantity of material, packaging, and permit status of the receiving facility.

### 3.6.1. Sample Packaging Requirements

The Field Sample Custodian is responsible for the packing and shipping of the samples from the field to the laboratory. Samples shall be properly packaged for shipment and dispatched to the laboratory for analysis with a signed custody record enclosed in the shipping container box or cooler. Shipping containers shall be locked or secured with strapping tape in at least two locations. Shipments that are sent to an on-site laboratory or one in close proximity that does not require the use of a common carrier shall be transferred in accordance with local regulations. Table 3-1 below lists sample packaging procedures that will ensure samples arrive at the laboratory with the COC record intact.

The following major issues must be addressed in preparing environmental samples for shipment to the laboratory by common carrier:

- Compliance with EPA regulations, so the samples are not classified as hazardous waste
- Compliance with transportation regulations, including use of the proper shipping containers, use of warning labels, and completion of the required paper work
- Packing, to assure that the samples do not break or leak during shipping. This includes:

- Using approved containers meeting DOT drop test specification
- Lining coolers or containers with plastic bags
- For glass containers, wrapping each in bubble wrap and placing in a clear plastic resealable food bag
- For plastic containers, placing each in a clear plastic resealable food bag
- Never stacking glass containers or laying glass on its side.

### 3.6.1.1. Samples Classified as Flammable Liquid

Table 3-2 Column 1 lists packaging procedures that apply to those flammable and combustible liquids that do not meet the definitions of another hazard class except DOT Class 9, and for which exceptions under 49 CFR 173.150 are allowed. This includes Flammable Liquids Not Otherwise Specified (NOS), toluene, gasoline, and many of the other flammable liquids that are commonly encountered on hazardous waste sites.

**Note:** The DOT definition of “liquid” is different from that used by EPA. For purposes of transportation, liquid means a material that has a vertical flow of over 2 inches (50 mm) within a 3-minute period, or a material having 1 gram or more liquid separation, when determined in accordance with the procedures specified in *ASTM D4359-90, Standard Test Procedure for Determining whether a Material is a Liquid or Solid*, (49 CFR 171.8).

### 3.6.1.2. Samples Classified as Poison — DOT Class 6

Table 3-2 Column 2 lists packaging procedures that apply to those poisonous liquids and solids for which exceptions under 49 CFR 173.153 are allowed. This includes 1,1,1-trichloroethane,

trichloroethylene, trichlorobenzene, PCB transformer oil, and many of the other poisonous materials commonly encountered.

### 3.6.1.3. CERCLA Reportable Quantities — DOT Class 9

Table 3-2 Column 3 lists packaging procedures for substances (liquids and solids) where the waste material is not otherwise classified as a DOT Hazardous Material because of hazardous properties *and* for which the entry in Column 8a of 49 CFR 172.101 Table is 155. For the shipment of larger quantities of EPA hazardous waste and DOT Class 9 hazardous substances where the quantity of material in each container *exceeds* the CERCLA RQ and no other DOT Hazardous Material classification applies, the following packaging requirements apply:

- Label each container with a separate container number
- Seal each drum or pail with a Security Seal
- Prepare one COC record for each group of containers that is being shipped at the same time to the same destination. List the container numbers on the COC record.

These shipments may include EPA Hazardous Waste in 5-gallon cans and 55-gallon drums. Most DOT containers are approved. The list of approved containers for packing Groups II and III Class 9 Hazardous Substances are listed in §173.203 for liquids and §173.213 for solids. These lists include steel, aluminum, plastic and fiber drums (solids only). Quantity limitations are shown in 49 CFR 172.101, Column 9.

**Table 3-1. Packaging by Common Carrier**

Instructions	By Common Carrier	
	Non-hazardous Samples	Hazardous Samples
Secure sample container lids with strapping tape.	1*	1*
Mark the level of material in each sample container with a grease pencil.	2	2
Place each container in a clear plastic resealable food bag so that the sample container label can be read.		3
Place about ½ inch of inorganic cushioning material such as vermiculite in the bottom of a metal can.		4
Place each container in a separate can and fill the remaining volume of the can with an inorganic cushioning material such as vermiculite (do not use plastic foam cushioning material as it could dissolve if the sample container were to leak).		5
Close the can using three clips to secure the lid.		6
Write the sample number on the can lid. Indicate “This Side Up” by drawing an arrow on the can.		7
Put about 1 inch of cushioning material (e.g., vermiculite or plastic foam) in the bottom of a watertight metal or equivalent strength plastic shipping container. If the container is a cooler, seal the drain plug on the inside of the cooler with tape. Also line the inside of the container with a plastic bag.	3	8
Wrap glass bottles and jars in plastic bubble wrap.	4	
Place cans in the container and fill the remaining volume of the shipping container with packing material. Add ice bags if required.		9
Place the sample containers top-up in the shipping container. Arrange the sample containers so that glass containers are surrounded by plastic containers.	5	
Fill the void space around and on top of the sample containers with plastic bags filled with ice cubes or ice chips.	6	
Seal the COC record in a clear plastic resealable food bag and tape it securely to the inside of the shipping container lid.	7	10
Close and lock or latch the shipping container.	8	11

Instructions	By Common Carrier	
	Non-hazardous Samples	Hazardous Samples
If the shipping container used is a picnic cooler, use tape to seal the drain plug.	9	12
After acceptance by the shipper, tape the shipping container completely around with strapping tape at two locations. Secure the lid with tape. Do not cover any labels.		13
Place the laboratory address on the top of the shipping container.		14
For all hazardous shipments, complete shipper's hazardous material certification form.		15
Place a "This End Up" label on the lid and on all four sides of the shipping container.	10	16
Affix the signed and dated custody seals on the front right and back left of the shipping container. Cover the seals with wide, clear tape.	11	17

\*Numbers indicate the instructions that must be followed.

**Table 3-2. Packaging Not by Common Carrier**

Instructions	Flammable Liquid	Poison DOT Class 6.1	DOT Class 9
<p><b><i>Quantity limitations shipped by cargo aircraft</i></b> Gross weight of package:</p> <p>Total quantity of flammable liquid:</p> <p>Maximum sample container size:</p>	<p>66 pounds</p> <p>49 CFR 172.101 Table, Column 6b</p> <p>49 CFR 172.101 Table, Column 5 <i>or</i> The flash point of the liquid</p>	<p>66 pounds</p> <p><i>Liquids – 4 liters (1 gallon)</i> <i>Solids – 5 kilograms (11 pounds)</i></p>	<p>66 pounds</p> <p><i>Liquids – 4 liters (1 gallon)</i> <i>Solids – 5 kilograms (11 pounds)</i></p>
Check the caps of all sample containers to assure that they are secure. Tape caps.	1*	1*	1*
Place each sample container in an individual 6-mL plastic bag and secure with a twist tie. The sample identification tag should be positioned to enable it to be read through the bag.	2	2	2
Place sample containers in paint cans in a manner that will prevent bottle breakage.	3	<i>Liquids: 3</i>	
Place vermiculite in the paint can around the samples. The amount of vermiculite used should be sufficient to absorb the sample if a sample container should break.	4		
Secure the lid to the paint can with can clips and label the outside of the can with the sample ID numbers and quantity.	5		
Wrap bubble wrap around each glass sample container and fix with tape.		<i>Solids: 4</i>	3
Package the paint cans in DOT boxes or cooler. Use additional packaging to secure cans.	6		
Seal the drain plug with tape on the inside and outside of the cooler and line		5	4

<b>Instructions</b>	<b>Flammable Liquid</b>	<b>Poison DOT Class 6.1</b>	<b>DOT Class 9</b>
the cooler with a plastic bag. Place the canned or bagged sample containers in the cooler. If plastic bottles are being used, alternate them with any glass container.			
Fill any voids in the cooler with additional packing material.	7	6	5
Place ice contained in bags on top of all sample containers within the cooler. Use as much ice as space will allow.	8	7	6
Place the COC record in a clear plastic resealable food bag and tape to the inside of the cooler lid. Label the outside of the cooler as containing the COC record.	9	8	7
Seal the cooler lid with clear tape or strapping tape. Affix security seals.	10	9	8

\*Numbers indicate the instructions that must be followed.

### 3.6.2. Marking and Labeling

All samples *must be labeled* to prevent misidentification and should include the following information:

- Sample # or ID
- Date of collection
- Collector
- Analysis requested
- Preservative
- Sample location.

Sample labels must clearly link the sample to the field sheet or the COC record and must be written legibly and in permanent ink. In addition, all containers must be labeled and listed on the COC record.

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**Note:** If a three-bottle set is used for VOAs, all three bottles must be labeled and listed on the COC record.

EPA TSCA regulations [40 CFR 761.40(e)] require that a PCB label be put on all containers whose surfaces are in direct contact with material that is over 50 parts per million (ppm) PCBs.

This requirement applies to sample containers as well as pails, drums, and other containers that are in direct contact with the PCB material. The labeling requirement does not apply to containers in which PCB sample containers are shipped.

Although the sample containers must be individually labeled, this requirement is not affected by the quantity of sample or whether the sample is classified as hazardous under RCRA or DOT regulations. For DOT Class 9 and EPA Hazardous Waste the following labeling requirements apply:

- If EPA Hazardous Waste Manifest is required:
  - Hazardous waste
    - liquid, NOS, NA3082
    - solid, NOS, NA3077
- If EPA Hazardous Waste Manifest *is not* required:
  - Environmentally hazardous substances
    - liquid, NOS, UN3082
    - solid, NOS, UN3077

OSHA's Hazard Communication Standard requires all containers of hazardous materials coming in or out of a workplace to be labeled with the contents, appropriate hazard warnings, and the name and address of the manufacturer. OSHA does not specify a standard labeling method, but some commonly used ones are provided by National Fire Protection Association (NFPA), Hazardous Materials Identification System (HMIS), ANSI, and DOT.

### 3.6.3. Shipping Papers

Ship high hazard samples via overnight courier following the courier's documentation requirements. A special airbill must be completed for each shipment. An EPA manifest must be prepared if the shipping container contains hazardous waste *unless* the samples are exempt. The Hazardous Waste Manifest must bear the handwritten signatures of the generator, transporter, and designated facility. A copy of the manifest must be kept for 3 years by the shipper. The shipping papers must contain the name, address, and handwritten signature of the shipper.

The shipping papers (and Hazardous Waste Manifest if used) must contain a 24-hour emergency response telephone number. This phone number must be monitored at all times while the hazardous material is in transportation, including storage incidental to transportation. The phone must be monitored by a person who is either knowledgeable of the hazards and characteristics of the hazardous material being shipped and has comprehensive emergency response and incident mitigation information for that material, or who has immediate access to a person who possesses such knowledge and information. The emergency response phone number must be entered on the shipping paper immediately following the description of the hazardous material or entered once on a shipping paper if the number applies to all of the hazardous materials and is indicated for emergency response information.

### 3.7. QA/QC Protocol

QC is a normal part of good field and laboratory practice. QC includes all of the procedures ap-

plied to data collection and generation activities to achieve and maintain the level of pre-established data quality. The desired level of data quality should be based on the intended use of the data. Therefore, the QC protocol should include all technical controls (e.g., sampling and analytical methods, use of field blanks, field duplicate samples, inclusion of performance testing or reference samples, statistical analysis, etc.). The controls start with the regulatory requirements of the data acquisition project and carry through to the ultimate data reporting and completion of all of the documentation of the use of these controls.

QA refers to the procedures used by management to assure that the QC is what is required and that it is being adhered to at any point in the project. QA constitutes the overview and monitoring processes designed to ensure that the quality of the data generated meets the desired levels as established by management. These controls include establishing DQOs based on the intended use of the data, the institution of procedures for formalizing planning documents prior to the initiation of data collection activities, and the use of audits to identify problems in both QC and QA.

The QA/QC protocol is specified in the SAP for each job that involves field sampling. QA/QC requirements are based on the level of data quality required for the project, and may address specific regulatory requirements. The purpose of a QA/QC protocol is to ensure the following:

- The laboratory receives samples that accurately represent the conditions existing at the sample site
- The results of the analysis are traceable to the specific sample location
- Compliance requirements are met.

The methods used to attain this protocol include training of personnel, providing detailed procedures for preparation, collection, marking and handling, packaging, packing, transfer of samples, and validation and verification of the administrative process and sampling techniques.

### 3.7.1. Decontamination of Sampling Equipment

The SAP should address the extent of decontamination and specify the procedures to prevent sample contamination. Sampling may be performed using separate laboratory cleaned equipment for each sample location. Procedure effectiveness should be checked for each matrix by submitting equipment decontamination blank samples to the laboratory for analysis.

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**Note:** For specific information regarding the decontamination of field equipment, refer to *ASTM D5088-02, Standard Practices for Decontamination of Field Equipment Used at Waste Sites*. This standard describes the decontamination process for field equipment used in the sampling of soils, soil gas, sludges, surface water, and groundwater at waste sites. According to this standard, these practices are applicable only at sites where chemical (organic and inorganic) wastes are a concern, *not* for radiological, mixed (chemical and radiological), or biohazard sites.

### 3.7.2. Sample Container Cleanliness Requirements

Sample containers are a possible source of sample contamination. The SAP should specify the level of QC for sample containers. Pre-cleaned containers meeting EPA CERCLA cleanliness endurance criteria are available from several suppliers. If these containers are used, the serial number and QA batch number of each one should be recorded in the FLB/FN or on the field form. A review of the cleanliness should be made to ensure all parameters are checked to be below the detection limit of the contaminants to be tested for compliance. Some SDWA and CWA parameters may require laboratory cleaned containers proven to be below the limit of detection for the method.

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**Note:** In no case should an effort be made in the field to decontaminate a sample container. If a container becomes contaminated, it should be replaced, with a note to that effect recorded in the FLB/FN.

### 3.7.3. Sample Container Type and Size Requirements

The types and sizes of sample containers to be filled for each sample will depend on method requirements and on QC requirements of the SAP. General sample container requirements are shown in Appendix B for different matrices and



analytical parameters. Compliance with specific instructions in the SAP is mandatory. If specified sample containers are not available, permission must be obtained from the Program Manager in writing for the use of other sizes and types of sample containers.

#### **3.7.4. Sample Preservation and Storage Requirements**

Special preservation and storage requirements should be specified in the SAP to ensure that samples do not undergo chemical changes from the time they were collected until their analysis by the laboratory. General requirements are specified in Appendix B. The specific requirements of the SAP will govern.

The quality of the reagents, water and materials used for preservation should be verified to ensure these items do not invalidate the reported results. Chemicals used as preservatives may be traced by lot number and quality by maintaining a reagent record keeping system. The water and acid preservatives used for trip and field blanks may be checked prior to use in the field and lot controlled to ensure no contamination is present prior to the material leaving the laboratory.

#### **3.7.5. Sample Holding Time Limits**

Even with preservation and special storage procedures, the composition of samples can change over time. The holding time for samples is the time from collection to laboratory preparation or analysis. Holding time limits summarized in Appendix B are method and program requirements. Site-specific holding times specified in the SAP take precedence.

#### **3.7.6. Laboratory and Field Analytical Procedures**

Laboratory analytical procedures for each parameter are specified based on the compliance limits, permit limits and data needs stated in the SAP. The SAP or COC record indicates to the laboratory which sample containers are to be analyzed for what parameters and specifies the analytical methods. Based on the DQOs, field testing may require the same level of QC as laboratory testing, and the procedures specified in

the field sampling or test plan must be followed exactly. Any deviations from established test procedures must be entered in the FLB/FN or on the field form and the Program Manager must be informed immediately of sample numbers affected.

#### **3.7.7. QC Samples**

Field QC samples are prepared and analyzed to determine whether test samples have become accidentally contaminated, check on the repeatability of the method, and ensure the samples are representative of the site or matrix sampled. A number of different QC samples may be specified. Each of the QC samples checks for a potential problem that can affect data reliability. The recommended frequency for each type of QC sample is summarized in Appendix C.

##### **3.7.7.1. Test Sample**

The test sample consists of one or more sample containers filled with material collected at one sampling point within a stated time. Several sampling containers may be required if material collected for analysis for different parameters must be preserved differently or sent to different laboratories. For a specific test sample, all containers are designated by the same sample location number, but may have different sample container numbers or designations to indicate variations made to the samples.

##### **3.7.7.2. Field Duplicates and Split Samples**

Field duplicate samples are two separate samples taken from the same source and are used to determine data repeatability based on field sampling and laboratory analysis procedures. Field duplicate samples are as follows:

- Assigned different container numbers
- Specified in the FLB/FN or on the field form
- Distinguished from the test samples on the COC record or field records
- Often submitted blind as to designation so the laboratory data assures objectivity.

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**Exception:** Each test sample collected for a specific organic analysis may consist of two or more containers filled with the same material; these may be given different

container numbers but are designated as the same sample on the COC record. Only one sample container will be analyzed; the other being saved as a backup in case the laboratory must repeat the extraction and/or analysis.

Duplicate samples for analysis consist of sets of two containers, with each pair of containers being designated on the COC record.

Field duplicate samples may be submitted to one laboratory for analysis for the same parameters. The comparability of the results provides information on the repeatability of the field sampling and laboratory analysis procedures.

The containers may be submitted to different laboratories for identical analyses to obtain information on inter-laboratory repeatability of field sampling and laboratory analysis procedures. This is a split sample.

Sample heterogeneity may cause major problems with the representativeness of field duplicate or split samples of soil/sediment matrices. Proper sample homogenization in the field will significantly improve the repeatability of the field sampling procedure. (Gy P. 1993, *Sampling for Analytical Purposes*, Wiley, West Sussex. Pitard F. F. 1993, *Pierre Gy's Sampling Theory and Sampling Practice: Heterogeneity, Sample Correctness and Statistical Process Control*, Books Britain, London.)

Typically, both field duplicates and split samples will be collected at a rate of 10% of field samples or at a minimum of one, per analyte, matrix, and sampling technique. More duplicates and split samples may be collected depending on the data quality needs.

### 3.7.7.3. Equipment Decontamination Blanks

Equipment decontamination blanks, or rinsate blanks, provide information on the levels of cross-contamination resulting from field or laboratory sample preparation actions. These blanks are specified in the SAP and on field sampling forms, and are prepared in the field. An equipment decontamination blank is usually reagent or deionized water that is free of the analyte of interest and is transported to the site, opened in the field, and poured over or through the sample collection device, collected in a sample container,

and returned to the laboratory and analyzed. This serves as a check on sampling device cleanliness. For example:

- **Field Groundwater Equipment Decontamination Blank for Metals Analysis.** Handled by the bailer, use ASTM Type II water, or better. Filter, place in a sample container, and preserve using the same procedures as for the test and duplicate samples.
- **Soil Sampling Equipment Decontamination Blank for Semivolatile Organics.** Rinse the field equipment prior to its use and collect the rinsate for analysis.
- **PCB Wipe Sample Equipment Decontamination Blank.** Use a wipe pad to wipe the sampling template in the same way the pad is handled during the actual wipe sampling of a surface.

One equipment decontamination blank is collected for each type of equipment used during the day or sampling event. Equipment decontamination blanks are assigned container numbers from the same sequence as the test samples, and may not be distinguished from the test samples on the COC record. More blanks may be collected depending on the data quality needs.

### 3.7.7.4. Field Blanks

Field blanks are prepared and analyzed to check cleanliness of sample containers, environmental contamination, and purity of reagents or solvents used in the field. A sample container is filled with laboratory ASTM Type I or II water, preserved, shipped to the field with clean sample containers, opened in the field to exposure to ambient field air for a time compatible to field sampling process, and is closed and submitted for analysis using the same parameters as the test sample. The reported results will indicate the presence of contamination. Field blanks are most often used when measuring for volatile analytes.

### 3.7.7.5. Trip Blanks

A trip blank is used with VOA analysis of water. A blank may consist of two 40-milliliter VOA vials filled at the laboratory with laboratory ASTM Type I or II water, transported to the

sampling site and returned to the laboratory without being opened. This serves as a check on sample contamination during sample transport and shipping.

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**Note:** The caps used on VOA vials have Teflon®-lined septa. The Teflon® side of the silicone septum should face the sample. Prior to closing a vial, make sure there is no soil particle or dirt on the sealing surface of the VOA vial to prevent leaks. If a high concentration of volatile chemicals is present in the air in a shipping container, these chemicals can pass through the septum and contaminate the sample.

A trip blank is included in each shipping container used to ship VOA water samples. One VOA trip blank (two vials) is submitted to the laboratory in each cooler or per sampling event. The frequency of collection for trip blanks is specified in the SAP and is based on the data quality needs. Trip blanks are assigned container numbers from the same sequence used for the test samples, and are not designated as blanks on the COC record.

#### **3.7.7.6. Matrix Spike (MS)/Matrix Spike Duplicate (MSD)**

Project or compliance QC procedures require that the laboratory spike a portion of the matrix with a predetermined quantity of analyte(s) prior to sample extraction/digestion and analysis. The frequency of performing an MS is dependent on the data quality needs and method requirements.

A spiked sample is processed and analyzed in the same manner as the sample. The result of the analysis of the spike compared with the non-spike sample indicates the ability of the test procedures to recover the analyte from the matrix, and provides a measure of the performance of the analytical method executed by the laboratory.

For an MSD, a second portion of the matrix is spiked, and the recovery of the MSD can be compared with the recovery of the MS.

Depending on the matrix and analysis, additional sample containers may be specified to provide enough material for this laboratory procedure. These sample containers are assigned container numbers from the same sequence as the test samples and are designated MS/MSD materials on the COC record.

The MS/MSD samples are commonly used in CERCLA testing, but are not commonly used in CWA or SDWA testing. MSs are routinely performed by the laboratory as part of its internal QC on randomly chosen samples. If MS data is required for SDWA or CWA reporting requirements, a request must be made to the laboratory to ensure the MS is performed and reported on the appropriate sample. The sample selected for MSs should have the same or similar matrix as the field samples' but without high levels of target analytes.

#### **3.7.8. Field Audits**

The SAP will specify who will conduct field audits, along with their frequency and procedures. QA/QC procedures of the sample collection effort must identify and determine the magnitude of error associated with the contamination introduced through the sample collection effort. Audits are perhaps the most effective tool to ensure that the sampling is done correctly. The two factors most likely to influence the magnitude of the sample collection error are collection methods and frequency of sampling.

In general, a field sampling audit provides an independent outside check on the following:

- **Field Records**
  - COC records
  - Sample container labels
  - FLBs or field forms
  - Personnel training records
- **Sampling Procedures**
  - Equipment
  - Sample containers
  - Accuracy of sample location descriptions
  - Comparability of field sampling techniques
  - Collection and preparation of QC samples
  - Sample preservation
  - Equipment decontamination
  - Contaminated waste storage and disposal

- Sample packing, storage, security, and transportation
- Shipping containers, including use of custody seals (if applicable).

### 3.8. Generic Sampling Equipment List

Equipment specific to each type of media is found at the end of the related chapters. The following is a generic sampling equipment list:

- Map of sampling location(s)
- Sampling SOP
- FLB or field form
- Pens
- Containers
- Preservatives
- Labels
- Markers
- Coolers
- Ice
- Packing material
- Packaging tape
- COC form
- Custody seals (if required)
- Decontamination storage containers, equipment, and materials
- Personal safety equipment, safety test equipment
- Field screening or testing equipment, standards, reagents, and SOP
- Testing field forms or logbooks
- Laboratory instructions (if different from custody form).

## ATTACHMENT B

### Analytical Laboratory Information

1. Certificate of Accreditation, ISO/IEC 17025:2005 and DoD ELAP, Certificate Number ADE-1451 (Eurofins)
2. ORELAP Approval to Perform Analyses on Environmental Samples in Air, Certificate Number CA300005-011 (Eurofins)
3. Certificate of Accreditation, ISO/IEC 17025:2005, Certificate Number AT-1908 (Atmospheric Analysis and Consulting)
4. South Coast Air Quality Management District, Reference #03LA0606 (Atmospheric Analysis and Consulting)

SOP No.	SOP Title	Author Organization
6	EPA Method TO-14A/TO-15 Volatile Organic Compounds (Standard/Quad)	Eurofins
54	ASTM D1945 – Fixed Gases & C1-C6	Eurofins
A.5504.04	Standard Operating Procedure, Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence 9/11/2018, Revision 5	Atmospheric
ST-1	Source Test Protocol, Former Fort Ord, Monterey, CA. Thermal Treatment Unit (TTU). June 4,2018	Best Environmental



# CERTIFICATE OF ACCREDITATION

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This is to certify that

**Eurofins Air Toxics, LLC**  
**180 Blue Ravine Road**  
**Folsom, CA 95630**

has been assessed by ANAB  
and meets the requirements of international standard

**ISO/IEC 17025:2005**  
**and DoD Quality Systems Manual for Environmental**  
**Laboratories (DoD QSM V 5.1)**

while demonstrating technical competence in the fields of

## TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

ADE-1451  
Certificate Number

  
ANAB Approval

Certificate Valid: 04/18/2018-04/27/2020  
Version No. 005 Issued: 04/18/2018



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND DOD  
QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL  
LABORATORIES (DOD QSM V5.1)**

**Eurofins Air Toxics, LLC**

180 Blue Ravine Road  
Folsom, CA 95630  
Melanie Levesque  
(916) 605-3396

**TESTING**

Valid to: **April 27, 2020**

Certificate Number: **ADE-1451**

**Environmental**

<b>Air and Emissions</b>		
<b>Technology</b>	<b>Method</b>	<b>Analyte</b>
GC/FID/dual TCD	ASTM D1945	Acetylene
GC/FID/dual TCD	ASTM D1945	Carbon Dioxide
GC/FID/dual TCD	ASTM D1945	Carbon Monoxide
GC/FID/dual TCD	ASTM D1945	Ethane
GC/FID/dual TCD	ASTM D1945	Ethylene
GC/FID/dual TCD	ASTM D1945	Helium
GC/FID/dual TCD	ASTM D1945	Hydrogen
GC/FID/dual TCD	ASTM D1945	Isobutane
GC/FID/dual TCD	ASTM D1945	Isopentane
GC/FID/dual TCD	ASTM D1945	Methane
GC/FID/dual TCD	ASTM D1945	n-Butane
GC/FID/dual TCD	ASTM D1945	Neopentane
GC/FID/dual TCD	ASTM D1945	Nitrogen
GC/FID/dual TCD	ASTM D1945	n-Pentane





<b>Air and Emissions</b>		
<b>Technology</b>	<b>Method</b>	<b>Analyte</b>
GC/FID/dual TCD	ASTM D1945	Oxygen
GC/FID/dual TCD	ASTM D1945	Propane
GC/FID/dual TCD	ASTM D1946	Carbon Dioxide
GC/FID/dual TCD	ASTM D1946	Carbon Monoxide
GC/FID/dual TCD	ASTM D1946	Ethane
GC/FID/dual TCD	ASTM D1946	Ethylene
GC/FID/dual TCD	ASTM D1946	Helium
GC/FID/dual TCD	ASTM D1946	Hydrogen
GC/FID/dual TCD	ASTM D1946	Methane
GC/FID/dual TCD	ASTM D1946	Nitrogen
GC/FID/dual TCD	ASTM D1946	Oxygen
GC/FID/PID	TO-3	TPH(GRO)
GC/FID/PID	TO-3	TPH(JP4)
GC/MS	TO-15 (Full Scan/SIM)	1,1,1-Trichloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1,1,2-Tetrachloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1,2-Trichloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1-Dichloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1-Dichloroethene
GC/MS	TO-15 (Full Scan)	1,2,4-Trimethylbenzene
GC/MS	TO-15 (Full Scan)	1,2,4-Trichlorobenzene
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dibromoethane (EDB)
GC/MS	TO-15 (Full Scan)	1,2-Dichlorobenzene
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dichloroethane
GC/MS	TO-15 (Full Scan)	1,2-Dichloropropane





<b>Air and Emissions</b>		
<b>Technology</b>	<b>Method</b>	<b>Analyte</b>
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dichlorotetrafluoroethane
GC/MS	TO-15 (Full Scan)	1,3,5-Trimethylbenzene
GC/MS	TO-15 (Full Scan)	1,3-Butadiene
GC/MS	TO-15 (Full Scan)	1,3-Dichlorobenzene
GC/MS	TO-15 (Full Scan/SIM)	1,4-Dichlorobenzene
GC/MS	TO-15 (Full Scan)	1,4-Dioxane
GC/MS	TO-15 (Full Scan)	2,2,4-Trimethylpentane
GC/MS	TO-15 (Full Scan)	2-Butanone (MEK)
GC/MS	TO-15 (Full Scan)	2-Hexanone
GC/MS	TO-15 (Full Scan)	2-Propanol
GC/MS	TO-15 (Full Scan)	4-Methyl-2-pentanone (MIBK)
GC/MS	TO-15 (Full Scan)	3-Chloropropene
GC/MS	TO-15 (Full Scan)	Acetone
GC/MS	TO-15 (Full Scan)	alpha-chlorotoluene
GC/MS	TO-15 (Full Scan/SIM)	Benzene
GC/MS	TO-15 (Full Scan)	Bromodichloromethane
GC/MS	TO-15 (Full Scan)	Bromoform
GC/MS	TO-15 (Full Scan)	Bromomethane
GC/MS	TO-15 (Full Scan)	Carbon disulfide
GC/MS	TO-15 (Full Scan/SIM)	Carbon tetrachloride
GC/MS	TO-15 (Full Scan)	Chlorobenzene
GC/MS	TO-15 (Full Scan)	Chlorodibromomethane
GC/MS	TO-15 (Full Scan/SIM)	Chloroethane
GC/MS	TO-15 (Full Scan/SIM)	Chloroform



Air and Emissions		
Technology	Method	Analyte
GC/MS	TO-15 (Full Scan/SIM)	Chloromethane
GC/MS	TO-15 (Full Scan/SIM)	cis-1,2-Dichloroethene
GC/MS	TO-15 (Full Scan)	cis-1,3-Dichloropropene
GC/MS	TO-15 (Full Scan)	Cyclohexane
GC/MS	TO-15 (Full Scan)	Cumene
GC/MS	TO-15 (Full Scan/SIM)	Dichlorodifluoromethane
GC/MS	TO-15 (Full Scan)	Ethanol
GC/MS	TO-15 (Full Scan/SIM)	Ethylbenzene
GC/MS	TO-15 (Full Scan)	Hexachlorobutadiene
GC/MS	TO-15 (Full Scan)	Methylene Chloride
GC/MS	TO-15 (Full Scan/SIM)	m,p-Xylene
GC/MS	TO-15 (Full Scan/SIM)	Naphthalene
GC/MS	TO-15 (Full Scan)	n-Heptane
GC/MS	TO-15 (Full Scan)	n-Hexane
GC/MS	TO-15 (Full Scan)	n-Propylbenzene
GC/MS	TO-15 (Full Scan)	p-Ethyltoluene
GC/MS	TO-15 (Full Scan/SIM)	o-Xylene
GC/MS	TO-15 (Full Scan)	Propylene
GC/MS	TO-15 (Full Scan)	Styrene
GC/MS	TO-15 (Full Scan/SIM)	tert-Butyl methyl ether (MTBE)
GC/MS	TO-15 (Full Scan/SIM)	Tetrachloroethylene
GC/MS	TO-15 (Full Scan)	Tetrahydrofuran
GC/MS	TO-15 (Full Scan/SIM)	Toluene
GC/MS	TO-15 (Full Scan/SIM)	trans-1,2-Dichloroethene



Air and Emissions		
Technology	Method	Analyte
GC/MS	TO-15 (Full Scan)	trans-1,3-Dichloropropene
GC/MS	TO-15 (Full Scan/SIM)	Trichloroethene
GC/MS	TO-15 (Full Scan)	Trichlorofluoromethane
GC/MS	TO-15 (Full Scan)	Trichlorotrifluoroethane
GC/MS	TO-15 (Full Scan/SIM)	Vinyl chloride
GC/MS	TO-17 (WMS/RAD130)	1,1,1-Trichloroethane
GC/MS	TO-17 (WMS/RAD130)	1,1,2,2-Tetrachloroethane
GC/MS	TO-17 (WMS/RAD130)	1,1,2-Trichloroethane
GC/MS	TO-17 (WMS/RAD130)	1,1-Dichloroethane
GC/MS	TO-17 (WMS/RAD130)	1,1-Dichloroethene
GC/MS	TO-17 (WMS/RAD130)	1,2,4-Trimethylbenzene
GC/MS	TO-17 (WMS/RAD130)	1,2-Dichlorobenzene
GC/MS	TO-17 (WMS/RAD130)	1,2-Dichloroethane
GC/MS	TO-17 (WMS/RAD130)	1,3,5-Trimethylbenzene
GC/MS	TO-17 (WMS/RAD130)	1,3-Dichlorobenzene
GC/MS	TO-17 (WMS/RAD130)	1,4-Dichlorobenzene
GC/MS	TO-17 (WMS/RAD130)	2-Butanone (MEK)
GC/MS	TO-17 (WMS/RAD130)	4-Methyl-2-pentanone (MIBK)
GC/MS	TO-17 (WMS/RAD130)	Acetone
GC/MS	TO-17 (WMS/RAD130)	Benzene
GC/MS	TO-17 (WMS/RAD130)	Carbon tetrachloride
GC/MS	TO-17 (WMS/RAD130)	Chlorobenzene
GC/MS	TO-17 (WMS/RAD130)	Chloroform
GC/MS	TO-17 (WMS/RAD130)	cis-1,2-Dichloroethene



Air and Emissions		
Technology	Method	Analyte
GC/MS	TO-17 (WMS/RAD130)	Cyclohexane
GC/MS	TO-17 (WMS/RAD130)	Ethanol
GC/MS	TO-17 (WMS/RAD130)	Ethyl Acetate
GC/MS	TO-17 (WMS/RAD130)	Ethylbenzene
GC/MS	TO-17 (WMS/RAD130)	m,p-Xylene
GC/MS	TO-17 (WMS/RAD130)	Naphthalene
GC/MS	TO-17 (WMS/RAD130)	n-Heptane
GC/MS	TO-17 (WMS/RAD130)	n-Hexane
GC/MS	TO-17 (WMS/RAD130)	o-Xylene
GC/MS	TO-17 (WMS/RAD130)	Propylbenzene
GC/MS	TO-17 (WMS/RAD130)	Styrene
GC/MS	TO-17 (WMS/RAD130)	tert-Butyl methyl ether (MTBE)
GC/MS	TO-17 (WMS/RAD130)	Tetrachloroethylene
GC/MS	TO-17 (WMS/RAD130)	Toluene
GC/MS	TO-17 (WMS/RAD130)	trans-1,2-Dichloroethene
GC/MS	TO-17 (WMS/RAD130)	Trichloroethene
GC/MS	TO-17 (WMS)	Vinyl chloride

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. ADE 1451

Vice President



# OREGON

## Environmental Laboratory Accreditation Program



NELAP Recognized

**Eurofins Air Toxics, LLC**

**CA300005**

180 Blue Ravine Road, Ste. B

Folsom, CA 95630

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

<i>Air</i>	<i>Drinking Water</i>	<i>Non Potable Water</i>	<i>Solids and Chem. Waste</i>	<i>Tissue</i>
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Chemistry

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

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

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

Alia D. Servin, Ph.D.  
Oregon State Public Health Laboratory  
ORELAP Program Manager  
7202 NE Evergreen Parkway, Suite 100  
Hillsboro, OR 97124

EFFECTIVE DATE : 10/18/2018

EXPIRATION DATE : 10/17/2019

Certificate No : CA300005 - 011





# OREGON

## Environmental Laboratory Accreditation Program



### ORELAP Fields of Accreditation

ORELAP ID: CA300005

EPA CODE: CA00933

Certificate: CA300005 - 011

Eurofins Air Toxics, LLC

180 Blue Ravine Road, Ste. B

Folsom, CA 95630

Issue Date: 10/18/2018 Expiration Date: 10/17/2019

As of 10/18/2018 this list supersedes all previous lists for this certificate number.

MATRIX	Reference	Code	Analyte	Code	Description
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### Air

ASTM D1945 03				30024443	Natural Gas by Gas Chromatography
	4938		2-Methylbutane (Isopentane)		
	4942		2-methylpropane (Isobutane)		
	4323		Acetylene		
	3755		Carbon dioxide		
	3780		Carbon monoxide		
	4747		Ethane		
	4752		Ethene		
	1767		Helium		
	1772		Hydrogen		
	4926		Methane		
	3853		Natural Gas		
	5007		n-Butane		
	9511		Neopentane		
	1843		Nitrogen		
	5028		n-Pentane		
	5029		n-Propane		
	3895		Oxygen		
ASTM D1946- 90				30024465	Reformed Gas by Gas Chromatography
	3755		Carbon dioxide		
	3780		Carbon monoxide		
	4747		Ethane		
	4752		Ethene		
	1767		Helium		
	1772		Hydrogen		
	4926		Methane		
	1843		Nitrogen		
	3895		Oxygen		
EPA 325B 2013				10277437	Sorbent Tubes Coupled with Thermal Desorption and GC/MS
	9318		1,3-Butadiene		
	4375		Benzene		
	4765		Ethylbenzene		
	5240		m+p-xylene		
	5250		o-Xylene		
	5100		Styrene		
	5140		Toluene		
EPA TO-12				10248201	Non-Methane Organic Compounds by GC/FID
	3860		Non-methane organics		



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Air	EPA TO-13A	10248405	Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS
	5795	2-Chloronaphthalene	
	6385	2-Methylnaphthalene	
	5500	Acenaphthene	
	5505	Acenaphthylene	
	5555	Anthracene	
	5575	Benzo(a)anthracene	
	5580	Benzo(a)pyrene	
	5590	Benzo(g,h,i)perylene	
	5600	Benzo(k)fluoranthene	
	5585	Benzo[b]fluoranthene	
	5855	Chrysene	
	5895	Dibenz(a,h) anthracene	
	6265	Fluoranthene	
	6270	Fluorene	
	6315	Indeno(1,2,3-cd) pyrene	
	5005	Naphthalene	
	6615	Phenanthrene	
	6665	Pyrene	
EPA TO-13A SIM		10248449	Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS SIM
	5795	2-Chloronaphthalene	
	6385	2-Methylnaphthalene	
	5500	Acenaphthene	
	5505	Acenaphthylene	
	5555	Anthracene	
	5575	Benzo(a)anthracene	
	5580	Benzo(a)pyrene	
	5590	Benzo(g,h,i)perylene	
	5600	Benzo(k)fluoranthene	
	5585	Benzo[b]fluoranthene	
	5855	Chrysene	
	5895	Dibenz(a,h) anthracene	
	6265	Fluoranthene	
	6270	Fluorene	
	6315	Indeno(1,2,3-cd) pyrene	
	5005	Naphthalene	
	6615	Phenanthrene	
	6665	Pyrene	
EPA TO-14A		10248609	Volatile Organic Compounds with SUMMA canister and GC/MS
	5160	1,1,1-Trichloroethane	
	5110	1,1,2,2-Tetrachloroethane	



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Air	EPA TO-14A		
	5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	
	5165	1,1,2-Trichloroethane	
	4630	1,1-Dichloroethane	
	4640	1,1-Dichloroethylene	
	5155	1,2,4-Trichlorobenzene	
	5210	1,2,4-Trimethylbenzene	
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)	
	4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	
	4610	1,2-Dichlorobenzene	
	4635	1,2-Dichloroethane (Ethylene dichloride)	
	4655	1,2-Dichloropropane	
	5215	1,3,5-Trimethylbenzene	
	9318	1,3-Butadiene	
	4615	1,3-Dichlorobenzene	
	4620	1,4-Dichlorobenzene	
	4735	1,4-Dioxane (1,4- Diethyleneoxide)	
	4836	1-Propene (Propylene)	
	4410	2-Butanone (Methyl ethyl ketone, MEK)	
	4860	2-Hexanone (MBK)	
	4542	4-Ethyltoluene	
	4995	4-Methyl-2-pentanone (MIBK)	
	4315	Acetone	
	4375	Benzene	
	5635	Benzyl chloride	
	4395	Bromodichloromethane	
	4400	Bromoform	
	4450	Carbon disulfide	
	4455	Carbon tetrachloride	
	4475	Chlorobenzene	
	4575	Chlorodibromomethane	
	4485	Chloroethane (Ethyl chloride)	
	4505	Chloroform	
	4705	cis & trans-1,2-Dichloroethene	
	4680	cis-1,3-Dichloropropene	
	4555	Cyclohexane	
	4625	Dichlorodifluoromethane (Freon-12)	
	4750	Ethanol	
	4765	Ethylbenzene	
	4835	Hexachlorobutadiene	
	4895	Isopropyl alcohol (2-Propanol, Isopropanol)	
	4900	Isopropylbenzene (Cumene)	





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Air	EPA TO-14A			
		5240	m+p-xylene	
		4950	Methyl bromide (Bromomethane)	
		4960	Methyl chloride (Chloromethane)	
		5000	Methyl tert-butyl ether (MTBE)	
		4975	Methylene chloride (Dichloromethane)	
		5005	Naphthalene	
		4825	n-Heptane	
		4855	n-Hexane	
		5090	n-Propylbenzene	
		5250	o-Xylene	
		5100	Styrene	
		5115	Tetrachloroethylene (Perchloroethylene)	
		5120	Tetrahydrofuran (THF)	
		5140	Toluene	
		4685	trans-1,3-Dichloropropylene	
		5170	Trichloroethene (Trichloroethylene)	
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	
		5235	Vinyl chloride	
		5260	Xylene (total)	
	EPA TO-15			10248803 VOCs collected in Canisters by GC/MS
		5160	1,1,1-Trichloroethane	
		5110	1,1,2,2-Tetrachloroethane	
		5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	
		5165	1,1,2-Trichloroethane	
		4630	1,1-Dichloroethane	
		4640	1,1-Dichloroethylene	
		5182	1,2,3-Trimethylbenzene	
		5155	1,2,4-Trichlorobenzene	
		5210	1,2,4-Trimethylbenzene	
		4585	1,2-Dibromoethane (EDB, Ethylene dibromide)	
		4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	
		4610	1,2-Dichlorobenzene	
		4635	1,2-Dichloroethane (Ethylene dichloride)	
		4655	1,2-Dichloropropane	
		5215	1,3,5-Trimethylbenzene	
		9318	1,3-Butadiene	
		4615	1,3-Dichlorobenzene	
		4676	1,3-Diethylbenzene	
		4620	1,4-Dichlorobenzene	
		4735	1,4-Dioxane (1,4- Diethyleneoxide)	



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Air	EPA TO-15	4917	1-Butene
		4833	1-Pentene
		4836	1-Propene (Propylene)
		5220	2,2,4-Trimethylpentane
		4666	2,2-Dimethylbutane
		4667	2,3,4-Trimethylpentane
		4669	2,3-Dimethylbutane
		4671	2,3-Dimethylpentane
		4672	2,4-Dimethylpentane
		4410	2-Butanone (Methyl ethyl ketone, MEK)
		4538	2-Ethyltoluene
		4860	2-Hexanone (MBK)
		4934	2-Methyl-2-Butene
		4937	2-Methylbutadiene (Isoprene)
		4938	2-Methylbutane (Isopentane)
		4939	2-Methylheptane
		4946	2-Methylhexane
		4941	2-Methylpentane (Isohexane)
		4942	2-methylpropane (Isobutane)
		4531	3-Ethyltoluene (1-Methyl-3-ethylbenzene)
		4529	3-Methyl-1-Butene
		4532	3-Methylheptane
		4533	3-Methylhexane
		4534	3-Methylpentane
		4542	4-Ethyltoluene
		4913	4-Methyl-1-Pentene
		4995	4-Methyl-2-pentanone (MIBK)
		4300	Acetaldehyde
		4315	Acetone
		4320	Acetonitrile
		4323	Acetylene
		4325	Acrolein (Propenal)
		4340	Acrylonitrile
		4355	Allyl chloride (3-Chloropropene)
		4375	Benzene
		5635	Benzyl chloride
		4390	Bromochloromethane
		4395	Bromodichloromethane
		4400	Bromoform
		4450	Carbon disulfide
		4455	Carbon tetrachloride
		4475	Chlorobenzene
		4575	Chlorodibromomethane



# OREGON

## Environmental Laboratory Accreditation Program



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Air	EPA TO-15	4485	Chloroethane (Ethyl chloride)
		4505	Chloroform
		4525	Chloroprene (2-Chloro-1,3-butadiene)
		4705	cis & trans-1,2-Dichloroethene
		4680	cis-1,3-Dichloropropene
		4602	cis-2-Butene
		4604	cis-2-Hexene
		4603	cis-2-pentene
		4555	Cyclohexane
		4562	Cyclopentane
		4563	Cyclopentene
		4625	Dichlorodifluoromethane (Freon-12)
		4627	Dichlorofluoromethane (Freon 21)
		4747	Ethane
		4750	Ethanol
		4752	Ethene
		4765	Ethylbenzene
		4835	Hexachlorobutadiene
		4895	Isopropyl alcohol (2-Propanol, Isopropanol)
		4900	Isopropylbenzene (Cumene)
		5240	m+p-xylene
		4930	Methanol
		4950	Methyl bromide (Bromomethane)
		4960	Methyl chloride (Chloromethane)
		5000	Methyl tert-butyl ether (MTBE)
		4965	Methylcyclohexane
		4966	Methylcyclopentane
		4975	Methylene chloride (Dichloromethane)
		5005	Naphthalene
		5007	n-Butane
		5875	n-Decane
		4825	n-Heptane
		4855	n-Hexane
		5026	n-Nonane
		5027	n-Octane
		5028	n-Pentane
		5029	n-Propane
		5090	n-Propylbenzene
		6747	n-Undecane
		5250	o-Xylene
		5253	p-Diethylbenzene
		5100	Styrene
		5115	Tetrachloroethylene (Perchloroethylene)



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### ORELAP Fields of Accreditation

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Eurofins Air Toxics, LLC

EPA CODE: CA00933

180 Blue Ravine Road, Ste. B

Certificate: CA300005 - 011

Folsom, CA 95630

Issue Date: 10/18/2018 Expiration Date: 10/17/2019

**As of 10/18/2018 this list supersedes all previous lists for this certificate number.**

Air	EPA TO-15			
		5120	Tetrahydrofuran (THF)	
		5140	Toluene	
		4685	trans-1,3-Dichloropropylene	
		4607	trans-2-Butene	
		4606	trans-2-Hexene	
		4608	trans-2-pentene	
		5170	Trichloroethene (Trichloroethylene)	
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	
		5225	Vinyl acetate	
		5230	Vinyl bromide (Bromoethane)	
		5235	Vinyl chloride	
		5260	Xylene (total)	
	EPA TO-15 GC/MS SIM			10248858 VOCs collected in Canisters by GC/MS SIM
		5160	1,1,1-Trichloroethane	
		5110	1,1,2,2-Tetrachloroethane	
		5185	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	
		5165	1,1,2-Trichloroethane	
		4630	1,1-Dichloroethane	
		4640	1,1-Dichloroethylene	
		4585	1,2-Dibromoethane (EDB, Ethylene dibromide)	
		4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	
		4635	1,2-Dichloroethane (Ethylene dichloride)	
		4620	1,4-Dichlorobenzene	
		4375	Benzene	
		4455	Carbon tetrachloride	
		4485	Chloroethane (Ethyl chloride)	
		4505	Chloroform	
		4645	cis-1,2-Dichloroethylene	
		4625	Dichlorodifluoromethane (Freon-12)	
		4765	Ethylbenzene	
		5240	m+p-xylene	
		4960	Methyl chloride (Chloromethane)	
		5000	Methyl tert-butyl ether (MTBE)	
		5005	Naphthalene	
		5250	o-Xylene	
		5115	Tetrachloroethylene (Perchloroethylene)	
		5140	Toluene	
		4700	trans-1,2-Dichloroethylene	
		5170	Trichloroethene (Trichloroethylene)	



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Air	EPA TO-15 GC/MS SIM	5175	Trichlorofluoromethane (Fluorotrchloromethane, Freon 11)
		5235	Vinyl chloride
	EPA TO-17	10312206	Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes
		5160	1,1,1-Trichloroethane
		5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
		5165	1,1,2-Trichloroethane
		4630	1,1-Dichloroethane
		4640	1,1-Dichloroethylene
		5155	1,2,4-Trichlorobenzene
		5210	1,2,4-Trimethylbenzene
		4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
		4610	1,2-Dichlorobenzene
		4635	1,2-Dichloroethane (Ethylene dichloride)
		4655	1,2-Dichloropropane
		5215	1,3,5-Trimethylbenzene
		9318	1,3-Butadiene
		4615	1,3-Dichlorobenzene
		4620	1,4-Dichlorobenzene
		4735	1,4-Dioxane (1,4- Diethyleneoxide)
		6380	1-Methylnaphthalene
		5220	2,2,4-Trimethylpentane
		4410	2-Butanone (Methyl ethyl ketone, MEK)
		4860	2-Hexanone (MBK)
		4938	2-Methylbutane (Isopentane)
		6385	2-Methylnaphthalene
		4542	4-Ethyltoluene
		4995	4-Methyl-2-pentanone (MIBK)
		5500	Acenaphthene
		5505	Acenaphthylene
		5555	Anthracene
		4375	Benzene
		4450	Carbon disulfide
		4455	Carbon tetrachloride
		4475	Chlorobenzene
		4485	Chloroethane (Ethyl chloride)
		4505	Chloroform
		4645	cis-1,2-Dichloroethylene
		4555	Cyclohexane
		4765	Ethylbenzene
		6265	Fluoranthene



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Air	EPA TO-17	6270	Fluorene
		4835	Hexachlorobutadiene
		4895	Isopropyl alcohol (2-Propanol, Isopropanol)
		4900	Isopropylbenzene (Cumene)
		5240	m+p-xylene
		5000	Methyl tert-butyl ether (MTBE)
		4965	Methylcyclohexane
		4975	Methylene chloride (Dichloromethane)
		5005	Naphthalene
		4825	n-Heptane
		4855	n-Hexane
		5090	n-Propylbenzene
		5250	o-Xylene
		6615	Phenanthrene
		6665	Pyrene
		5100	Styrene
		5115	Tetrachloroethylene (Perchloroethylene)
		5140	Toluene
		4700	trans-1,2-Dichloroethylene
		5170	Trichloroethene (Trichloroethylene)
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
		5235	Vinyl chloride
		5260	Xylene (total)
	EPA TO-17 Modified 2	10312217	Hydrocarbons in Ambient Air Using WMS Passive Sampling Tubes
		5160	1,1,1-Trichloroethane
		5110	1,1,2,2-Tetrachloroethane
		5165	1,1,2-Trichloroethane
		4630	1,1-Dichloroethane
		4640	1,1-Dichloroethylene
		5150	1,2,3-Trichlorobenzene
		5155	1,2,4-Trichlorobenzene
		5210	1,2,4-Trimethylbenzene
		4610	1,2-Dichlorobenzene
		4635	1,2-Dichloroethane (Ethylene dichloride)
		5215	1,3,5-Trimethylbenzene
		4615	1,3-Dichlorobenzene
		4620	1,4-Dichlorobenzene
		9546	1,4-Dithiane
		4410	2-Butanone (Methyl ethyl ketone, MEK)
		4995	4-Methyl-2-pentanone (MIBK)
		4315	Acetone



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<b>Air</b>	EPA TO-17 Modified 2	6698	alpha-Pinene		
		4375	Benzene		
		4455	Carbon tetrachloride		
		4475	Chlorobenzene		
		4505	Chloroform		
		4645	cis-1,2-Dichloroethylene		
		4555	Cyclohexane		
		6208	d-Limonene		
		4750	Ethanol		
		4755	Ethyl acetate		
		4765	Ethylbenzene		
		6774	Halothane (2-Bromo-2-chloro-1,1,1-trifluoroethane)		
		5240	m+p-xylene		
		4960	Methyl chloride (Chloromethane)		
		4990	Methyl methacrylate		
		5000	Methyl tert-butyl ether (MTBE)		
		5005	Naphthalene		
		4825	n-Heptane		
		4855	n-Hexane		
		5090	n-Propylbenzene		
		5250	o-Xylene		
		5100	Styrene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5140	Toluene		
		4700	trans-1,2-Dichloroethylene		
5170	Trichloroethene (Trichloroethylene)				
5235	Vinyl chloride				
EPA TO-3		10249000	Cryogenic Trapping		
		4375	Benzene		
		4765	Ethylbenzene		
		5000	Methyl tert-butyl ether (MTBE)		
		5140	Toluene		
		5260	Xylene (total)		
MADEP APH		90017188	Air-Phase Petroleum Hydrocarbons		
		9318	1,3-Butadiene		
		3792	APH Aliphatics C5-C8		
		3793	APH Aliphatics C9-C12		
		3794	APH Aromatics C9-C10		
		4375	Benzene		
		4765	Ethylbenzene		
		5240	m+p-xylene		
		5000	Methyl tert-butyl ether (MTBE)		



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Air	MADEP APH	5005	Naphthalene
		5250	o-Xylene
		5140	Toluene
Modified EPA TO-17 Passive RAD130 Tube 2		60032351	The Determination of Hydrocarbons in Air Via RAD130 RADIELLO Passive Sample Tubes
	5160		1,1,1-Trichloroethane
	5110		1,1,2,2-Tetrachloroethane
	5165		1,1,2-Trichloroethane
	4630		1,1-Dichloroethane
	4640		1,1-Dichloroethylene
	5210		1,2,4-Trimethylbenzene
	4610		1,2-Dichlorobenzene
	4635		1,2-Dichloroethane (Ethylene dichloride)
	5215		1,3,5-Trimethylbenzene
	4615		1,3-Dichlorobenzene
	4620		1,4-Dichlorobenzene
	4410		2-Butanone (Methyl ethyl ketone, MEK)
	4995		4-Methyl-2-pentanone (MIBK)
	4315		Acetone
	4375		Benzene
	4455		Carbon tetrachloride
	4475		Chlorobenzene
	4505		Chloroform
	4645		cis-1,2-Dichloroethylene
	4555		Cyclohexane
	4750		Ethanol
	4755		Ethyl acetate
	4765		Ethylbenzene
	5240		m+p-xylene
	5000		Methyl tert-butyl ether (MTBE)
	5005		Naphthalene
	4825		n-Heptane
	4855		n-Hexane
	5090		n-Propylbenzene
	5250		o-Xylene
	5100		Styrene
	5115		Tetrachloroethylene (Perchloroethylene)
	5140		Toluene
	4700		trans-1,2-Dichloroethylene
	5170		Trichloroethene (Trichloroethylene)
	5235		Vinyl chloride



**ANALYTICAL METHODS**

**Section 2.0**

**Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds (Standard/Quad)**

Eurofins Air Toxics SOP #6      Revision 37      Effective Date: March 24, 2017      Methods Manual Summary

**Description:** This method involves full scan gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of up to 0.5 liters of air is withdrawn from the canister utilizing a volumetric syringe, volumetric loop, or mass flow controller. This volume is loaded onto a hydrophobic multibed sorbent trap to remove water and carbon dioxide and to concentrate the vapor sample. The focused sample is then flash-heated to sweep adsorbed VOCs onto a secondary trap for further concentration and/or directly onto a GC/MS for separation and detection.

Eurofins Air Toxics maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 (Standard or Quad).

Eurofins Air Toxics Method	Base Reporting Limits	Typical Application
TO-14A/TO-15 (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
→ TO-14A/TO-15 (Standard or Quad)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-15 (Extended)	0.2 – 1.5 ppbv	Ambient air and ppbv level vapor matrices
TO-14A/TO-15 (Low-level)	0.1 – 0.5 ppbv	Indoor and outdoor air
TO-14A/TO-15 SIM	0.003 – 0.5 ppbv	Indoor and outdoor air

Certain compounds are not included in Eurofins Air Toxics’ standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, Eurofins Air Toxics reports these non-routine compounds with partial validation. Validation may include a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification analyzed, and no method detection limit study performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

***Eurofins Air Toxics takes no modifications of technical significance to Method TO-15 for the “Quad” configurations.*** Since Eurofins Air Toxics applies TO-15 methodology to all Summa canisters regardless of whether TO-14A or TO-15 is specified by the project, the laboratory performs a modified version of method TO-14A as detailed in Table 1. Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient or indoor air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

**Table 1. Summary of TO-14A Method Modifications**

Requirement	TO-14A	Eurofins Air Toxics Modifications
Sample Drying System	Nafion Drier	Multibed hydrophobic sorbent.
Blank acceptance criteria	≤ 0.2 ppbv	≤ RL
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15.
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action when recovery is less than 60%.
Initial Calibration	≤ 30% RSD for listed 39 VOCs	≤ 30% RSD with 2 of Eurofins Air Toxics' 62 standard compounds allowed out to ≤ 40% RSD

The standard target analyte list, reporting limit (RL) also referred to as Limit of Quantitation, QC criteria, and QC summary can be found in Tables 2 through 5.

**Table 2. Method TO-14A/TO-15 Analyte List (Quad)**

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trichlorobenzene	2.0	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trimethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane (EDB)	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloropropane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3,5-Trimethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Benzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromomethane*	5.0	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
Chloroethane	2.0	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chlorotoluene (Benzyl Chloride)	0.5	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
cis-1,3-Dichloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Dichloromethane (Methylene Chloride)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Ethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 11 (Trichlorofluoromethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 113 (Trichlorotrifluoroethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 12 (Dichlorodifluoromethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Hexachlorobutadiene	2.0	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Methyl Chloroform (1,1,1-Trichloroethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Styrene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Toluene	0.5	≤ 30%	70 – 130	70 – 130	± 25
trans-1,3-Dichloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3-Butadiene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dioxane	2.0	≤ 30%	70 – 130	70 – 130	± 25
2-Butanone (Methyl Ethyl Ketone)	2.0	≤ 30%	70 – 130	70 – 130	± 25
2-Hexanone	2.0	≤ 30%	70 – 130	70 – 130	± 25
4-Ethyltoluene	0.5	≤ 30%	70 – 130	70 – 130	± 25
4-Methyl-2-Pentanone (MIBK)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Acetone	5.0	≤ 30%	70 – 130	70 – 130	± 25
Bromodichloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromoform	0.5	≤ 30%	70 – 130	70 – 130	± 25
Carbon Disulfide	2.0	≤ 30%	70 – 130	70 – 130	± 25

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
Cyclohexane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Dibromochloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Ethanol	2.0	≤ 30%	70 – 130	70 – 130	± 25
Heptane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Hexane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Isopropanol	2.0	≤ 30%	70 – 130	70 – 130	± 25
Methyl t-Butyl Ether (MTBE)	2.0	≤ 30%	70 – 130	70 – 130	± 25
Tetrahydrofuran	0.5	≤ 30%	70 – 130	70 – 130	± 25
trans-1,2-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
2,2,4-Trimethylpentane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Cumene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Propylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
3-Chloroprene	2.0	≤ 30%	70 – 130	70 – 130	± 25
Naphthalene**	1.0	≤40%	60 – 140	60 – 140	± 25
TPH (Gasoline) ***	50	1-Point Calibration	N/A	ICV only; 60 – 140	± 25
NMOC (Hexane/Heptane)***	10	1-Point Calibration	N/A	NA	± 25

\*Bromomethane recovery can be variable due to moisture/sorbent interactions specifically on the 2-trap concentration system. Data may require qualifier flags.

\*\*Due to its low vapor pressure, Naphthalene may exceed TO-15 performance requirements. The wider QC limits reflect typical performance. Although Naphthalene is not on Eurofins Air Toxics “standard” TO-15 list, it is commonly requested and included in Table 2.

\*\*\*TPH and NMOC are not on Eurofins Air Toxics’ “standard” TO-15 list, but are included in Table 2 due to common requests.

**Table 3. Internal Standards**
**Table 4. Surrogates**

Analyte	Accuracy (% R)	Analyte	Accuracy (% R)
Bromochloromethane	60 – 140	1,2-Dichloroethane-d <sub>4</sub>	70 – 130
1,4-Difluorobenzene	60 – 140	Toluene-d <sub>8</sub>	70 – 130
Chlorobenzene-d <sub>5</sub>	60 – 140	4-Bromofluorobenzene	70 – 130

**Table 5. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	TO-15 ion abundance criteria	Correct problem then repeat tune.
Minimum 5-Point Initial Calibration (ICAL)	Prior to sample analysis	% RSD $\leq$ 30 with 2 compounds allowed out to $\leq$ 40% RSD	Correct problem then repeat Initial Calibration curve.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each Initial Calibration curve, and daily prior to sample analysis	Recoveries for 85% of "Standard" compounds must be 70–130%. No recovery may be < 50%.  If specified by the client, in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS) for Non-standard compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV) for Standard compounds	At the start of each analytical clock after the tune check	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects.  If more than two compounds from the standard list recover outside of 70–130% or > 10% of VOCs if short list is used (20 compounds or less), corrective action will be taken. If any compound exceeds 60–140%, samples are not analyzed unless data meets project needs. Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV) for Non-standard Compounds	Per client request or specific project requirements only.	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit	Inspect the system and re-analyze the blank. "B"-flag data for common contaminants.
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (RT) for blanks and samples must be within $\pm 0.33$ min of the RT in the CCV and within $\pm 40\%$ of the area counts of the daily CCV internal standards.	<b>For blanks:</b> Inspect the system and reanalyze the blank. <b>For samples:</b> Re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded	70–130%  If specified by the client, in-house generated control limits may be used.	<b>For blanks:</b> Inspect the system and reanalyze the blank. <b>For samples:</b> Re-analyze the sample unless obvious matrix interference is documented. If the %Rs are within limits in the re-analysis, report the second analysis. If %Rs are out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates – Laboratory Control Spike Duplicates (LCSD)	One per analytical batch	RPD $\leq 25\%$	Narrate exceedances. If more than 5% of compound list is outside criteria or if compound has $>40\%$ RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.

**ANALYTICAL METHODS**

**Section 8.0**

**Method: ASTM D1945 – Fixed Gases & C1-C6**

Eurofins Air Toxics SOP #54    Revision 22    Effective Date: December 08, 2016    Methods Manual Summary

**Description:** This method involves gas chromatograph (GC) analysis of soil gas, landfill gas, ambient air, or stack gas collected in Summa™ canisters, Tedlar bags, or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for Methane and fixed gases and can be used to speciate individual light hydrocarbons up to C6. This method is also used to provide an estimation of the heating value of the gas by method ASTM D3588. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using UHP Helium or Nitrogen. Samples are then analyzed using a GC equipped with a Flame Ionization Detector (FID) and a Thermal Conductivity Detector (TCD).

Certain compounds are not included in Eurofins Air Toxics’ standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 5-point calibration with the lowest concentration defining the reporting limit (RL), no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compounds during sample storage is not validated. Full validation may be available upon request.

Since the protocols in the ASTM D1945 standard were designed for the analysis of natural gas, the laboratory has made modifications in order to apply the method to environmental samples covering a wide concentration range and to implement standard NELAP and EPA calibration criteria. The method modifications, standard target analyte list, RL, Quality Control (QC) criteria, and QC summary can be found in the following tables.

**Table 1. Summary of Method Modifications for ASTM D1945**

<b>Requirement</b>	<b>ASTM D1945</b>	<b>Eurofins Air Toxics Modifications</b>
Sample Injection Volume	0.50 mL to achieve Methane linearity.	1.0 mL
Calibration	A single point calibration is performed using a reference standard closely matching the composition of the unknown. Standard is analyzed such that 2 consecutive runs meet method repeatability requirements.	A minimum 5-point calibration curve is performed. Quantitation is based on the initial calibration response factor. A single run of a mid-level calibration standard is used to verify the initial calibration and may or may not resemble the composition of the associated samples.
Sample Analysis	Equilibrate samples to 20-50° F above source temperature at field sampling.	No heating of samples is performed.
Sample Calculation	Response factor is calculated using peak height for C5 and lighter compounds.	Peak areas are used for all target analytes to quantitate concentrations.
Normalization	Sum of original values should not differ from 100.0% by more than 1.0%.	Sum of original values may range between 85–115%; normalization of data not performed unless client requested.

**Table 2. ASTM Method D1945 Compound List and QC Limits**

Analyte	Reporting Limit (%)	QC Acceptance Criteria		
		ICAL (%RSD)	CCV/LCS/ICV (%R)	Precision* (%RPD)
Carbon Dioxide	0.01	≤ 15%	± 15%	≤ 25%
Carbon Monoxide	0.01	≤ 15%	± 15%	≤ 25%
Ethene	0.001	≤ 15%	± 15%	≤ 25%
Ethane	0.001	≤ 15%	± 15%	≤ 25%
Acetylene	0.001	≤ 15%	± 15%	≤ 25%
Isobutane	0.001	≤ 15%	± 15%	≤ 25%
Isopentane	0.001	≤ 15%	± 15%	≤ 25%
Methane	0.0001	≤ 15%	± 15%	≤ 25%
n-Butane	0.001	≤ 15%	± 15%	≤ 25%
Neopentane	0.001	≤ 15%	± 15%	≤ 25%
n-Pentane	0.001	≤ 15%	± 15%	≤ 25%
Nitrogen**	0.10	≤ 15%	± 15%	≤ 25%
NMOC (C6+)	0.01	≤ 15%	± 15%	≤ 25%
Oxygen	0.10	≤ 15%	± 15%	≤ 25%
Propane	0.001	≤ 15%	± 15%	≤ 25%
Hydrogen***	0.01	≤ 15%	± 15%	≤ 25%
Helium****	0.05	≤ 15%	± 15%	≤ 25%

\* For detections at > 5X the Reporting Limit.

\*\*For canisters that have been pressurized with Nitrogen, the amount of Nitrogen in the sample is determined by subtraction.

\*\*\*For canisters that have been pressurized with Helium, the Reporting Limit is 1.0%.

\*\*\*\*Included by special request only.

*Note: Results are reported in units of mol %. If required to report volume % or ppmV, a compressibility factor of 1 for all gases will be assumed. As a result, mol % is assumed to be equivalent to volume %. This assumption may result in a bias for highly compressible gases at high concentrations and pressures.*



**Table 3. Summary of Calibration and QC Procedures for Mod. ASTM Method D1945**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration (ICAL)	Prior to sample analysis and annually	≤ 15% RSD	Correct problem, then repeat Initial Calibration.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each Initial Calibration and once per analytical batch.	85–115% Recovery If specified by the client, in-house generated control limits may be used.	Check the system and re-analyze the standard. Re-prepare the standard if necessary. If the primary standard is found to be in error, re-prepare the primary and calibrate the instrument.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, and can be used as an End Check.	± 15% Difference	Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met. If the closing CCV fails, the system is checked and the standard is re-analyzed. Re-prepare the standard if necessary. If the second analysis fails, identify and correct the problem, then re-analyze all samples since the last acceptable CCV.
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory Reporting Limit	Inspect the system and re-analyze the Laboratory Blank.
Laboratory Duplicates- Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. Investigate the cause and perform maintenance as required and re-calibrate as needed.



# CERTIFICATE OF ACCREDITATION

## ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

### Atmospheric Analysis & Consulting, Inc.

1534 Eastman Ave., Suite A

Ventura, CA 93003

has been assessed by ANAB  
and meets the requirements of international standard

## ISO/IEC 17025:2005

while demonstrating technical competence in the field of

## TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of tests to which this accreditation applies.

AT-1908

Certificate Number



ANAB Approval

Certificate Valid: 03/15/2018-01/15/2019  
Version No. 005 Issued: 03/15/2018



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005**

**Atmospheric Analysis & Consulting, Inc.**

1534 Eastman Ave., Suite A  
 Ventura, CA 93003  
 Marcus Hueppe 805-650-1642  
[mhueppe@aaclab.com](mailto:mhueppe@aaclab.com) [www.aaclab.com](http://www.aaclab.com)

**TESTING**

Valid to: **January 5, 2019**

Certificate Number: **AT-1908**

**Chemistry**

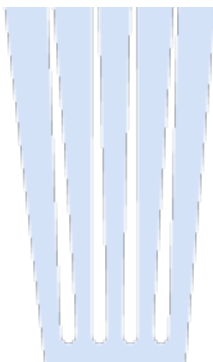
Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Extractable Organic Compounds	EPA TO-8	Air	HPLC
Extractable Organic Compounds	EPA TO-11A	Air	HPLC
Volatile Organic Compounds	EPA TO-14A	Air	GC/MS
Volatile Organic Compounds	EPA TO-15	Air	GC/MS

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. AT-1908.



Vice President





# South Coast Air Quality Management District



21865 Copley Drive, Diamond Bar, CA 91765-4178  
(909) 396-2000 • www.aqmd.gov

October 20, 2017

Dr. Sucha S. Parmar  
Atmospheric Analysis & Consulting  
1534 Eastman Ave., Suite A  
Ventura, CA 93003



Subject: LAP Approval Notice  
Reference # 03LA0606

Dear Dr. Parmar:

We completed our review of the renewal application you submitted for approval under the South Coast Air Quality Management District's Laboratory Approval Program (SCAQMD LAP). We are pleased to inform you that your firm is approved for the period beginning November 30, 2017, and ending November 30, 2018 for the following methods:

SCAQMD Method 307-91  
SCAQMD Method 25.1 (Analysis)  
SCAQMD Method 25.3 (Analysis)

Thank you for participating in the SCAQMD LAP. Your cooperation helps us to achieve the goal of the LAP: to maintain high standards of quality in the sampling and analysis of source emissions. You may direct any questions or information to LAP Coordinator, Glenn Kasai. He may be reached by telephone at (909) 396-2271, or via e-mail at [gkasai@aqmd.gov](mailto:gkasai@aqmd.gov).

Sincerely,

Dipankar Sarkar  
Program Supervisor  
Source Test Engineering

GK/gk

171020 LapRenewal.doc

**STANDARD OPERATING PROCEDURE**

**DETERMINATION OF SULFUR COMPOUNDS IN NATURAL GAS AND GASEOUS FUELS BY GAS CHROMATOGRAPHY AND CHEMILUMINESCENCE**

**Method Number: ASTM D-5504-12**

**Matrix: Air**

**Sampling Media: Tedlar Bag or Passivated Canister**

APPROVAL

Date Issued: September 11, 2018

Prepared By: Zandra Baja

Laboratory Manager Approval \_\_\_\_\_

Laboratory Director Approval \_\_\_\_\_

**PREFACE**

This is a Standard Operating Procedure (SOP). The analyst must read, understand, and follow this procedure explicitly.

A copy of this SOP is permanently placed in the laboratory area where the work is performed. The Department Supervisor, Quality Assurance Coordinator, and President/General Manager of Operations each have a copy of this document. Any changes in the SOP need to be approved by the Quality Assurance Coordinator. Each page of such changes will be initialed, dated, and concurrently incorporated into all copies located in the laboratory.

**Revision History**

Revision #	Date	Author	Change Reference	Reason for Change
01	Unknown	Unknown	NA	Initial Release
02	05/29/2002	Vanessa Vera	All Pages	Periodic Review
03	01/04/2007	Marcus Hueppe	All Pages	Periodic Review
04	11/23/2009	Diana Ngo	All Pages	Periodic Review
05	09/11/2018	Zandra Baja	All Pages	Periodic Review

## 1. SCOPE AND APPLICATION

- 1.1. This method applies to the analysis of speciated volatile sulfur-containing compounds in high methane content gaseous fuels such as natural gas samples utilizing Gas Chromatography (GC) with Sulfur Chemiluminescence Detection (SCD). This method has also been applied to other types of gaseous samples including air, digester, landfill, and refinery fuel gas.
- 1.2. The method suggests a detection range of 0.01 to 1,000 mg/m<sup>3</sup> or 7 to 700,000 ppbv for a 1 mL sample. This SOP covers the low-level instrumentation system used to perform this methodology.
  - 1.2.1. A Limit of Detection (LOD) of 1.043 ppbv was achieved and a Practical Quantitation Limit (PQL) of 10.0 ppbv was determined for Hydrogen Sulfide (H<sub>2</sub>S). The Method Reporting Limit (MRL) was established at 3.28 ppbv for H<sub>2</sub>S.
  - 1.2.2. A Limit of Detection (LOD) of 1.079 ppbv was achieved and a Practical Quantitation Limit (PQL) of 10.0 ppbv was determined for Methyl Mercaptan (MeSH). The Method Reporting Limit (MRL) was established at 3.39 ppbv for MeSH.
  - 1.2.3. A Limit of Detection (LOD) of 1.328 ppbv was achieved and a Practical Quantitation Limit (PQL) of 10.0 ppbv was determined for Dimethyl Sulfide (DMS). The Method Reporting Limit (MRL) was established at 4.17 ppbv for DMS.
- 1.3. For LOD and PQL determinations refer to the QA/QC plan. Sample Reporting Limits (SRLs) are calculated as the product of the MRL and all sample dilution factors or concentration factors.

## 2. SUMMARY OF METHOD

Air samples are collected using either Tedlar bags or passivated (Silco or Silonite) Canisters. The individual sulfur components of a gas mixture are separated by GC and quantified using a SCD.

## 3. SAFETY

- 3.1. All samples should be treated as hazardous and precautions should be taken when handling. Personal Protective Equipment (PPE) such as safety glasses, gloves and lab coats should be worn at all times. Solvents and reagents should be handled under fume hoods and used only by trained personnel. Refer to the MSDS before use if there are any concerns as to the safe handling and disposal of material.
- 3.2. All solvents and materials used for preparation of standards or sample preparation are emptied into the Organic Waste Drum or other appropriate container. An outside contractor according with proper waste disposal procedures disposes of the organic waste drum contents. Procedures and waste manifest are in possession of the Technical Director.

## 4. SAMPLE HANDLING AND PRESERVATION

- 4.1. Air samples are collected and stored in Tedlar Bags, Silco or Silonite Canisters, non-reactive vessels,

or other approved sampling media.

- 4.2. A minimum of 20 mL of sample is needed to flush the loop.
- 4.3. Air samples should be stored in a cool, dry, dark place and must be analyzed within 24 hours of sampling time if collected in a Tedlar Bag, and within seven (7) days if collected in a Silco or Silonite Canister or other passivated container.

## 5. INTERFERENCES

- 5.1. Method interferences may be caused by contaminants in solvents, reagents, glassware and/or other sample processing hardware. All materials used must routinely demonstrate that they are free from interferences under the conditions of the analysis by running method blanks.
- 5.2. Syringes must be thoroughly cleaned and stored in a clean environment to help minimize interference problems.
- 5.3. The use of high purity gases, reagents, and solvents helps to minimize interference problems.
- 5.4. Canisters must be thoroughly cleaned and stored in a clean environment to help minimize interference problems. Refer to the Canister Cleaning SOP for further details.
- 5.5. Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. Whenever an unusually high sample is encountered, it should be followed by the analysis of a Method Blank to check for carryover.

## 6. INSTRUMENTATION AND EQUIPMENT

- 6.1. Gas Chromatograph with Sulfur Chemiluminescence Detection
  - 6.1.1. Agilent 6890N GC with Agilent 355 SCD (Low-Level System)
    - 6.1.1.1. Analytical Column – Agilent DB-Sulfur SCD 60 m x 0.320 mm x 4.2  $\mu$ m
    - 6.1.1.2. Data Processing System – Agilent Chemstation
- 6.2. Digital Pressure Gauge – Ashcroft Model # 2074 ( $\pm$  0.25% Full scale)
- 6.3. Silco or Silonite Canisters – 6.0L, 1.4L, or other customer provided sizes
- 6.4. Graduated Gastight Syringes – various sizes of clean graduated gastight glass syringes equipped with three-way on/off valves.

## 7. STANDARDS AND REAGENTS

- 7.1. Standards – Stock standard solutions may be purchased as a certified solution or prepared from pure

materials. Purchased certified standards may be used until their certified expiration date. Prepared standards that are greater than 1,000 ppm are good for 1 year. Prepared standards that are less than or equal to 1,000 ppm are good for 6 months.

- 7.1.1. Each standard is logged into the AAC Stock Standard / Reagent Logbook and given a unique identification number (SS#####) upon receipt. All standard preparations are logged into the AAC Standard Preparation Logbook and given a unique identification number (PSmmddyy-##). This PS # is noted for all QC standards in the sequence.
- 7.1.2. Our current working standards are from Airgas: NIST certified 105.1 ppm ( $\pm 2\%$ ) standard of H<sub>2</sub>S with a balance gas of Air (Part Number: X02 A199C33A6767) and NIST certified 97.76 ppm ( $\pm 2\%$ ) standard of CS<sub>2</sub> with a balance gas of Air (Part Number: X02 A199C33A25G9)

## 8. PROCEDURE

### 8.1. Sample Preparation

- 8.1.1. Upon receipt, samples are assigned a unique laboratory ID number and stored either on the canister storage racks or in the bag storage area.
- 8.1.2. The Canister initial pressure is measured using the certified digital pressure gauge and then recorded on the canister tag, in the shipping and receiving logbook, and in the canister pressure log that goes with each project.
- 8.1.3. The Canister is then pressurized with UHP Helium using the certified digital pressure gauge to 900mmHgA and the final pressure is recorded on the canister tag, in the shipping and receiving logbook, and in the canister pressure log that goes with each project.

### 8.2. Sample Analysis

- 8.2.1. Check that all of the GC operating conditions are properly set and that the sample injection loop is in the load position.
- 8.2.2. For Ambient (Trace level) analysis
  - 8.2.2.1. For Canister samples
    - 8.2.2.1.1. Inject at least 20 mL (preferably 50-100 mL) of sample slowly through the sampling loop using a 1/8" Teflon line.
    - 8.2.2.1.2. A gastight syringe is used to make any necessary dilutions.
  - 8.2.2.2. For Tedlar Bag samples
    - 8.2.2.2.1. Withdraw ~50 to 100 mL of sample from the Tedlar bag using a gastight syringe.
    - 8.2.2.2.2. Inject at least 20 mL (preferably 50-100 mL) of sample slowly through



the sampling loop using a gastight syringe.

8.2.2.3. Allow the sample to equilibrate to atmospheric pressure and press the start button on the GC.

8.2.2.4. All samples must be analyzed in duplicate.

8.2.3. For all non-ambient high sulfur concentration samples including natural gas, refinery fuel gas, landfill gas, and digester gas, dilute the samples 5 to 100 times with UHP Helium before analyzing to prevent overloading the detector. Look up historical reports to determine what dilution levels to start with. Follow the same analysis procedures outlined in section 8.2.2 for ambient samples.

### 8.3. Standard Preparation and generation of calibration curve

8.3.1. The method recommends preparing a curve with at least three points but typically the curve includes the following points: 0, 10, 50, 500, and 2500 ppbv.

8.3.2. The calibration points are prepared by first diluting the 100 ppmv stock standards from section 7.1.2 to 2500 and 500 ppbv using UHP Helium in a Silonite Canister. The 10 and 50 ppbv calibration points are prepared by diluting the 500 ppbv standard with UHP Helium in a gastight glass syringe.

8.3.3. Each calibration point is analyzed in triplicate and the peak areas should be within 5% of their average. The average area for each point is used to produce a linear regression curve forced through zero.

8.3.4. SCDs are equimolar, therefore the response factor of each single sulfur compound should be within 5% of the H<sub>2</sub>S response factor. The H<sub>2</sub>S response factor is used for quantification of all single sulfur compounds and unidentified analytes. The CS<sub>2</sub> response factor is used for quantification of all sulfide and disulfide compounds. Identification is based on comparing retention times of authentic standards to those in the samples.

### 8.4. GC Preparation

8.4.1. GC 6890N with Agilent 355 SCD – “ASTM5504.M” Run Method

GC 6890N Instrument Control Parameters

#### Control Information

Sample Inlet = GC

Injection Source = sampling loop

#### Oven

Initial Temperature = 40°C

Initial Time = 12 min

Rate 1 = 10°C/min to 180°C

Final Temperature = 180°C

Final Temperature Hold = 5 min

Total GC Run Time = 31 min  
Maximum Temperature = 250°C  
Equilibration Time = 0.50 min

Inlet (Back)

Initial Temperature = 200°C (On)  
Carrier Gas Pressure = 41.27 psi (On)  
Gas Type = Helium  
Inlet Split Ratio = 6.0:1

Column

Model Number = Agilent G3903-63001  
Max Temperature = 250°C  
Nominal Length = 60 m  
Nominal Diameter = 0.320 mm  
Mode = constant flow  
Initial Flow = 7.5 mL/min  
Outlet Pressure = Ambient

Detector (Back)

Temperature = 200°C (On)

Signal 2

Data Rate = 50 Hz  
Save Data = On  
Zero = 0.0 (Off)  
Range = 0

Agilent 355 SCD

Hydrogen Pressure = 35 psi  
Oxygen Pressure = 3 psi  
He Makeup Pressure = 0 psi  
Ozone Pressure = ~4.5 psi  
Furnace Temperature = 900°C

8.5. Analysis Sequence

- 8.5.1. System Blank – For the first injection of the day on the instrument, and any time that sample carryover has occurred, the analyst must demonstrate, through the analysis of a system blank that there are no interferences from the analytical system. The system blank used in this method is UHP Helium.
- 8.5.2. Calibration Standards – Each calibration standard must be analyzed in triplicate with a minimum of three calibration points that bracket the anticipated analyte concentrations when a new calibration is required.
- 8.5.3. Continuing Calibration Verification (CCV) – Before analyzing any samples and at the end of each sequence a CCV should be analyzed to verify that the instrument's calibration is still

valid. The concentration of the standard used should be within the range of the samples and at least 10 times the detection limit. Generally, the CCV concentration is 500 ppbv. The opening CCV is analyzed in triplicate.

- 8.5.4. Method Blank (MB) – For each batch (up to 20 samples), a MB must be analyzed. This blank should go through all of the stages of sample preparation and measurements that the samples undergo. The MB used in this method is UHP Helium.
- 8.5.5. Matrix Spike (MS) and Matrix Spike Duplicate (MSD) – For each batch (up to 20 samples) an MS and MSD must be analyzed. The MS / MSD are prepared by the addition of a known amount of the standard to a sample extract. Generally, the MS and MSD concentrations are prepared with a 1:1 mixture of 500 ppbv H<sub>2</sub>S/CS<sub>2</sub> standard and a known volume of sample gas.
- 8.5.6. Sample Analysis – Every sample must be analyzed in duplicate. When a concentration of a compound within the sample falls out of linear range for the calibration curve, dilutions of the sample are made and reanalyzed. Each sample is analyzed and the concentration calculated. If the concentration of the duplicate run is outside of the range of the ±10% from the initial sample, then the sample must be reanalyzed until that condition is met. Enter the sample dilution factor ( $DF_E$ ) into the data processing software sequence.

## 9. QUALITY CONTROL

QC Performed	Frequency	Acceptance Criteria	Corrective Action
Calibration Curve	Recommended every month or whenever maintenance is performed	1 – Correlation Coefficient of a linear least-squares fit $R^2 \geq 0.990$ 2 – Max range $\leq 5\%$ for three consecutive trials 3 – Recovery of $100 \pm 5\%$ of theoretical value	1 - Rerun curve 2 - Prepare new standards and rerun curve
Continuing Calibration Verification (CCV)	After the curve; Before analyzing any samples; and At the end of each sequence	1 – Max range $\leq 5\%$ for three consecutive trials 2 – Recovery of $100 \pm 10\%$ of theoretical value	1 – Rerun check 2 – Prepare new standard and rerun 3 – Rerun calibration
Matrix Spike and Matrix Spike Duplicate (MS / MSD)	For each batch – up to 20 samples	1 – Recovery of $100 \pm 10\%$ of theoretical value 2 – RPD $< 10\%$	1 – Rerun check 2 – Prepare new standard and rerun 3 – Flag data
Field Sample Duplicates	Every sample is analyzed in duplicate	Within 10% of initial analysis	1 – Rerun check 2 – Prepare new sample and rerun 3 – Flag data

Method Blank	For each batch – up to 20 samples	< RL	1 – Rerun check 2 – Prepare new blank and rerun 3 – Perform blank subtraction for all samples included in batch
System Blank	Before and after the curve; Before processing any samples	< RL	1 – Rerun check 2 – Prepare new blank and rerun

- 9.1. The QC criteria outlined here is above and beyond what the method requires but is adhered to in this lab as good laboratory practice.
- 9.2. It is the responsibility of the analyst to perform the analysis according to this SOP and complete the documentation required for review.
- 9.3. It is the responsibility of all personnel who work with samples involving this method to note any anomalies or out-of-control events associated with the analysis of the samples. Any discrepancies must be noted and corrective action taken and documented.
- 9.4. Document all maintenance procedures in the instrument logbook assigned to each instrument.

**10. CALCULATIONS**

- 10.1. The data processing software calculates a Response Factor from the curve generated in Section 8.3 for each analyte concentration as follows:

$$RF = \frac{P_{ST} - P_0}{C_{ST}}$$

where:

$RF$  = Response factor for the analyte given as area counts per ppbv

$P_{ST}$  = Peak area counts for the analyte standard

$P_0$  = Calibration curve intercept; in most cases this is zero

$C_{ST}$  = Concentration of analyte in the calibration standard in units of ppbv

- 10.2. The data processing software calculates the analyte concentration in ppbv for each sample using the following equation:

$$C_{SAM} = \frac{P_{SAM} - P_0}{RF}$$

where :

$C_{SAM}$  = Concentration of analyte in the sample in units of ppbv

$P_{SAM}$  = Peak area counts for the analyte sample

- 10.3. For those samples that were diluted in Section 8.5.7 the data processing software calculates the analyte concentration using the following formula:

$$C_{SAM} = C_{SAM_{DIL}} * DF_E$$

where :

$C_{SAM_{DIL}}$  = Concentration of analyte in the diluted sample

$DF_E$  = Sample dilution factor used in Section 8.5.7

- 10.4. The canister dilution factor is calculated using the following formula:

$$DF_C = \frac{P_F}{P_I}$$

where:

$DF_C$  = Canister Dilution Factor

$P_F$  = Pressure after canister has been pressurized using UHP He (should be ~900mmHg)

$P_I$  = Return initial pressure upon receipt from the field.

- 10.5. Calculate the CCV recoveries as follows:

$$\%Rec_{CCV} = \left( \frac{C_{CCV}}{C_{TC}} \right) * 100$$

where:

$C_{CCV}$  = Measured concentration of the CCV

$C_{TC}$  = Theoretical concentration of the CCV

- 10.6. Calculate the Matrix Spike recoveries as follows:

$$\%Rec_{MS} = \left( \frac{C_{MS}}{C_{SAM} + C_{spike}} \right) * 100$$

where:

$C_{MS}$  = Measured concentration of the Matrix Spike in units of ppbv

- 10.7. Calculate the Relative Percent Difference (RPD) for the Matrix spike samples using the following formula:

$$RPD_{MS} = ABS \left[ \frac{C_{MSdup} - C_{MS}}{Average(C_{MSdup}, C_{MS})} \right] * 100$$

where:

$C_{MSdup}$  = Measured concentration of the Matrix Spike duplicate in units of ppbv

$ABS$  = Absolute Value

10.8. Calculate the Relative Percent Difference (RPD) for the duplicate samples using the following formula:

$$RPD_{SAM} = ABS \left[ \frac{C_{DUP} - C_{SAM}}{Average(C_{SAM}, C_{DUP})} \right] * 100$$

where:

$C_{DUP}$  = Duplicate sample concentration in units of ppbv

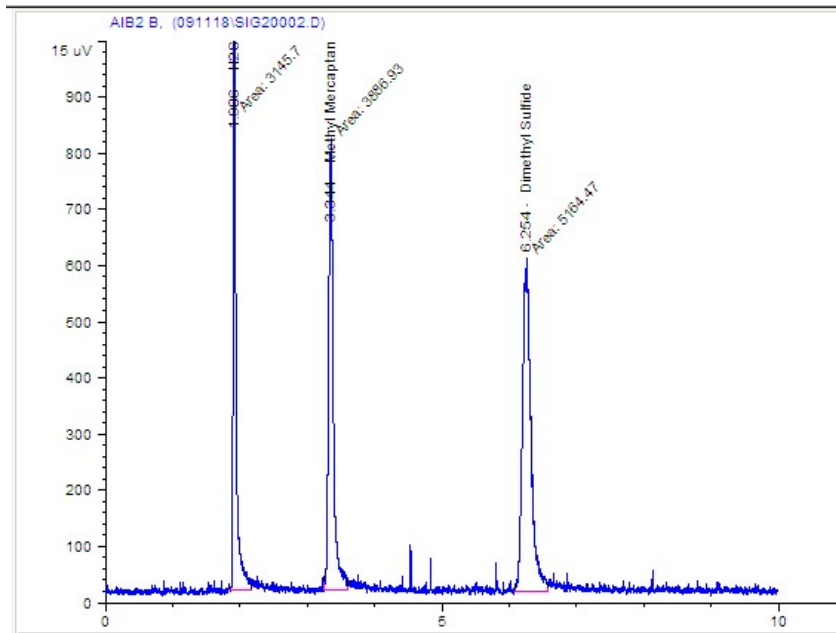
## 11. REPORTING FORMAT

- 11.1. The samples are reported as the total quantity of analyte (ppbv) in the sample.
- 11.2. Any samples with analyte values below the Sample Reporting Limit are reported as <SRL for the specific analyte. If other analytes are present they are reported as stated in section 11.1.

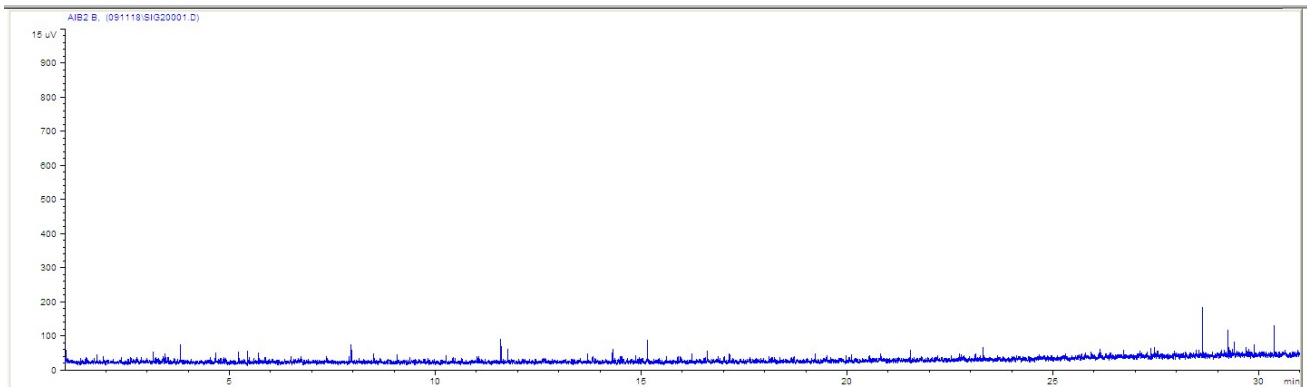
## 12. REFERENCES

ASTM D-5504-12 “Standard Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence”

**FIGURE 1 – TYPICAL ASTM D-5504 CCV CHROMATOGRAM**



**FIGURE 2 – TYPICAL ASTM D-5504 BLANK CHROMATOGRAM**

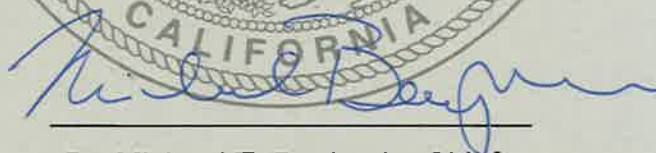


State of California  
Air Resources Board  
Approved Independent Contractor

**Best Environmental**

This is to certify that the company listed above has been approved  
by the Air Resources Board to conduct compliance testing  
pursuant to California Code of Regulations, title 17, section 91207,  
until June 30, 2019, for the test method listed below:

Visible Emissions Evaluation



Dr. Michael T. Benjamin, Chief  
Monitoring and Laboratory Division



State of California  
**Air Resources Board**  
Approved Independent Contractor

**Best Environmental**

This is to certify that the company listed above has been approved by the Air Resources Board to conduct compliance testing pursuant to California Code of Regulations, title 17, section 91207, until June 30, 2019, for the test methods listed below:

ARB Source Test Methods:

1, 2, 3, 4, 5, 8, 11, 17

100 (CO, CO<sub>2</sub>, NO<sub>x</sub>, O<sub>3</sub>, SO<sub>2</sub>, THC)



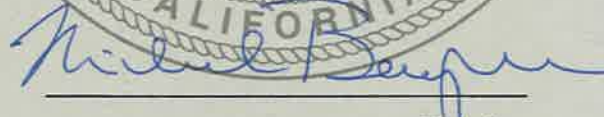
Dr. Michael T. Benjamin, Chief  
Monitoring and Laboratory Division

State of California  
**Air Resources Board**  
Approved Independent Contractor

**Best Environmental**

This is to certify that the company listed above has been approved by the Air Resources Board to conduct compliance testing pursuant to California Code of Regulations, title 17, section 91207, until June 30, 2019, for the test methods listed below:

U.S. EPA Source Test Methods:  
15A, 201A, 202



Dr. Michael T. Benjamin, Chief  
Monitoring and Laboratory Division

# **Source Test Protocol**

## **Former Fort Ord**

**Monterey, CA**

## **Thermal Treatment Unit (TTU)**

### **Prepared For:**

Ahtna Environmental Inc.

296 12<sup>th</sup> Street

Marina, CA 93933

Attn: Eric Schmidt

### **Prepared By:**

**BEST ENVIRONMENTAL**

339 Stealth Court

Livermore, CA 94551

Phone (925) 455-9474

Fax (925) 455-9479

Email: [bestair@best-enviro.com](mailto:bestair@best-enviro.com)

Date Issued: June 4, 2018

**SUMMARY INFORMATION****Source Test Information****General Information**

Source Owner: US Army

Source Location: Former Fort Ord  
Operable Unit 2 (OU2) Landfill  
Monterey Bay, CA

Contact: Eric Schmidt  
Phone: (831) 824-2308

Source Description: Thermal Treatment Unit

Test Parameters & Limits: NOx: 0.06 lbs/MMBtu  
CO: 0.4 lbs/MMBtu  
THC: 0.03 lbs/MMBtu  
NMOC: 98% DRE  
SOx: 2000 ppm  
Fuel Sulfur: 50 grs/100 scf

Source Testing Firm: **BEST ENVIRONMENTAL (BE)**  
339 Stealth Court  
Livermore, CA 94551  
Phone: (925) 455-9474  
Email: [bestair@best-enviro.com](mailto:bestair@best-enviro.com)  
Contact: Regan Best or Bobby Asfour

Proposed Testing Date(s): June 20, 2018  
Test Start Time: ~10:00 A.M.

Analytical Laboratories: **Eurofins/Air Toxics Ltd. (VOC's, Fixed Gases & Sulfur)**  
180 Blue Ravine Road  
Suite B  
Folsom, CA 95630  
Attn: Maria Barahas  
Phone: (800) 985-5955 x 1039

## 1.0 Introduction:

Annual source testing of the TTU is conducted to demonstrate that the TTU operates efficiently and meets air quality regulations for emissions. The TTU remedy is being performed under CERCLA (42 USC 9601 et seq.) as amended by SARA. As such, the MBUAPCD does not have jurisdiction and a permit for operating the TTU and exhaust stack is not required; however MBUAPCD Rule 207 and Rule 1000 are identified as applicable or relevant and appropriate requirements in the OU2 Landfills ROD (Army, 1994) and the substantive permit requirements were met during the reporting period. Meeting these objectives will require NO<sub>x</sub>, CO and THC/NMOC emission testing to be performed at the exhaust outlet of the TTU. The TTU fuel testing is required for NMOC, speciated VOCs, Total Sulfur as H<sub>2</sub>S & composition (including fixed gases & BTU/HHV).

## 2.0 Emission Source Information:

Ahtna Environmental (Ahtna) operates one TTU at the former Fort Ord Landfill. The TTU is used as a control device for removing the landfill gas created by the underground solid waste. The TTU stack will be equipped with proper sampling ports that meet and/or exceed the minimum location criteria of 2 stack diameters downstream from the burners and 0.5 diameters upstream from the stack exit. The sample ports will be accessed using a 40-foot boom-lift.

The TTU inlet gases will be accessed with a sample tap located downstream of the flame arrestor.

The flare will be operated at a flow rate of ~95 SCFM and an operating set point of ~1,650 deg-F during the testing. The quality of the landfill gas is ~36% (by volume) methane.

Description	Limits
Thermal Treatment Unit	NO <sub>x</sub> 0.06 lbs/MMBtu, CO 0.4 lbs/MMBtu, SO <sub>2</sub> 2000 ppmv, Inlet total sulfur 50 grains/100scf, THC 0.03 lbs/MMBtu & DRE ≥98%

### 3.0 Source Testing Program Description:

Triplicate 40-minute test runs will be performed at the TTU outlet for O<sub>2</sub>, NO<sub>x</sub>, CO, THC, CH<sub>4</sub> & NMOC. Two samples of the TTU inlet gas (landfill gas) will be collected and analyzed for fixed gases (O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub> & C<sub>1</sub>-C<sub>6</sub>+), BTU/HHV, speciated VOC and Sulfur compounds (AP-42 Table 2.4-1). A single outlet sample will be collected and analyzed for speciated VOC. For each test run the stack volumetric flow rate will be calculated from the corrected meter fuel flow, BTU/HHV and stack oxygen concentration. During each test run all relevant operating data (gas flow and operating temperature) will be monitored and recorded.

A mass balance calculation will be used to determine the outlet SO<sub>2</sub> emission rate according to EPA Method 19.

#### Overview of Sampling-Flare

Parameter	Location	Methods	Duration	# of Runs
NO <sub>x</sub> , CO and O <sub>2</sub>	Exhaust	EPA 7E, 10 & 3A	40 mins	3
THC, CH <sub>4</sub> & NMOC	Exhaust	EPA 25A	40 mins	3
Speciated VOCs	Exhaust	EPA Method TO-15	grab	1
Flow Rate	Exhaust	EPA 19	40 mins	3
Speciated VOCs	Inlet	EPA Method TO-15	grab	2
Speciated Sulfurs	Inlet	ASTM D-5504-98	grab	2
Fuel analysis (BTU, O <sub>2</sub> , CO <sub>2</sub> , N <sub>2</sub> , C <sub>1</sub> -C <sub>6</sub> + & NMOC*)	Inlet	ASTM D-1945-96	grab	2
Fuel Flow Rate	Inlet	Metering System	40 mins	3

**All laboratory gas samples will be shipped by Ahtna personnel.**

### 4.0 Source Testing Procedures:

This section is intended to provide an overview of the sampling strategy and does not attempt to summarize the sampling procedures, which are described in detail in the reference methods.

EPA Method 1 (Traverse points), EPA Method 3A, 7E and 10 (O<sub>2</sub>, NO<sub>x</sub>, and CO), EPA Method 25A (THC/NMOC), and EPA Method 19 will be used to determine outlet emission rates. A single sample of the exhaust will be collected and analyzed using EPA Method TO-15 (speciated organic compounds). Two LFG samples will be collected and analyzed using ASTM D-1945 (O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>, C<sub>1</sub>-C<sub>6</sub>+ & BTU/HHV), EPA Method TO-15 (speciated organic compounds) and ASTM D-5504 (speciated inorganic compounds).

Outlet VOC analysis may consist of continuously analyzing total hydrocarbons (THC) at the exhaust with a FID analyzer. If applicable an integrated outlet sample will be collected at the exhaust and will be sent to a lab for methane and ethane analysis. The appropriate calibration checks will be performed prior and throughout the sampling. VOC will be assumed equal to THC or total non-methane/non-ethane hydrocarbons.

Exhaust SO<sub>x</sub> emissions will be calculated using mass balance calculations based on the measured inlet total sulfur content as allowed by EPA Method 19.

**EPA Method 1.** This method is used to determine the duct or stack area and appropriate traverse points that represent equal areas of the duct for sampling and velocity measurements. The point selection is made based on the type of test (particulate or velocity), the stack diameter and port location distance from flow disturbance.

**For the Continuous Emission Monitoring procedures (EPA Methods 7E, 3A, & 10),** a sample is extracted from the exhaust stack conditioned and analyzed by continuous monitoring gas analyzers in a test van. The sampling system consists of a stainless steel sample probe, heated Teflon sample line, glass-fiber particulate filter, glass moisture-condensation knockouts, Teflon sample transfer tubing, diaphragm pump and a stainless steel/Teflon manifold and flow control system. A constant sample and calibration gas supply pressure of 5 PSI is provided to each analyzer to avoid pressure variable response errors. The entire sampling system is leak checked before and after the sampling program. The BE sampling and analytical system is checked for linearity with zero, mid and high span calibrations, and is checked for system bias at the beginning and end of each test run. System bias is determined by pulling calibration gas through the entire sampling system. Individual test run calibrations will use the calibration gas that most closely matches the stack gas effluent. The calibration gases will be selected to fall approximately within the following instrument ranges; 80 to 90 percent for the high calibration, 40 to 60 percent for the mid range and zero. An additional low NO<sub>x</sub> calibration gas in the 20 to 30 percent range may also be used. Zero and calibration drift values and system bias will be determined for each test run.

**The reference method system and test results will meet the following criteria:**

Parameter	Limits
<b>System Criteria</b>	
Instrument Linearity	± 2% Calibration Span
System Bias	± 5% Calibration Span
Calibration Gas	± 2% Value
NO <sub>x</sub> converter efficiency	> 90%
<b>Test Criteria</b>	
Instrument Zero Drift	± 3% Calibration Span
Instrument Span Drift	± 3% Calibration Span

A 12-point traverse will be performed through the two available sample ports according to EPA Method 7E.

**EPA 25A (THC by FID)** is an accepted method for the determination of THC. A flame ionization detector (FID) total hydrocarbon continuous monitor is used for the sampling. The sampling and calibrations are performed through an all heated sample line connected directly to the THC analyzer without the removal of moisture. The FID in the analyzer is heated to 185 °C. The calibration gases are selected to fall within the following instrument ranges; 80 to 90 percent for the high calibration, 45 to 55 percent for the mid range calibration, 25 to 35 percent for the low range calibration and zero. Zero and mid calibration drift values are determined for each test run. A methane cut can be

performed by passing stack gas through activated charcoal to determine stack methane concentration. Bag samples will be collected through activated charcoal during each run and analyzed at the end of each run with the THC analyzer.

**EPA Method 25A will meet the following QA/QC method requirements:**

**System Criteria**

Instrument Linearity  $\leq 5\%$  Calibration Gas Conc.

**Test Criteria**

Instrument Zero Drift  $\leq 3\%$  Span Range

Instrument Span Drift  $\leq 3\%$  Span Range

The following continuous monitoring analyzers or equivalents will be used:

<u>Parameter</u>	<u>Make Model</u>	<u>Principle</u>
NO <sub>x</sub>	CAI 600CLD	Chemiluminescence
O <sub>2</sub>	CAI 100P	Paramagnetic
CO	TECO 48i	GFC/NDIR
THC/CH <sub>4</sub>	CAI 300M	Flame Ionization Detector

The following expected concentrations and calibration ranges are proposed. Certain gases and instrument ranges may be changed depending on availability and stack concentrations at the time of testing.

Anticipated Emissions & Test Van Measurement Ranges

	<u>Expected</u>	
NO <sub>x</sub>	15 ppm	Range 0-50 ppm
O <sub>2</sub>	12.5%	Range 0-25%
CO	<10 ppm	Range 0-50 ppm
THC/CH <sub>4</sub>	<10 ppm	Range 0-100 ppm (as methane)

Anticipated Calibration Gas Concentrations

	<u>Low Range</u>	<u>Mid Range</u>	<u>High Range</u>
NO <sub>x</sub>	N.A.	22.5 ppm	45 ppm
O <sub>2</sub>	N.A.	12.5%	21.0%
CO	N.A.	25 ppm	45 ppm
THC/CH <sub>4</sub>	25.0	45	85

All calibration gases are EPA Protocol #1 rated or are traceable to the National Institute of Standards and Technology. Calibration gas certificates will be included in the final test report. The analyzer data recording system consists of a digital strip chart and a computer Data Acquisition System (DAS).

**EPA Method 19** is used to determine stack gas volumetric flow rates using oxygen-based F-factors. F-factors are ratios of combustion gas volumes generated from heat input. The heating value of the fuel in BTU per cubic foot is determined from lab analysis of the fuel gas samples using ASTM D-



1945/3588 gas chromatography analytical procedures. Total fuel consumption for the flare is monitored on the systems control panel. During each test run gas readings and samples were taken and used for determining the stack flow rate. The total cubic feet per hour of fuel multiplied times the BTU/cf provides million BTU per hour (MMBtu/hr) heat input. The heat input in MMBtu/hr is multiplied by the F-factor (DSCF/MMBtu) and adjusted for the measured oxygen content of the source to determine volumetric flow rate. The flow rates are used to determine stack emission rates.

**EPA Method TO-15 & D-5504 analysis** is used to determine concentrations of Organic and inorganic compounds including Non-methane Organic Compounds (NMOC) and sulfurs compounds. Inlet gases are filled into tedlar bags in triplicate corresponding to the test program. The bags are labeled respectively then sent to a laboratory and analyzed for NMOC and speciated compounds using GC/MS (gas chromatography/mass specrometer) within 72 hours and GC/SCD (gas chromatography/Sulfur Chemiluminescence Detector) within 24 hours for sulfur.

**EPA Method ASTM D-1945 & D-3588 analysis** is used to determine the composition of gaseous fuels (e.g. Methane, fixed gases & BTU Content). Inlet gases are filled into a tedlar bag, the bag is labeled respectively then sent to a laboratory and analyzed for fixed gases, methane and C<sub>1</sub>-C<sub>6</sub> using GC/FID (gas chromatography/flame ionization detector). Each compound has calorific values that are used to calculate the combustion factors.

## **5.0 QA & QC Procedures:**

QA/QC Program: All quality assurance and quality control procedures will be followed as prescribed in the appropriate methods and Ahtna Quality Assurance Project Plan Former Fort Ord, California, Volume 1 Appendix D, Draft Final Revision 1 Operable Unit 2 Landfills.

Adherence to QA/QC procedures during field test preparation and field sampling will be the responsibility of the QA/QC Officer and/or Project Manager. This test program would include all QA/QC procedures specified in the test methods (equipment calibration, field data recording, contamination control and record keeping). Analytical QA/QC protocol will be the responsibility of the Analytical Liaison (Ahtna), and the laboratory manager and QA/QC coordinator assigned to this program by the laboratory Ahtna has subcontracted. Any deviations from stated protocols not mentioned herein would be discussed with the appropriate individuals prior to implementation.

Chain of Custody: A sample is considered to be under a person's custody if (1) if in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person that no one can tamper with the sample, or (4) secured by that person in an area which is restricted to authorized personnel. The following steps are taken to ensure sample identification and integrity:

- 1) Sample labels (identity, #, date, time)
- 2) C.O.C. seals (with sample #)
- 3) Field sample log book and field notes

- 4) C.O.C. record and analysis request sheet
- 5) Shipping papers (Courier, Fed. Ex.)
- 6) Receiving/Log-in (signed receipt of samples and their condition)

Once the sample has been received in the laboratory and the status of the sample integrity has been determined, the lab QA/QC supervisor is responsible for care and custody. The lab should be prepared to testify to the possession and security of the sample until analysis is complete.

In addition to the QA/QC procedures mentioned, BE uses EPA Protocol or 1% NIST Traceable calibration gases.

### **6.0 Source Test Report:**

Data reduction/reporting procedures: All data reduction is performed using Excel spreadsheet programs developed by BE. The report will be written by a senior project manager and will be reviewed by his peers. All supporting documentation, field data sheets, lab reports, lab and field QA/QC reports, emission calculations, etc., will be included in the final report. Calculations are contained in the referenced methods and in the APCD/AQMD source Test Procedure Guidelines where applicable. The expected date for a final report is approximately two weeks after the analytical work is completed. The analytical turn around time is approximately two to three weeks.

Submitted by,



Bobby Asfour  
Sr. Project Manager

### **Attachments:**

**Calculations and Nomenclature**  
**Sample System diagrams**  
**Report table of contents-Example**  
**Example Tabulated Data**  
**Stack Images**  
**Site Map and Regional Map**

## ***ATTACHMENTS***

**Standard Abbreviations for Reports**

Unit	Abbreviation	Unit	Abbreviation
billion	G	microgram	µg
Brake horsepower	bhp	milligram	mg
Brake horsepower hour	bhp-hr	milliliter	ml
British Thermal Unit	Btu	million	MM
capture efficiency	CE	minute	min
destruction efficiency	DE	Molecular Weight	M
Dry Standard Cubic Feet	DSCF	nanogram	ng
Dry Standard Cubic Feet per Minute	DSCFM	Parts per Billion	ppb
Dry Standard Cubic Meter	DSCM	Parts per Million	ppm
Dry Standard Cubic Meter per Minute	DSCMM	pennyweight per firkin	pw/fkn
grains per dry standard cubic foot	gr/DSCF	pound	lb
gram	g	pounds per hour	lbs/hr
grams per Brake horsepower hour	g/bhp-hr	pounds per million Btu	lbs/MMBtu
kilowatt	kW	second	sec
liter	l	Specific Volume, ft <sup>3</sup> /lb-mole	SV
Megawatts	MW	Thousand	k
meter	m	watt	W

**Common Conversions / Calculations / Constants**

1 gram = 15.432 grains

1 pound = 7000 grains

grams per pound = 453.6

bhp = 1.411 \* Engine kW, (where Engine kW = Generator kW output / 0.95) @ 95% efficiency

g/bhp-hr = 453\*ppm\*(MW / (385E6))\* 0.00848 \* f-factor \* (20.9 / (20.9-O<sub>2</sub>)); **CARB**

g/bhp-hr = lbs/hr \* 453.6 / bhp

2.59E-9 = Conversion factor for ppm to lbs/scf; **EPA 40CFR60.45**

Correction Multiplier for Standard Temperature = (460 + T<sub>std.</sub> °F) / 528

dscf / MMBTU = 8710 for Natural gas; **EPA Method 19**

Btu/ft<sup>3</sup> = 1040 for Natural Gas; **EPA Method 19**

lb/hr Part. Emission Rate = 0.00857 \* gr/dscf \* dscfm; **EPA Method 5**

lbs/hr = ppm / SV x dscfm x M \* 60; **CARB Method 100**; where SV ≈ 385E<sup>6</sup> @ 68°F or ≈ 379E<sup>6</sup> @ 60°F or ≈ 386E<sup>6</sup> @ 70°F.

Correction to 12% CO<sub>2</sub> = gr/dscf \* 12% / stack CO<sub>2</sub>%; **EPA Method 5**

Correction to 3% O<sub>2</sub> = ppm \* 17.9 / (20.9 - stack O<sub>2</sub> %); **CARB Method 100**

Correction to 15% O<sub>2</sub> = ppm \* 5.9 / (20.9 - stack O<sub>2</sub> %); **CARB Method 100**

dscfm = Gas Fd \* MMBtu/min \* 20.9 / (20.9 - stack O<sub>2</sub> %); **EPA Method 19**

lb/MMBtu = Fd \* M \* ppm \* 2.59E-9 \* 20.9 / (20.9 - stack O<sub>2</sub> %); **EPA Method 19**

**Standard Temperatures by District**

EPA	68 °F	NSAPCD - Northern Sonoma	68 °F
CARB	68 °F	PCAPCD - Placer	68 °F
BAAQMD - Bay Area	70 °F	SLOCAPCD - San Luis Obispo	60 °F
SJVUAPCD - San Joaquin	60 °F	SMAQMD - Sacramento	68°F de facto
SCAQMD - South Coast	60 °F	SCAQMD - Shasta County	68 °F
MBUAPCD - Monterey Bay	68 °F	YSAPCD - Yolo-Solano	68 °F
FRAQMD - Feather River	68 °F	AADBAPC - Amador County	68 °F

**EPA Method 1**

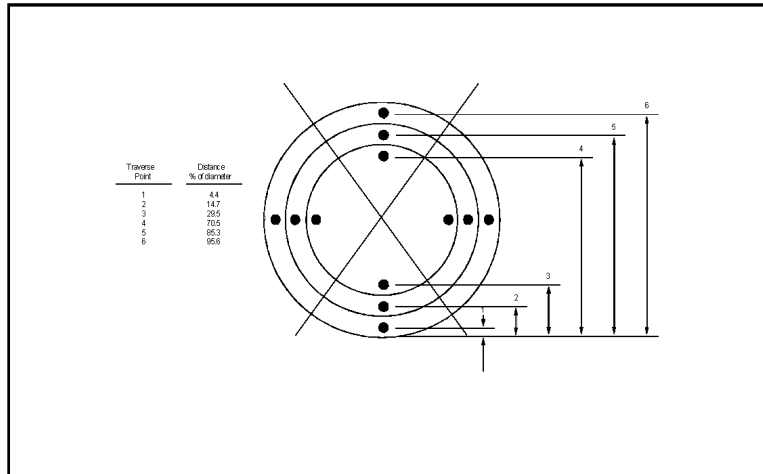


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse areas.

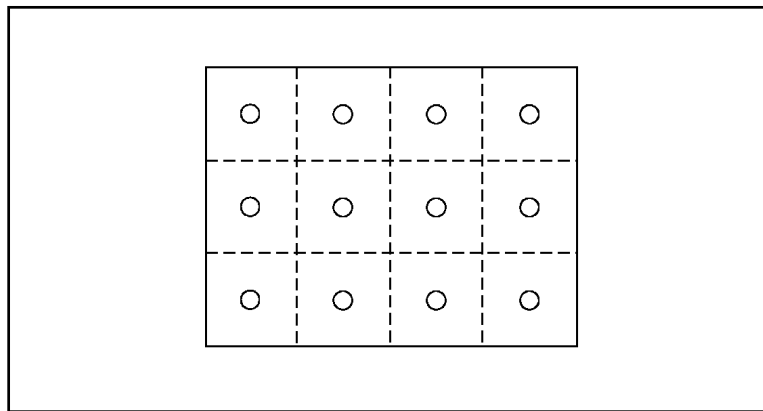
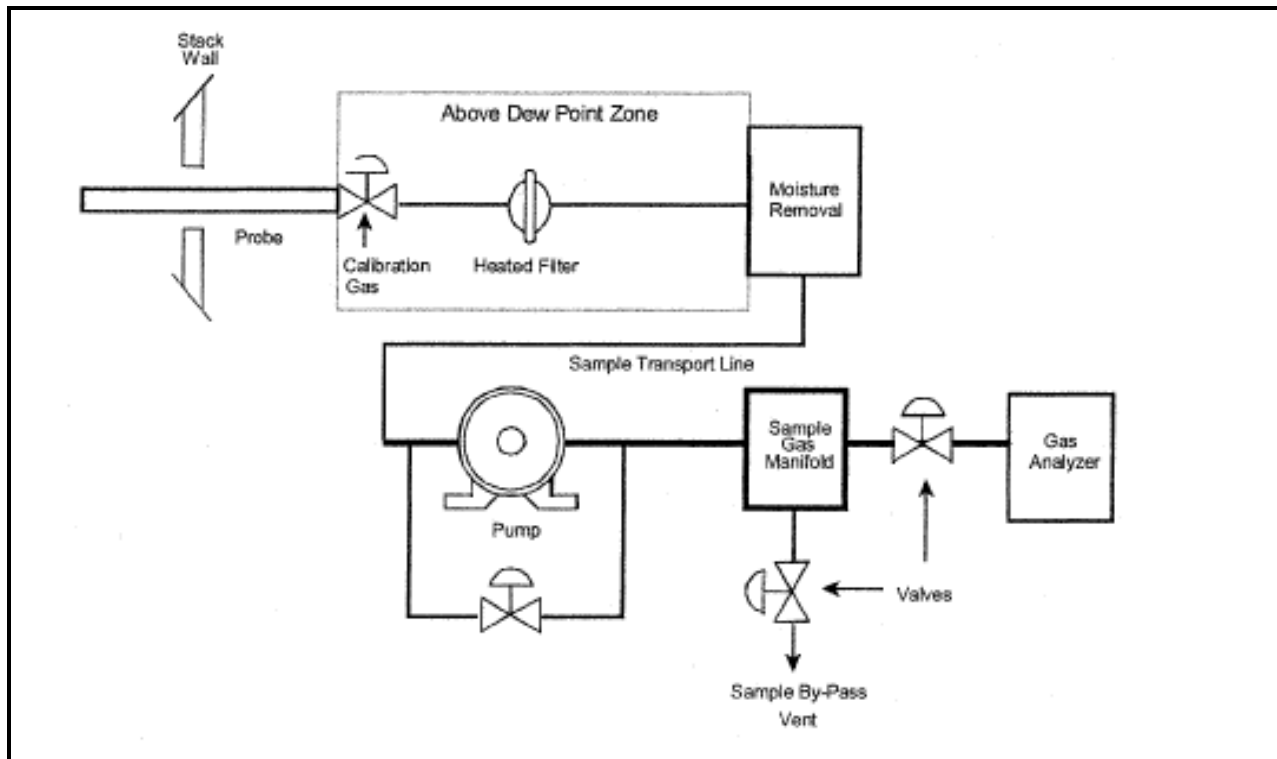


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with traverse points at centroid of each area.

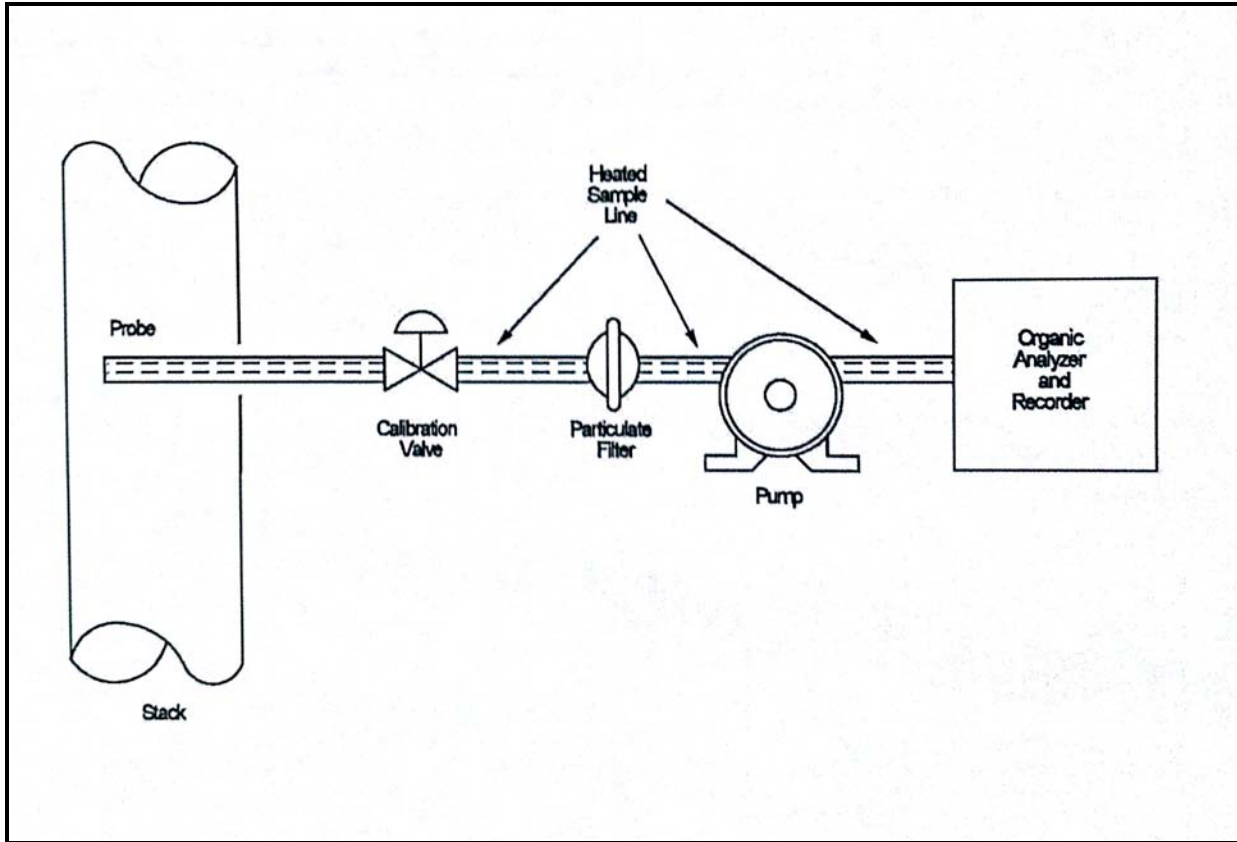


**EPA Methods 3A, 6C, 7E & 10**



**CEM Sampling Train**

**EPA Method 25A**



**Organic Concentration Measurement System**



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**TABLE #1**  
**EXAMPLE**  
**NO<sub>x</sub>, CO, THC, NMOC & SO<sub>x</sub> Emissions Results**  
**TTU**

TEST	1	2	3	AVERAGE	LIMIT
Test Location	Outlet	Outlet	Outlet		
Test Date	6/3/15	6/3/15	6/3/15		
Test Time	1026-1106	1120-1200	1208-1248		
Standard Temp., °F	68	68	68		
Flare Temp., °F	1,649	1,647	1,645		
Fuel F-Factor, DSCF/MMBtu	10,204	10,201	10,203		
Flare, MMBtu/hr	2.31	2.34	2.34	2.33	
Flare Load, %	9.6%	9.7%	9.7%	9.7%	
Inlet Methane (CH <sub>4</sub> ) Content, %	41.0%	41.0%	N.M.		
Inlet Fuel Flow Rate, DSCFM	94	95	95	95	
Outlet Flow Rate, DSCFM	1,028	1,004	1,018	1,017	
O <sub>2</sub> , %	12.91	12.63	12.74	12.76	
CO <sub>2</sub> , %	7.2	7.4	7.3	7.3	
H <sub>2</sub> O, %	8.9	9.1	9.0	9.0	
NO <sub>x</sub> , ppm	16.18	16.58	16.26	16.34	
NO <sub>x</sub> , lbs/hr	0.119	0.119	0.119	0.119	
NO <sub>x</sub> , lbs/day	2.86	2.86	2.85	2.86	
<b>NO<sub>x</sub>, lbs/MMBtu</b>	0.05	0.05	0.05	<b>0.05</b>	<b>0.06</b>
CO, ppm	<0.50	<0.50	<0.50	<0.50	
CO, lbs/hr	<0.002	<0.002	<0.002	<0.002	
CO, lbs/day	<0.05	<0.05	<0.05	<0.05	
<b>CO, lbs/MMBtu</b>	<0.0010	<0.0009	<0.0009	<b>&lt;0.0009</b>	<b>0.40</b>
THC, ppm (Wet)	1.09	<1.00	<1.00	<1.03	
THC, ppm (Dry)	1.19	<1.10	<1.10	<1.13	
THC, lbs/hr as methane	0.003	<0.003	<0.003	<0.003	
<b>THC, lbs/MMBtu as methane</b>	0.0013	<0.0012	<0.0012	<b>&lt;0.0012</b>	<b>0.03</b>
CH <sub>4</sub> , ppm as methane	<1.00	<1.00	<1.00	<1.00	
CH <sub>4</sub> , lbs/hr as methane	<0.003	<0.003	<0.003	<0.003	
CH <sub>4</sub> , lbs/MMBtu as methane	<0.0011	<0.0011	<0.0011	<0.0011	
NMOC, ppm as methane	<1.00	<1.00	<1.00	<1.00	
NMOC, ppm @ 3% O <sub>2</sub> as Methane	<2.24	<2.16	<2.19	<2.20	
NMOC, ppm @ 3% O <sub>2</sub> as Hexane	<0.37	<0.36	<0.37	<0.37	
NMOC, lbs/hr as methane	<0.003	<0.003	<0.003	<0.003	
NMOC, lbs/day as methane	<0.06	<0.06	<0.06	<0.06	
NMOC, lbs/MMBtu as methane	<0.0011	<0.0011	<0.0011	<0.0011	
Test Location	Inlet	Inlet	Inlet		
Inlet NMOC, ppm as methane (ASTM D-1945)	590.0	630.0	N.M.	610.0	
Inlet NMOC, lbs/hr as methane	0.138	0.149	N.M.	0.144	
<b>NMOC, Removal Efficiency %</b>	<b>&gt;98.15%</b>	<b>&gt;98.32%</b>	N.M.	<b>&gt;98.23%</b>	<b>98</b>
Inlet Total Sulfur, ppm as H <sub>2</sub> S	1.20	1.20	N.M.	1.20	
<b>Inlet Total Sulfur, grs/100scf as H<sub>2</sub>S</b>	0.08	0.08	N.M.	<b>0.08</b>	<b>50.00</b>
Inlet Total Sulfur, lbs/hr as SO <sub>2</sub>	0.0011	0.0011	N.M.	0.0011	
<b>Outlet SO<sub>2</sub>, ppm (Calculated)</b>	0.11	0.11	N.M.	<b>0.11</b>	<b>2000</b>
Inlet Total Sulfur, g/scf	0.00009	0.00009	N.M.	0.0001	

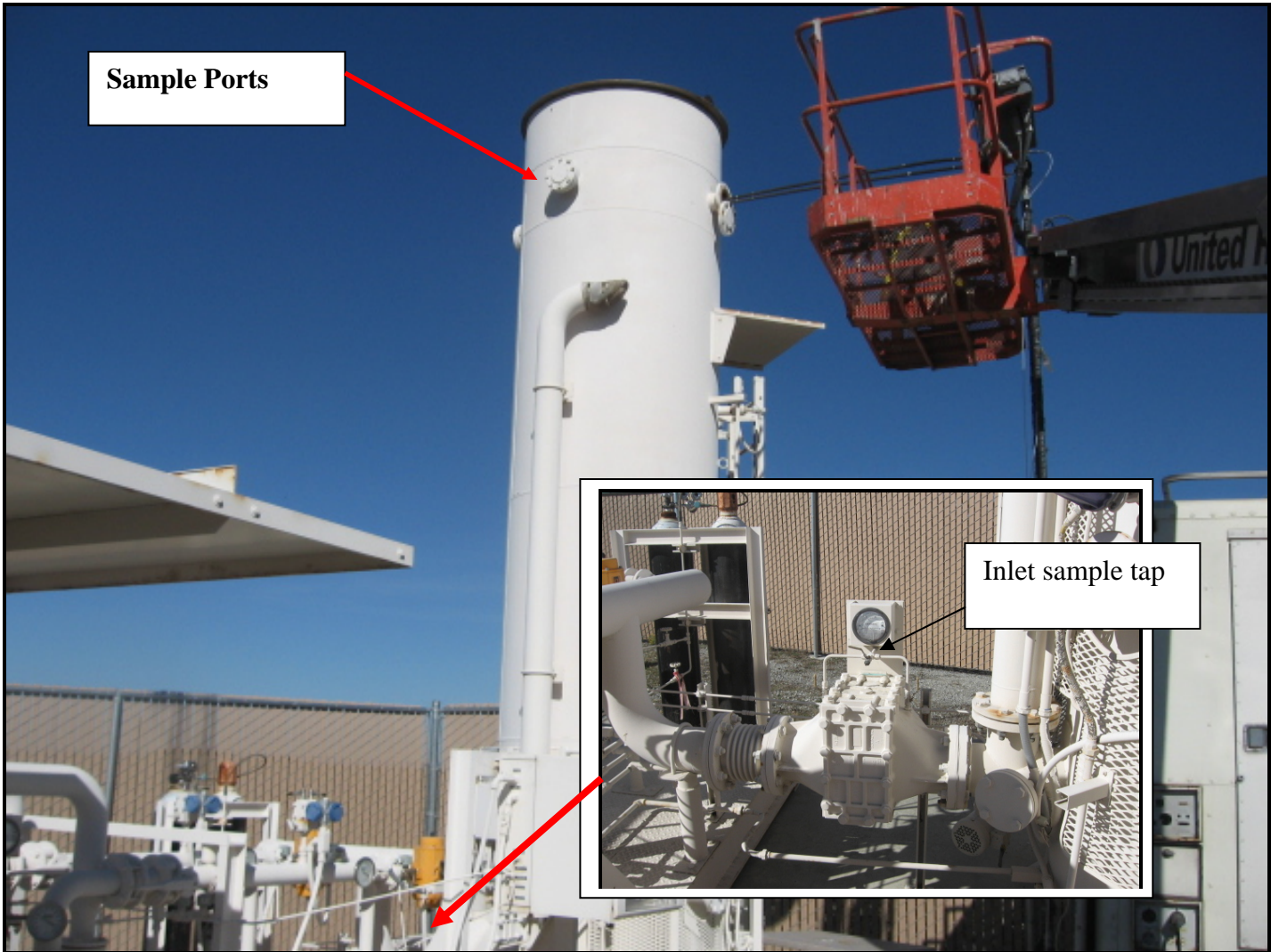
**WHERE:**

MW = Molecular Weight  
DSCFM = Dry Standard Cubic Feet Per Minute  
ppm = Parts Per Million Concentration  
lbs/hr = Pound Per Hour Emission Rate  
CO = Carbon Monoxide (MW = 28)  
NO<sub>x</sub> = Oxides of Nitrogen as NO<sub>2</sub> (MW = 46)  
THC = Total Hydrocarbons as Methane (MW = 16)  
SO<sub>2</sub> = Sulfur Dioxide (MW = 64)  
H<sub>2</sub>S = Hydrogen Sulfide (MW = 32)  
lbs/MMBtu = Pounds per million BTU  
g/scf = grams per standard cubic foot of inlet gas  
gr/100scf = grains per 100 standard cubic foot of inlet gas  
NMOC = Total Non-Methane Hydrocarbons as Methane (MW = 16) CH<sub>4</sub>  
NMOC = Total Non-Methane Hydrocarbons as Hexane (MW = 86.18) C<sub>6</sub>H<sub>14</sub>

**CALCULATIONS:**

lbs/hr = ppm \* MW \* DSCFM \* 60 / 385E6 (Tstd 68°F)  
lbs/day = lbs/hr \* 24  
Removal Efficiency = (inlet lbs/hr - outlet lbs/hr) / Inlet lbs/hr  
ppm @ 3% O<sub>2</sub> = ppm \* 17.9 / (20.9 - stack O<sub>2</sub>)  
lbs/MMBtu = Fd \* M.W. \* ppm \* 2.59E-9 \* (20.9 / (20.9 - %O<sub>2</sub>))  
ppm dry = ppm wet \* (100 / (100 - H<sub>2</sub>O%))  
g/scf = lbs/hr \* 453 / (Inlet SCFM \* 60)  
gr/100scf = ppm H<sub>2</sub>S \* 0.0626285  
SO<sub>2</sub> ppm (outlet) = lbs/hr / (DSCFM \* M.W. \* 60) \* 385E6

# Former Fort Ord TTU



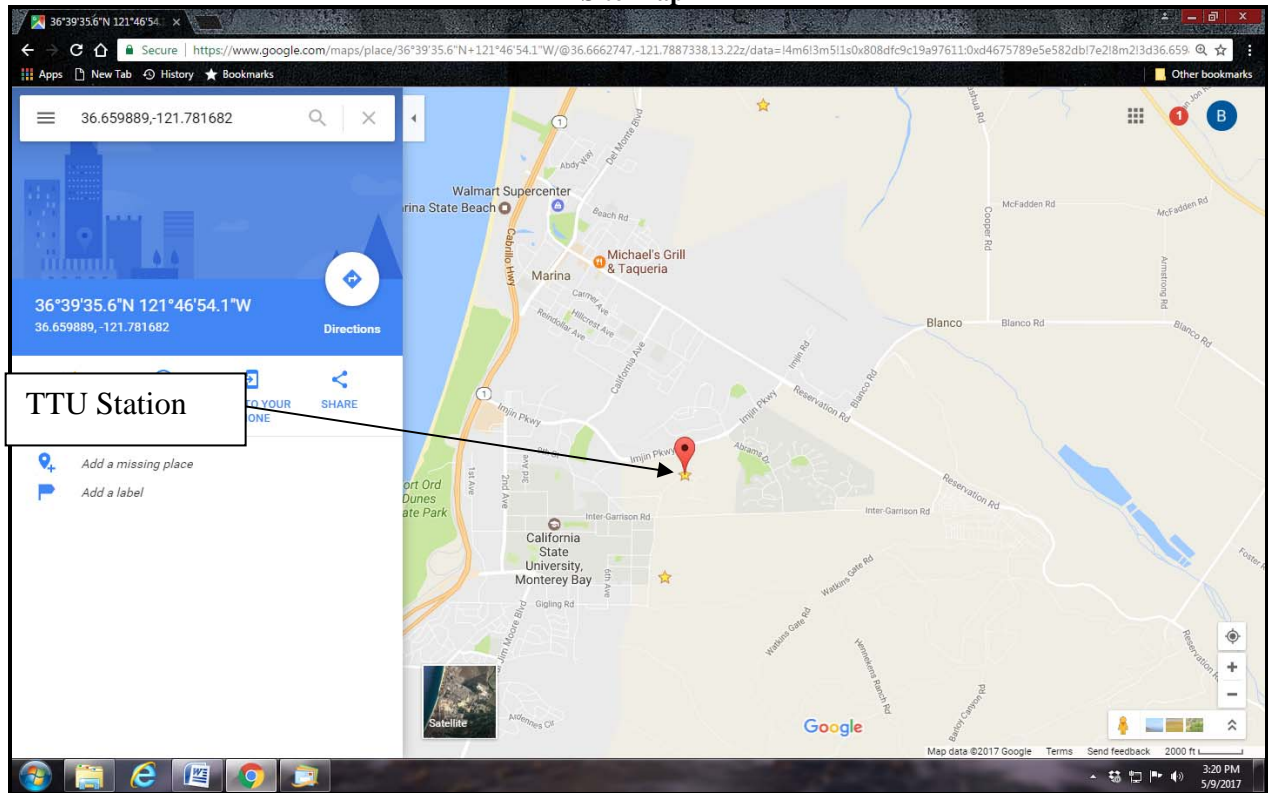
# Former Fort Ord Monterey, CA

## Thermal Treatment Unit (TTU)

### Site Map and Regional Map



Site Map



Regional Map

## **ATTACHMENT C**

### Field Documentation Forms

Ph Jeff Fenton  
Ft. Ord. GW monitoring 0406  
12/14

Team 2  
SB/SK  
Sounder 36392  
Cor. -.06

0746 @ MW-02-04-180 WL-94.57  
SN2 @ 103' Cor. -.06

0757 sampled # 0650L002024F  
Dropped 1 @ 2

0808 @ MW-12-05-180 WL-74.61  
SN3 @ 88' Cor. -.06

<sup>18</sup>  
0820 sampled # 0650L012025F & 026D  
Dropped 1 @ 3

0835 @ MW-10-04-180 WL-259.75  
SN2 @ 271' Cor. -.06

0845 sampled # 0650L010027F  
Dropped 1 @ 2

0902 @ MW-002-25-A WL-129.38  
SN4 @ 146' Cor. -.06

0910 sampled # 0650L002028F  
Dropped 1 @ 4

0919 @ MW-002-53-180 WL-204.09  
SN5 @ 259' Cor. -.06

0927 sampled # 0650002029F  
Dropped 1 @ 5

0934 @ MW-002-39-180 WL-203.99  
SN4 @ 244' Cor. -.06

0943 sampled # 0650L002030F  
Dropped 1 @ 4

Team 2  
SB/SK  
12/14/06

0950 @ MW-002-24-180 WL-187.97  
SN3 @ 214 Cor. -.06

1002 sampled # 0650L002031F  
Dropped 1 @ 3

1009 @ MW-002-09-180R WL-156.08  
SN2 @ 199' Cor. -.06

<sup>1022</sup>  
1024 sampled # 0650L002032F & 033D  
Dropped 1 @ 2

1029 @ MW-002-06-A WL-106.26  
SN6 @ 128' Cor. -.06

1039 sampled # 0650L002034F  
Dropped 1 @ 6

1046 @ MW-002-06-180R WL-157.87  
SN4 @ 214' Cor. -.06

1053 sampled # 0650L002035F (ms/msd)  
Dropped 1 @ 4

1110 @ MW-002-07-180R WL-182.36  
SN3 @ 233' Cor. -.06

1117 sampled # 0650L002036F  
Dropped 1 @ 3

1123 @ MW-002-05-180 WL-155.49  
SN4 @ 215' Cor. -.06

1130 sampled # 0650L002037F  
Dropped 1 @ 1

**UNITED STATES ARMY CORPS OF ENGINEERS  
PROJECT SITE SAFETY LOG**

**GENERAL DATA**

Job # \_\_\_\_\_

Activity \_\_\_\_\_

Location Description \_\_\_\_\_

**DOCUMENTATION OF DAILY MORNING SAFETY MEETING:  
TOPICS OF DISCUSSION (check all that apply)**

_____ scope of work/SAP	_____ PPE requirements
_____ potential hazards	_____ equipment calibration
_____ health and safety plan highlights/revisions	_____ special topics (specify) _____
_____ emergency procedures	_____

**MEETING ATTENDEES:**

NAME	DATE	COMPANY	SIGNATURE

**DAILY INSPECTIONS: (Site crew chief shall initial each completed inspection)**

_____ PPE	_____ required eyewash station filled, and charged
_____ field equipment	_____ fire extinguisher
_____ vehicles	_____ communication check
_____ safety equipment	method _____
_____ field health and safety binder in vehicle	time _____
_____ first aid kit	

Note any deficiencies:

\_\_\_\_\_

\_\_\_\_\_

I acknowledge that the above health and safety program self audit and inspections have been performed prior to the initiation of scheduled work.

Signature of Site Health and Safety Officer (SHSO) \_\_\_\_\_

**LIST OF AUTHORIZED VISITORS NOT NORMALLY ASSIGNED TO THIS SITE**

(Note: SHSO must initial verification that each personnel record is present in the field binder.)

NAME	HAZWOPER CERTIFICATION	MEDICAL CLEARANCE	RESPIRATOR FIT TEST	FIRST AID/CPR



I have read and become familiar with all aspects of the Site Safety and Health Plan. I also understand that the Site Safety and Health Plan may be supplemented with other site--specific health and safety documents for which I will be held equally responsible.

NAME	DATE	COMPANY	SIGNATURE





# INSTRUMENT CALIBRATION RECORD

Daily Log	Date:			
	No.			
	Sheet	1 Of		1

PROJECT NAME: FORT ORD, CA	Project Number: 05055.02.15
----------------------------	-----------------------------

FIELD ACTIVITY SUBJECT:	Calibration of Landtec GEM 2000
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DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

Landtec Calibration Gas (high-level) Lot# \_\_\_\_\_, Expiration Date: \_\_\_\_\_

Compound	Initial Reading	Calibrated to	Comments
CH4		50%	
CO2		35%	

Landtec Calibration Gas (Oxygen) Lot# \_\_\_\_\_, Expiration Date: \_\_\_\_\_

Compound	Initial Reading	Calibrated to	Comments
O2		4%	

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:

WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:

PERSONNEL ON SITE:

SIGNATURE:	DATE:
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## **ATTACHMENT D**

### Three Phase Quality Control Process and Documentation

**PREPARATORY PHASE INSPECTION COVER SHEET**

Contract No.: \_\_\_\_\_

Date: \_\_\_\_\_

Task No.: \_\_\_\_\_

Location/Project: \_\_\_\_\_

**A. Key Personnel Present:**

	<u>Name</u>	<u>Position</u>	<u>Company</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____

**B. Submittals:**

1. Review submittals and/or submittal register. Have all applicable submittals been approved?  
Yes \_\_\_ No \_\_\_

If No, what items have not been submitted?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

\_\_\_\_\_  
USACE Representative Signature

\_\_\_\_\_  
Quality Control Manager Signature

### INVESTIGATION PROJECT PREPARATORY PHASE INSPECTION CHECKLIST

Assessment Activity	Assessment Mechanism	Person(s) Responsible	Response Action	Completed by/Date
Have planning documents been prepared in accordance with the statement of work, regulatory requirements, and contract requirements?	Quality control review of document by Project Manager and QC reviewer.	Project Manager, QC Reviewer	Modify document as directed by reviewers	
Prior to project activities: Have planning documents been read by appropriate project personnel (including subcontractors) before work is conducted.	Documentation (e.g., sign-off form, note to file, email acknowledgement) that document has been read and requirements are understood.	Subcontractors as required. Project Manager, Task Manager, and Project Chemist to check signoff and forms.	Direct project personnel to read relevant documents.	
Prior to project activities: Has required preliminary work (e.g., clearance activities, permits, site access) been completed in accordance with project plan.	Comparison of information obtained from preliminary work completion assessment as specified in the project planning document(s).	Project Manager, Safety and Health Officer, Quality Control Manager, Task Manager, Project Chemist, Field Staff	Delay startup if necessary preliminary work has not been completed. Implement corrective actions by directing appropriate personnel or subcontractors to complete necessary preliminary work.	
Prior to project activities: Are staff and subcontractors prepared to implement project activities according to planning documents?	Review and discussion of planned activities prior to implementation.	Project Manager, Safety and Health Officer, Quality Control Manager, Task Manager, Project Chemist, Field staff.	Delay startup if staff and subcontractors are not prepared to implement activities <i>in</i> accordance with specification.	
Prior to project activities: Is necessary field equipment available and in acceptable working order?	Compare field equipment list with planned activities. Compare field equipment calibration documentation with project goals specified in the SAP.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, Field staff.	Delay startup if equipment is unavailable or not in proper working order. Implement corrective actions to include use of alternate equipment, or recalibration of available equipment.	

**INITIAL PHASE INSPECTION COVER SHEET**

Contract No.: \_\_\_\_\_

Date: \_\_\_\_\_

Task No.: \_\_\_\_\_

Location/Project: \_\_\_\_\_

Description and Location of Work  
Inspected: \_\_\_\_\_

---

A. Key Personnel Present:

	<u>Name</u>	<u>Position</u>	<u>Company</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____

\_\_\_\_\_  
Quality Control Manager Signature

### INITIAL PHASE INSPECTION CHECKLIST

Assessment Activity	Assessment Mechanism	Person(s) Responsible	Response Action	Completed by/Date
Beginning of project activity: Is work being performed according to project plans?	Conduct field and laboratory audits.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, Field staff.	Stop work if audits indicate significant deviation from project plan. Implement immediate or long- term corrective actions. Communicate deficiencies to USACE Project Manager.	
Early phase of project: Have necessary audits been performed?	Review project phase and check to see if required audits have been satisfactorily completed.	Project Manager, Project Manager, Quality Control Manager_	Stop work if reviewer decides that absence of audit jeopardizes successful implementation of project plans. Immediately schedule necessary audits.	
Ongoing throughout project: Are daily quality control reports being prepared according to contract requirements?	Review daily CQCRs from field supervisors.	Project Manager, Task Manager, Project Chemist, Project Staff	Correct deficiencies in reports or reporting delays.	
Ongoing throughout project: Do project plans adequately address any changes in project activities or goal?	Compare data gathered to assess conformance to the project plan and conceptual site model.	Project Manager, Safety and Health Officer, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Stop work if assessor decides that project plan deficiencies are significant. Implement corrective action to include modification of project plans. Notify USACE Project Manager.	
Ongoing throughout project: Do project plans adequately address any changes in project activities or goals?	Compare data gathered to assess conformance to the conceptual site model, data quality objectives, and project plan.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Stop work if assessor decides that project plan deficiencies are significant. Implement corrective action to include modification of project plans. Notify USACE Project Manager. Identify data gaps.	





**FOLLOW-UP PHASE INSPECTION CHECKLIST**

<b>Assessment Activity</b>	<b>Assessment Mechanism</b>	<b>Person(s) Responsible</b>	<b>Response Action</b>	<b>Completed by/Date</b>
Reporting phase of project: Have data reports been prepared in accordance with project plans?	Compare data reports to specifications detailed in planning documents.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Revise documents and reports as appropriate.	
After draft report submittal or project completion: Are reports adequate to meet client and regulatory agency requirements?	Review client and agency comments. Prepare responses to comments.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Revise documents and reports as appropriate.	
Have other definable features of work been completed in accordance to project requirements	Compare definable features of work with project requirements.	Project Manager, Quality Control Manager	Complete definable feature of work as required.	

## **ATTACHMENT E**

### **Electronic Data Deliverable File Specifications**

## **ADR Electronic Data Deliverable (EDD) File Specifications**

The ADR EDD consists of three separate, comma-delimited ASCII text files or Excel CSV files (two, if instrument calibration information is not required by the project). Each file corresponds to a table in the ADR application. These tables are identified as the Analytical Results Table (A1), Laboratory Instrument Table (A2), and Sample Analysis Table (A3). Each file follows the naming convention of using the Laboratory Reporting Batch ID (SDG Number or some other identifier for the EDD) followed by the table identifier (A1, A2, or A3), and then a ".txt" or ".csv" extension. For example, the EDD file names for a laboratory reporting batch identified as SDG001 that includes instrument calibration data would be as follows.

SDG001A1.txt or SDG001A1.csv  
SDG001A2.txt or SDG001A2.csv (A2 file is optional)  
SDG001A3.txt or SDG001A3.csv

### **Analytical Results Table (A1 File)**

The Analytical Results table contains analytical results and related information on an analyte level for field samples and associated laboratory quality control samples (excluding calibrations and tunes). Field QC blanks and laboratory method blanks must report a result record for each analyte reported within a method. The method target analyte list is matrix dependent and specified in the project library. Laboratory control samples (LCS and LCSD) and matrix spike samples (MS and MSD) must report a result record for every analyte specified as a spiked analyte in the project library. The project library is a reference table ADR uses for both EDD error checking and automated data review. The project library is populated with information from the project QAPP. Refer to the User Manual for detailed information on project libraries. Table 1 in this document lists all field names and their descriptions for the Analytical Results Table (A1).

### **Laboratory Instrument Table (A2 File)**

The Laboratory Instrument table contains results and related information on an analyte level for instrument initial calibration standards, initial calibration verification standards, continuing calibration standards, and GC/MS tunes. A record must exist for each target analyte reported in a method (specified in the project library), for every calibration type (the field named QCType) associated to samples reported in the EDD. Initial calibrations, initial calibration verifications, and associated samples are linked to each other using a unique Run Batch ID for every distinct initial calibration within a method. Continuing calibrations and associated samples are linked to each other using a unique Analysis Batch ID for every distinct continuing calibration within a method. GC/MS tunes are linked to initial and continuing calibrations (and hence samples) using the Run Batch and Analysis Batch IDs respectively. The Laboratory Instrument Table (A2) is optional. Depending on the level of validation required by the data user, the Laboratory Instrument table may not be requested in the deliverable. Table 2 in this document lists field names and descriptions for the Laboratory Instrument Table (A2).

## Sample Analysis Table (A3 File)

The Sample Analysis table contains information on a sample level for field samples and laboratory quality control analyses (excluding calibrations and tunes). A sample record exists for each sample/method/matrix/analysis type combination. Table 3 in this document lists field names and descriptions for the Sample Analysis Table (A3).

## EDD Field Properties

Tables 1, 2, and 3 in this document specify the EDD field properties for each file. These include the field name and sequence, field name description, data type and length for each field, and whether or not a particular field requires a standard field. Field elements in the EDD must be sequenced according to the order they appear in Tables 1, 2, and 3. For example, in the Analytical Result table (the A1 file), the field “ClientSampleID” will always be the first piece of information to start a new line of data (or database record), followed by the fields “LabAnalysisRefMethodID”, “AnalysisType”, and so on.

Table 4 in this document lists standard values for those fields that hold standard values. Required field constraints depend on the combination of sample, matrix, method, analyte type, and calibration or QC type information reported in a record. Tables 5 through 9 in this document indicate required fields for each EDD file (table) according to the method category, matrix, analyte type, sample, and QC or calibration type reported in a record.

When creating an EDD as a text file, use the ASCII character set in a file of lines terminated by a carriage return and line feed. No characters are allowed after the carriage return and line feed. Enclose each data set in double quotes (") and separate each field by a comma (comma delimited). Data fields with no information (null) may be represented by two consecutive commas. For example, in the Sample Analysis table, since the “Collected”, “ShippingBatchID”, and “Temperature” fields do not apply to laboratory generated QA/QC samples, the record for a Laboratory Control Sample by Method 8270C would be entered as follows. Note that the first two fields (“ProjectNumber” and “ProjectName”) are omitted in this example.

...“LCSW100598”,,”AQ”,,”LCSW100598”,,”LCS”,,”8270C”,... (and so on)

Do not pad fields with leading or trailing spaces if a field is populated with less than the maximum allowed number of characters. In the above example, although the “MatrixID” field can accommodate up to 10 characters, only 2 characters were entered in this field.

The EDD can be constructed within Excel and saved as .csv file for import into the application. Be sure to format all cells as text beforehand, otherwise Excel will reformat entered values in some cases.

## Table 1

### Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ClientSampleID	<p>Client or contractor's identifier for a field sample as reported on the chain-of-custody</p> <p>If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field</p> <p>Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the AnalysisType field is used for this distinction). For example, MW01<u>DL</u> and MW01<u>RE</u> are not allowed</p> <p>Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Analytical Results table for both EDDs.</p>	Text	25	NO
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or a Lab Identifier for a method such as a SOP Number, however; method ID is specified by the project. The method ID must be entered into the standard list.	Text	25	YES (specified in project plan)
AnalysisType	Defines the analysis type (i.e., Dilution, Reanalysis, etc.). This field provides distinction for sample result records when multiple analyses are submitted for the same sample, method, and matrix; for example dilutions, re-analyses, and re-extracts.	Text	10	YES (See Table 4)
LabSampleID	<p>Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except for field length and that the LabSampleID must be distinct for a given field sample or lab QC sample and method.</p> <p>Suffixes may be applied to the LabSampleID to designate dilutions, reanalysis, etc.</p>	Text	25	NO
LabID	Identification of the laboratory performing the analyses.	Text	7	NO
ClientAnalyteID	<p>CAS Number or unique client identifier for an analyte or isotope.</p> <p>If a CAS Number is not available, use a unique identifier provided by the client or contractor. The ClientAnalyteID for a particular target analyte or isotope should be specified by the project and must exist in the standard value tables for Analytes.</p> <p>For the LCS, LCSD, MS, and MSD, it is only necessary to report the compounds designated as spikes in the library (and surrogates for organic methods.)</p> <p>For TICs from GC/MS analyses, enter the retention time in decimal minutes as the Client Analyte ID.</p>	Text	12	YES (specified by project)

## Table 1

### Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalyteName	Chemical name for the analyte or isotope. The project specifies how an analyte or isotope is named. The analyte name must be associated to a ClientAnalyteID in the standard values table for Analytes (excluding compounds designated as TIC's).	Numeric	60	YES (specified by project)
Result	Result value for the analyte or isotope.  Entries must be numeric. For non-detects of target analytes or isotopes and spikes, do not enter "ND" or leave this field blank. If an analyte or spike was not detected, enter the reporting limit value corrected for dilution and percent moisture as applicable. Do not enter "0"	Text	10	NO
ResultUnits	The units defining how the values in the Result, DetectionLimit, and ReportingLimit fields are expressed. For radiochemistry this also includes how the value in the Error field is expressed.	Text	10	YES (specified by project in the library)
LabQualifiers	A string of single letter result qualifiers assigned by the lab based on client-defined rules and values.  <u>The "U" Lab Qualifier must be entered for all non-detects.</u> Other pertinent lab qualifiers may be entered with the "U" qualifier. Order is insignificant. Lab qualifiers other than those listed in the standard values table may be used. If so, these must be added to the standard value table in the application.	Text	7	YES (See Table 4)
DetectionLimit	For radiochemistry methods, the minimum detectable activity for the isotope being measured.  For all other methods: The minimum detection limit value for the analyte being measured.  <b>For DoD QSM enter the Limit of Detection (LOD)</b>	Numeric	10	NO
DetectionLimitType	Specifies the type of detection limit (i.e., MDA, MDL, IDL, etc.).	Text	10	YES (See Table 4)
RetentionTime or Error	<u>For radiochemistry methods only</u> , enter the 2 Sigma Counting Error. The units for error are entered in the ResultUnits field.  <u>For GC/MS methods only</u> , enter the time expressed in decimal minutes between injection and detection for <u>GC/MS TICs only</u>  <u>For target analytes in all other methods</u> , leave this field blank. Note: GC retention times are not evaluated at this time.	Text	5	NO
AnalyteType	Defines the type of result, such as tracer, surrogate, spike, or target compound.	Text	7	YES (See Table 4)

## Table 1

### Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRecovery	<p>For radiochemistry methods: The tracer yield, if applicable.</p> <p>For all other analytical methods: The percent recovery value of a spiked compound or surrogate.</p> <p>If the spike or surrogate was not recovered because of dilution, enter "DIL". If a spike or surrogate was not recovered because of matrix interference, enter "INT". If a spike or surrogate was not recovered because it was not added to the sample, enter "NS".</p>	Numeric	5	NO
RelativePercentDifference	<p>The relative percent difference (RPD) of two QC results, such as MS/MSD, LCS/LCSD, and Laboratory Duplicates. Report RPD in Laboratory Duplicate, LCSD, and MSD records only.</p> <p>If the RPD is not calculable, enter "NC".</p>	Numeric	5	NO
ReportingLimit	<p>Reporting limit value for the measured analyte or isotope Factor in the dilution factor and percent moisture correction, if applicable. The Reporting Limit for each analyte and matrix in a given method is specified in the project library or QAPP.</p> <p><b>For DoD QSM enter the Limit of Quantitation (LOQ)</b></p>	Numeric	10	NO
ReportingLimitType	<p>Specifies the type of reporting limit (i.e., CRQL, PQL, SQL, RDL, etc). The Reporting Limit Type for each method and matrix is specified in the project library or QAPP.</p>	Text	10	YES (specified by the project)



## Table 1

### Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ReportableResult	<p>This field indicates whether or not the laboratory chooses an individual analyte or isotope result as reportable. Enter "YES" if the result is reportable. Enter "NO" if the result is not reportable. This field applies to target analytes only.</p> <p>If only one analysis is submitted for a particular sample and method, enter "YES" for all target compounds (where Analyte Type = TRG). For GC/MS methods enter yes for tentatively identified compounds ( where Analyte Type = TIC).</p> <p>If two or more analyses are submitted for a particular sample and method (i.e. initial analysis, reanalysis and/or dilutions), enter "YES" from only <u>one</u> of the analyses for each target compound. For example: a sample was run a second time at dilution because benzene exceeded the calibration range in the initial, undiluted analysis. All target analytes are reported in each analysis. For the initial analysis, (Analysis Type = RES), enter "NO" for benzene and enter "YES" for all other compounds. For the diluted analysis (Analysis Type = DL), enter "YES" for benzene and enter "NO" for all other compounds.</p> <p>For TICs (Analyte Type = TIC), if more than one analysis is submitted for a particular sample and method, choose only one of the analyses where Reportable Result = YES for <u>all</u> TICs. For example, a sample was run a second time because one or more target compounds exceeded the calibration range in the undiluted analysis. Choose a particular analysis and enter "YES" for all TICs. In the other analysis enter "NO" for all TICs.</p> <p>Note that it is not necessary to report the full target analyte list for the initial result, dilution, re-analysis, or re-extraction. However, each target analyte must be reported YES once and once only in the case of multiple analyses for a given sample, method, and matrix. In the case of organics, all surrogates must be reported for all analyses submitted for a given sample, method, and, matrix.</p>	Text	3	YES (See Table 4)
MDL_DoD	<p>This field is not part of the standard ADR EDD format.</p> <p><b>For DoD QSM enter the MDL, otherwise leave blank. (ADR does not perform error checks on this field)</b></p>	Numeric	10	NO

**Table 2****Field Descriptions for the Laboratory Instrument Table (A2 file)**

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. **Do not report Table A2 for radiochemistry methods.**

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
InstrumentID	Laboratory instrument identification.	Text	15	NO
QCType	Type of instrument QC (i.e., Instrument_Performance_Check or type of calibration standard).	Text	10	YES (See Table 4)
Analyzed	Analysis date/time for BFB, DFTPP, initial calibration verification standards, calibration verification standards, and continuing calibration standards. For the <u>initial calibration</u> , enter date and time of the <u>last</u> standard analyzed. Also, see comments about initial calibrations in the Alternate_Lab_Analysis_ID field name description.	Date/Time	*	NO
AlternateLab_AnalysisID	Common laboratory identification used for standards (i.e., VOA STD50, CCAL100, BFB50, etc). For initial calibration, enter ICAL. Information from the initial calibration is entered as one record for each analyte that summarizes the results of the initial calibration (i.e. %RSD, correlation coefficient, and avg RF). Records are <u>not</u> entered for each individual standard within the initial calibration.	Text	12	NO
LabAnalysisID	Unique identification of the raw data electronic file associated with the calibration standard or tune (i.e., 9812101MS.DV). Leave this field blank for the initial calibration. See comments about initial calibrations in the Alternate_Lab_Analysis_ID field description. This field is only applicable where an electronic instrument file is created as part of the analysis.	Text	15	NO
LabAnalysisRefMethodID	Laboratory reference method ID (i.e., 8260B, 8270C, 6010B, etc.). The method ID is specified by the project. The LabAnalysisRefMethodID must be in the standard value list for Method IDs.	Text	25	YES (specified by the project)
ClientAnalyteID	CAS number or unique client identifier for an analyte. If a CAS number is not available, use a unique identifier provided by the client. The unique identifier for a particular analyte should be specified by the project and must exist in the standard value list for ClientAnalyteID.  Records for each calibration must report the full target analyte list including surrogates as applicable. The target analyte list is specified for each method and matrix in the project	Text	12	YES (specified by the project)
AnalyteName	The chemical name for the analyte. The project specifies how an analyte is named. The AnalyteName must be associated to a ClientAnalyteID in the standard values.	Text	60	YES (specified by the project)

**Table 2****Field Descriptions for the Laboratory Instrument Table (A2 file)**

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. **Do not report Table A2 for radiochemistry methods.**

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
RunBatch	Unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The Run Batch ID links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the Run_Batch ID also links a BFB or DFTPP tune and the initial calibration and initial calibration verification standards to associated samples and method QC analyses. A new and unique Run Batch ID must be used with every new initial calibration.	Text	12	NO
AnalysisBatch	<p>Unique laboratory identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The Analysis Batch ID links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the Analysis Batch ID also links the BFB or DFTPP tune. A new and unique Analysis Batch ID must be used with every new continuing calibration or continuing calibration verification.</p> <p>For GC methods, only report opening standards, do not include closing standards (unless the closing standard functions as the opening standard for a subsequent set of analyses, in which case a new and unique Analysis Batch ID is assigned).</p> <p>When dual or confirmation columns/detectors are used, enter results from the primary column/detector only (this is similar to CLP Pesticide reporting).</p>	Text	12	NO
LabReportingBatch	Unique laboratory identifier for a batch of samples including associated calibrations and method QC, reported as a group by the lab (i.e., lab work order #, log-in #, or SDG). Links all instrument calibrations, samples, and method QC reported as a group or SDG.	Text	12	NO
PercentRelativeStandard Deviation	<p>The standard deviation relative to the mean used to evaluate initial calibration linearity. Organic methods may use either %RSD or Correlation Coefficient.</p> <p>If applicable, enter the %RSD. Leave this field blank if the Correlation Coefficient is used.</p>	Numeric	5	NO
CorrelationCoefficient	<p>The correlation coefficient resulting from linear regression of the initial calibration. For metals by ICAP, enter '1.0' if a two-point initial calibration was analyzed. Organic methods may use either %RSD or Correlation Coefficient.</p> <p>If applicable, enter the Correlation Coefficient. Leave this field blank if the %RSD is used</p>	Numeric	5	NO
RelativeResponseFactor	<p>This field applies to GC/MS only.</p> <p>For continuing calibration enter the relative response factor.</p> <p>For initial calibration enter the <u>average</u> relative response factor. Refer to comments about initial calibration records in the field description for Alternate_Lab_Analysis_ID.</p>	Numeric	5	NO

**Table 2****Field Descriptions for the Laboratory Instrument Table (A2 file)**

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. **Do not report Table A2 for radiochemistry methods.**

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
Percent_Difference (or Percent Recovery)	<p>For <u>organic methods</u>, this field is the difference between 2 measured values expressed as a percentage.</p> <p>If %RSD is reported, enter the % difference between the average response factor of the initial calibration (IC) and the response factor of the initial calibration verification (ICV) or continuing calibration (CCV).</p> <p>If correlation coefficient is used, enter the % difference between the true value and the measured value.</p> <p>The Percent_Difference is expressed as a negative or positive value. Do not express Percent_Difference as an absolute value. Use a negative value if the CCV or ICV response factor is less than the IC average response factor or, in the case of correlation coefficient, the CCV or ICV measured value is less than the true value. Use a positive value if the CCV or ICV response factor is greater than the IC average response factor, or in the case of correlation coefficient, the CCV or ICV measured value is greater than the true value.</p> <p>For <u>inorganic methods</u>, this field is the recovery of an analyte expressed relative to the true amount (i.e., %R for a metal in the continuing calibration or initial calibration verification by Method 6010B).</p>	Numeric	5	NO
PeakID01	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 50, for DFTPP enter 51.	Numeric	10	NO
PercentRatio01	<p>For BFB enter the relative percent abundance of m/z 50 measured relative to the raw abundance of m/z 95.</p> <p>For DFTPP enter the relative percent abundance of m/z 51 measured relative to the raw abundance of m/z 198.</p>	Numeric	10	NO
PeakID02	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 75, for DFTPP enter 68.	Numeric	10	NO
PercentRatio02	<p>For BFB enter the relative percent abundance of m/z 75 measured relative to the raw abundance of m/z 95.</p> <p>For DFTPP enter the relative percent abundance of m/z 68 measured relative to the raw abundance of m/z 69.</p>	Numeric	10	NO
PeakID03	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 95, for DFTPP enter 69.	Numeric	10	NO
PercentRatio03	<p>For BFB enter the ion abundance of m/z 95 as 100 percent.</p> <p>For DFTPP enter the relative percent abundance of m/z 69 measured relative to the raw abundance of m/z 198.</p>	Numeric	10	NO
PeakID04	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 96, for DFTPP enter 70.	Numeric	10	NO

**Table 2****Field Descriptions for the Laboratory Instrument Table (A2 file)**

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. **Do not report Table A2 for radiochemistry methods.**

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRatio04	For BFB enter the relative percent abundance of m/z 96 measured relative to the raw abundance of m/z 95.  For DFTPP enter the relative percent abundance of m/z 70 measured relative to the raw abundance of m/z 69	Numeric	10	NO
PeakID05	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 173, for DFTPP enter 127.	Numeric	10	NO
PercentRatio05	For BFB enter the relative percent abundance of m/z 173 measured relative to the raw abundance of m/z 174.  For DFTPP enter the relative percent abundance of m/z 127 measured relative to the raw abundance of m/z 198	Numeric	10	NO
PeakID06	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 174, for DFTPP enter 197.	Numeric	10	NO
PercentRatio06	For BFB enter the relative percent abundance of m/z 174 measured relative to the raw abundance of m/z 95.  For DFTPP enter the relative percent abundance of m/z 197 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID07	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 175, for DFTPP enter 198.	Numeric	10	NO
PercentRatio07	For BFB enter the relative percent abundance of m/z 175 measured relative to the raw abundance of m/z 174.  For DFTPP enter the ion abundance of m/z 198 as 100 percent.	Numeric	10	NO
PeakID08	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 176, for DFTPP enter 199.	Numeric	10	NO
PercentRatio08	For BFB enter the relative percent abundance of m/z 176 measured relative to the raw abundance of m/z 174.  For DFTPP enter the relative percent abundance of m/z 199 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID09	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 177, for DFTPP enter 275.	Numeric	10	NO
PercentRatio09	For BFB enter the relative percent abundance of m/z 177 measured relative to the raw abundance of m/z 176.  For DFTPP enter the relative percent abundance of m/z 275 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID10	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 365.	Numeric	10	NO

## Table 2

### Field Descriptions for the Laboratory Instrument Table (A2 file)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. **Do not report Table A2 for radiochemistry methods.**

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRatio10	For BFB leave blank.  For DFTPP enter the relative percent abundance of m/z 365 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID11	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 441.	Numeric	10	NO
PercentRatio11	For BFB leave blank.  For DFTPP the percent abundance of m/z 441 measured relative to the raw abundance of m/z 443	Numeric	10	NO
PeakID12	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 442.	Numeric	10	NO
PercentRatio12	For BFB leave blank.  For DFTPP enter the relative percent abundance of m/z 442 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID13	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 443.	Numeric	10	NO
PercentRatio13	For BFB leave blank.  For DFTPP enter the relative percent abundance of m/z 443 measured relative to the raw abundance of m/z 442.	Numeric	10	NO

\* Date/time format is: MM/DD/YYYY hh:mm where MM = month, DD = day, YYYY = four digits of the year, hh = hour in 24 hour format, and mm = minutes.

**Table 3**  
**Field Description for the Sample Analysis (A3 file)**

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ProjectNumber	Project number assigned by the client.	Text	30	YES (specified by project)
ProjectName	Project name assigned by the client.	Text	90	YES (specified by project)
ClientSampleID	<p>Client or contractor's identifier for a field sample</p> <p>If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field</p> <p>Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the Analysis_Type field is used for this distinction). For example, MW01DL and MW01RE are not allowed</p> <p>Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Sample Analysis table for both EDDs.</p>	Text	25	NO
Collected	<p><u>For radiochemistry methods</u> the Date of sample collection. Refer to the date format for radiochemistry methods at the end of this table.</p> <p><u>For all other methods</u> the Date and Time of sample collection. Refer to the date/time format at the end of this table.</p> <p>Leave this field blank for Method Blank, LCS, and LCSD</p>	Date/Time	16*	NO
MatrixID	Sample matrix (i.e., AQ, SO, etc.)	Text	10	YES (See Table 4)
LabSampleID	<p>Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD.</p> <p>There are no restrictions for the LabSampleID except field length and that the LabSampleID must be unique for a given field sample or lab QC sample and method.</p>	Text	25	NO
QCType	This record identifies the type of quality control sample QC (i.e., Duplicate, LCS, Method Blank, MS, or MSD). <u>For regular samples, leave this field blank.</u>	Text	10	YES (See Table 4)
ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport client or field samples. Links all samples to a cooler or shipping container. No entry for method blanks, LCS, and LCSD. This field is optional.	Text	25	NO
Temperature	<p>Temperature (in centigrade degrees) of the sample as received.</p> <p><u>This field is not required for radiochemistry methods.</u></p>	Numeric	10	NO

**Table 3**  
**Field Description for the Sample Analysis (A3 file)**

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or laboratory identifier for a method such as a SOP number, however; values used for Laboratory Method IDs are specified by the project and must be contained in the standard value list for method IDs.	Text	25	YES (Specified by the project)
PreparationType	Preparation Method Number (i.e., 3010A, 3510C, 3550C, 5030B, etc.)  For analytical procedures that do not have a specific preparation method number, use "Gen Prep".	Text	25	YES (See Table 4)
AnalysisType	Defines the type of analysis such as initial analysis, dilution, re-analysis, etc. This field provides distinction for sample records when multiple analyses are submitted for the same sample, method, and matrix, for example: dilutions, re-analyses, and re-extracts.	Text	10	YES (See Table 4)
Prepared	<u>For radiochemistry leave this field blank.</u>  For all other methods enter the date and time of sample preparation or extraction. Refer to the date/time format at the end of this table.	Date/Time	16*	NO
Analyzed	<u>For radiochemistry methods</u> the date of sample analysis. Refer to the date format for radiochemistry methods at the end of this table.  <u>For all other methods</u> the date and time of sample analysis. Refer to the date and time format at the end of this table.	Date/Time	*	NO
LabID	Identification of the laboratory performing the analysis.	Text	7	NO
QCLevel	The level of laboratory QC associated with the analysis reported in the EDD. If only the Analytical Results Table (A1) and the Sample Analysis Table (A3) information are submitted for the sample, enter "COA". If the Laboratory Instrument Table (A2) information is also submitted for the sample, enter "COCAL"	Text	6	YES (See Table 4)
ResultBasis	Indicates whether results associated with this sample record are reported as wet or percent moisture corrected. This field is only required for soils and sediments. Enter "WET" if results are not corrected for percent moisture. Enter "DRY" if percent moisture correction is applied to results.	Text	3	YES (See Table 4)
TotalOrDissolved	This field indicates if the results related to this sample record are reported as a total or dissolved fraction. This field is only required for metal methods. For all other methods leave this field blank.	Text	3	YES (See Table 4)
Dilution	Dilution of the sample aliquot. Enter "1" for method blanks, LCS, and LCSD, or if the field samples was analyzed without dilution.	Numeric	10	NO
HandlingType	Indicates the type of leaching procedure, if applicable (i.e., SPLP, TCLP, WET).  Leave this field blank if the sample analysis was <u>not</u> performed on a leachate.	Text	10	YES (See Table 4)



**Table 3**  
**Field Description for the Sample Analysis (A3 file)**

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
HandlingBatch	<p>Unique laboratory identifier for a batch of samples prepared together in a leaching procedure (i.e., SPLP, TCLP, or WET preparation). The HandlingBatch links samples with leaching blanks.</p> <p>Leave this field blank if the sample analysis was <u>not</u> performed on a leachate</p>	Text	12	NO
LeachateDate	<p>Date and time of leaching procedure (i.e., date for SPLP, TCLP, or WET preparation). Refer to the date and time format at the end of this table.</p> <p>Leave this field blank if the sample analysis was <u>not</u> performed on a leachate</p>	Date /Time	16*	NO
Percent_Moisture	Percent of sample composed of water. Enter for soil and sediment samples only.	Numeric	10	NO
MethodBatch	<p>Unique laboratory identifier for a batch of samples of similar matrices analyzed by one method and treated as a group for matrix spike, matrix spike duplicate, or laboratory duplicate association</p> <p>The method batch links the matrix spike and/or matrix spike duplicate or laboratory duplicates to associated samples. Note, the MethodBatch association may coincide with the PreparationBatch association. The MethodBatch is specifically used to link the MS/MSD and/or DUP to associated samples.</p>	Text	12	NO
PreparationBatch	<p>Unique laboratory identifier for a batch of samples prepared together for analysis by one method and treated as a group for method blank, LCS and LCSD association.</p> <p>The PreparationBatch links method blanks and laboratory control samples (blank spikes) to associated samples. Note, the PreparationBatch association may coincide with the MethodBatch association but the PreparationBatch specifically links the Method Blank and LCS to associated samples.</p>	Text	12	NO
RunBatch	<p><u>For radiochemistry methods leave this field blank.</u></p> <p><u>For all other methods</u> the RunBatch is the unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The RunBatch links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the RunBatch also links a BFB or DFTPP tune. A distinct RunBatch must used with every new initial calibration within a method</p> <p>The value entered in this field links a particular sample/method/analysis type record to a set of associated initial calibration and initial calibration verification records from Table A2.</p> <p>This field is only required if the A2 table is included with the EDD.</p>	Text	12	NO

**Table 3**  
**Field Description for the Sample Analysis (A3 file)**

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalysisBatch	<p><u>For radiochemistry methods</u> leave this field blank.</p> <p><u>For all other methods</u> the AnalysisBatch is the unique identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The AnalysisBatch links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the AnalysisBatch also links the BFB or DFTPP tune. A distinct AnalysisBatch must be used with every new continuing calibration or continuing calibration verification within a method</p> <p>The value entered in this field links a particular sample/method/analysis type record to a set of associated continuing calibration records in the Laboratory Instrument table.</p> <p>This field is only required if the A2 table is included with the EDD.</p>	Text	12	NO
LabReportingBatch	Unique laboratory identifier for the EDD. This is equivalent to the sample delivery group, lab work number, login ID, etc. The LabReportingBatch links all records in the EDD reported as one group. The value entered in this field must be the same in all records.	Text	12	NO
LabReceipt	Date and time the sample was received in the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/Time	16*	
LabReported	Date and time hard copy reported delivered by the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/Time	16*	

\* For radiochemistry methods format Date as MM/DD/YYYY (where MM = two digit month, DD = two digit day, and YYYY = four digit year)

For all other methods format Date and Time as MM/DD/YYYY hh:mm YYYY (where MM = two digit month, DD = two digit day, and YYYY = four digit year, hh = hour in 24 hour format, and mm = minutes)

## Table 4 Standard Value List

Field Name	Standard Value	Standard Value Description
Analysis_Type	DL	Dilution of the original sample
	DL2	Second dilution of the original sample
	DL3	Third dilution of the original sample
	DL4	Fourth dilution of the original sample
	RE	Reanalysis/re-extraction of sample
	RE2	Second reanalysis/re-extraction of sample
	RE3	Third reanalysis/re-extraction of sample
	RE4	Fourth reanalysis/re-extraction of the original sample
	RES	The initial or original sample.
Analyte_Name	Refer to QAPP and Project Library	Analyte names are specified by the project and entered into the library for each method and matrix. Analyte Names used in project libraries must first exist in the standard value table. The same holds true for the ClientAnalyteID
Analyte_Type	IS	Internal standard as defined per CLP usage
	SPK	Spiked analyte
	SURR	Surrogate as defined as per CLP usage
	TIC	Tentatively identified compound for GC/MS analysis
	TRG	Target compound
Detection_Limit_Type <sup>1</sup>	CRDL	Contract required detection limit
	IDL	Instrument detection limit
	MDA	Minimum detectable activity
	MDL	Method detection limit
Handling_Type <sup>2</sup>	WET	Wet leaching procedure
	SPLP	Synthetic Precipitation Leaching Procedure
	TCLP	Toxicity Characteristic Leaching Procedure
Lab_Analysis_Ref_Method_ID	Refer to QAPP and Project Library	Method IDs are specified by the project and entered into the library. Methods used in project libraries must first exist in the standard value table
Lab_Qualifiers <sup>3</sup>	*	INORG: Duplicate analysis was not within control limits
	*	ORG: Surrogate values outside of contract required QC limits
	+	INORG: Correlation coefficient for the method of standard additions (MSA) was less than 0.995
	A	ORG: Tentatively identified compound (TIC) was a suspected aldol-condensation product
	B	INORG: Value less than contract required detection limit but greater than or equal to instrument detection limit
	B	ORG: Compound is found in the associated blank as well as in the sample
	C	ORG: Analyte presence confirmed by GC/MS
	D	Result from an analysis at a secondary dilution factor
	E	INORG: Reported value was estimated because of the presence of interference
	E	ORG: Concentrations exceed the calibration range of the instrument
	H	Analysis performed outside method or client-specified holding time requirement
	J	Estimated value
	M	INORG: Duplicate injection precision was not met
	N	INORG: Spiked sample recovery was not within control limits
	N	ORG: Presumptive evidence of a compound
	P	ORG: Difference between results from two GC columns unacceptable (>25% Difference)
	S	Reported value was determined by the method of standard additions (MSA)
	U	Compound was analyzed for but not detected. Analyte result was below the Reporting Limit.
	W	INORG: Post digestion spike was out of control limits
X	Reserved for a lab-defined data qualifier	
Y	Reserved for a lab-defined data qualifier	
Z	Reserved for a lab-defined data qualifier	
Matrix_ID	AIR	Air
	AQ	Water
	ASH	Ash

## Table 4 Standard Value List

Field Name	Standard Value	Standard Value Description
Matrix_ID (continued)	BIOTA	Biological matter
	FILTER	Filter
	LIQUID	Non-aqueous liquid
	OIL	Oil
	SED	Sediment
	SLUDGE	Sludge
	SO	Soil
	SOLID	Non-soil/sediment solid
	TISSUE	Tissue
	WASTE	Waste
	WIPE	Wipe
Preparation_Type <sup>4</sup>	3005A	Acid Digestion of Waters for Total Recoverable or Dissolved Metals by FLAA or ICP
	3010A	Acid of Aqueous Samples and Extracts for Total Metals by FLAA or ICP
	3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts
	3020A	Acid Digestion of Aqueous Samples and Extracts for Total Metals by GFAA
	3031	Acid Digestion of Oils for Metals Analysis by AA or ICP
	3050B	Acid Digestion of Sediments, Sludges, and Soils
	3051	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils
	3052	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices
	3060A	Alkaline Digestion for Hexavalent Chromium
	3510C	Separatory Funnel Liquid-Liquid Extraction
	3520C	Continuous Liquid-Liquid Extraction
	3535	Solid Phase Extraction
	3540C	Soxhlet Extraction
	3541	Automated Soxhlet Extraction
	3545	Pressurized Fluid Extraction
	3550B	Ultrasonic Extraction
	3560	Supercritical Fluid Extraction of Total Recoverable Petroleum Hydrocarbons
	5030B	Purge and Trap for Aqueous Samples
	5035	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
	7470A	Acid digestion of waters for Mercury analysis
	7471A	Acid digestion of soils and solids for Mercury analysis
	Gen Prep	Generic preparation type when a preparation method ID does not exist (used mostly for general chemistry methods)
QC_Level	COA	Certificate of Analysis (accuracy and precision, no calibration)
	COACAL	Certificate of Analysis (accuracy and precision including calibration)
QC_Type	MB	Analytical control consisting of all reagents and standards that is carried through the entire procedure (Method Blank)
	CV	(Calibration Verification) Analytical standard run at a specified frequency to verify the calibration of the analytical system
	CCV	(Continuing Calibration Verification) Analytical standard run every 12 hours to verify the calibration of the GC/MS system
	DUP	A second aliquot of a sample that is treated the same as the original aliquot to determine the precision of the method
	IC	(Initial Calibration) Analysis of analytical standards for a series of different specified concentrations
	ICV	(Initial Calibration Verification) Analytical standard run at a specified frequency to verify the accuracy of the initial calibration of the analytical system
	IPC	(Instrument Performance Check) Analysis of DFTPP or BFB to evaluate the performance of the GC/MS system
	LCS	(Laboratory Control Sample) A control sample of known composition
	LCSD	(Laboratory Control Sample Duplicate) A duplicate control sample of known composition
	MS	(Matrix Spike) Aliquot of a matrix spiked with known quantities and subjected to the entire analytical procedure to measure recovery
	MSD	(Matrix Spike Duplicate) A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method
Reporting_Limit_Type <sup>1</sup>	CRDL	Contract required detection limit
	CRQL	Contract required quantitation limit

**Table 4**  
**Standard Value List**

Field Name	Standard Value	Standard Value Description
Reporting_Limit_Type (continued)	PQL	Practical quantitation limit
	SQL	Sample quantitation limit
	RDL	Reportable detection limit
Result_Basis	DRY	Result was calculated on a dry weight basis
	WET	Result was calculated on a wet weight basis
Result_Units <sup>5</sup>	ug/L	Micrograms per liter
	mg/L	Milligrams per liter
	ug/Kg	Micrograms per kilogram
	mg/Kg	Milligrams per kilogram
	pg/L	Picograms per liter
Total_Or_Dissolved	ng/Kg	Nanograms per kilogram
	DIS	Dissolved
	TOT	Total

- 1 Additional Detection Limit Types and Reporting Limit Types may be used. These must be added to the application standard values.
- 2 Additional Handling Types (leachate procedures) may be used. These must be added to the application standard values
- 3 Additional Lab Qualifiers may be used, or listed Lab Qualifiers may be used in a different manner than described in this table. New lab qualifiers must be added to the application standard value tables. NOTE: The “U” Lab Qualifier must be used for all non-detects.
- 4 Additional Preparation Types may be used. These must be added to the application standard value tables.
- 5 Additional Result Units may be used. The project library specifies the reporting limit used for each method and matrix

**Note:** If new standard values are used then these standard values must be entered in the software standard values for both the lab and contractor. The application will automatically update the standard values tables if an importing library contains standard values (method, client analyte ID, and analyte name) that do not exist in the software importing the new library.

**Table 5****Required Fields in the Analytical Results Table for GC/MS, GC, and HPLC Methods**

Field	GC/MS Methods			GC and HPLC Methods		
	Regular Sample*	MS/MSD	Method Blank, LCS/LCSD	Regular Sample*	MS/MSD	Method Blank, LCS/LCSD
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time	T		T			
Analyte_Type	X	X	X	X	X	X
Percent_Recovery	S	R	R	S	R	R
Relative_Percent_Difference		D	D		D	D
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

**Key**

- X Required Field
- D Required field for spiked compounds in the LCSD and MSD only
- Q Required field if laboratory has qualified result. The "U" qualifier MUST be entered if the result is non-detect.
- R Required field if Analyte\_Type = "SPK" or "SURR"
- S Required field for surrogate compounds only
- T Required field for tentatively identified compounds by GC/MS only
- \* Also includes Equipment Blanks, Field Blanks, and Trip Blanks

**Table 6**  
**Required Fields in the Analytical Results Table for ICAP, AA, and IC Methods**

Field	ICAP and AA Methods			IC and Wet Chemistry Methods		
	Regular Sample*	Sample Duplicate, MS/MSD	Method Blank, LCS/LCSD	Regular Sample*	Sample Duplicate MS/MSD	Method Blank, LCS/LCSD
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time						
Analyte_Type	X	X	X	X	X	X
Percent_Recovery		S	S		S	S
Relative_Percent_Difference		R	R		R	R
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

**Key**

- X Required field
- Q Required field if laboratory has qualified result. The “U” qualifier MUST be entered if the result is non-detect
- R Required field for spiked compounds in LCSD or MSD, or target compounds in the Sample Duplicate only
- S Required field if Analyte\_Type = “SPK”
- \* Also includes Trip Blanks, Equipment Blanks, and Field Blanks

**Table 7**  
**Required Fields in the Laboratory Instrument Table**

Field	GC/MS Tunes		Initial Calibration				Initial Calibration Verification				Calibration Verification, Continuing Calibration
	VOA	SVOA	GC/MS	GC HPLC	ICP/AA	IC*	GC/MS	GC HPLC	ICP/AA	IC*	ALL METHODS
Instrument_ID	X	X	X	X	X	X	X	X	X	X	X
QC_Type	X	X	X	X	X	X	X	X	X	X	X
Analyzed	X	X	X	X	X	X	X	X	X	X	X
Alternate_Lab_Analysis_ID	X	X	X	X	X	X	X	X	X	X	X
Lab_Analysis_ID	X	X					X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X	X	X	X	X	X
Run_Batch	X	X	X	X	X	X	X	X	X	X	X
Analysis_Batch	C	C									X
Lab_Reporting_Batch	X	X	X	X	X	X	X	X	X	X	X
Percent_Relative_Standard_Deviation			X	X							
Correlation_Coefficient			B	B	X	X					
Relative_Response_Factor			X				X				M
Percent_Difference							X	X	X	X	X
Peak_ID_01	X	X									
Percent_Ratio_01	X	X									
Peak_ID_02	X	X									
Percent_Ratio_02	X	X									
Peak_ID_03	X	X									
Percent_Ratio_03	X	X									
Peak_ID_04	X	X									
Percent_Ratio_04	X	X									
Peak_ID_05	X	X									
Percent_Ratio_05	X	X									
Peak_ID_06	X	X									
Percent_Ratio_06	X	X									
Peak_ID_07	X	X									
Percent_Ratio_07	X	X									
Peak_ID_08	X	X									
Percent_Ratio_08	X	X									
Peak_ID_09	X	X									
Percent_Ratio_09	X	X									
Peak_ID_10		X									
Percent_Ratio_10		X									
Peak_ID_11		X									
Percent_Ratio_11		X									
Peak_ID_12		X									
Percent_Ratio_12		X									
Peak_ID_13		X									
Percent_Ratio_13		X									

**Key**

- X Required field (some fields are not applicable to some General (Wet) Chemistry tests)
- B Required field if reporting best fit
- C Required field if BFB or DFTPP associated with a continuing calibration only
- M Required field for GC/MS continuing calibration only

\*IC Includes Ion Chromatography and Classical or Wet Chemistry methods. Methods such as pH, Conductivity, and others do not use traditional calibration procedures: therefore some fields marked as a required field under the "IC" column do not apply for these methods.



**Table 8**  
**Required Fields in the Sample Analysis Table**

Field	GC, GC/MS, HPLC Methods		ICAP and AA Methods		IC and Wet Chemistry Methods	
	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD
Client_Sample_ID	X	X	X	X	X	X
Collected		X		X		X
Matrix_ID	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
QC_Type	X	Q	X	Q	X	X
Shipping_Batch_ID		X		X		X
Temperature		X				X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Preparation_Type	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Prepared	A	A	X	X	N	N
Analyzed	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
QC_Level	X	X	X	X	X	X
Results_Basis		S		S		S
Total_Or_Dissolved			W	W		
Dilution	X	X	X	X	X	X
Handling_Type	L	L	L	L	L	L
Handling_Batch	L	L	L	L	L	L
Leachate_Date	L	L	L	L	L	L
Percent Moisture		S		S		S
Method_Batch	X	X	X	X	X	X
Preparation_Batch	X	X	X	X	X	X
Run_Batch	C	C	C	C	C	C
Analysis_Batch	C	C	C	C	C	C
Lab_Reporting_Batch	X	X	X	X	X	X
Lab_Receipt		X		X		X
Lab_Reported	X	X	X	X	X	X

**Key**

- X Required field
- A Required field for samples prepared by methanol extraction
- C Required field if Instrument Calibration Table (A2) is included in EDD
- L Required field if analysis performed on SPLP, TCLP, or WET extracts
- N Required field only for samples that require preparation before analysis
- Q Required field for Sample Duplicate, MS, and MSD only
- S Required field if "Matrix\_ID" = "SO" or "SED"
- W Required field for aqueous samples only
- \* Includes Trip Blanks, Equipment Blanks, and Field Blanks

**Reviewed EDD Export File Specifications - Analytical Results (A1)  
Comma Delimited Text File**

<b>Order</b>	<b>Field Name*</b>	<b>Field Description</b>
1	RecordID	Record number.
2	ClientSampleID	Client field sample identifier.
3	LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 6010B, etc.).
4	AnalysisType	Defines type of analysis (i.e. dilution, reanalysis, etc.).
5	LabSampleID	Internal laboratory sample tracking number for samples and lab generated QC.
6	LabID	Identifier of laboratory performing the analysis.
7	ClientAnalyteID	CAS number or unique analyte identifier.
8	AnalyteName	Chemical name for analyte.
9	Result	Reportable result for the analyte.
10	ResultUnits	Units of measure for the result (i.e. mg/Kg, ug/L, etc.).
11	LabQualifiers	A string of letter or symbol qualifiers assigned by the lab based on contractor defined rules and values.
12	DetectionLimit	Detection limit for the analyte being measured.
13	DetectionLimitType	Specifies the type of detection limit (i.e. MDL, IDL, etc.).
14	RetentionTime	The time expressed in decimal minutes between injection and detection for GC/MS TICs only.
15	AnalyteType	Defines the type of result such as surrogate, spike, or target analyte.
16	PercentRecovery	The percent recovery of a spiked QC compound such as a matrix spike, LCS spike, or surrogate.
17	RelativePercentDifference	RPD between to QC results such as MS/MSD.
18	ReportingLimit	Analyte reporting limit.
19	ReportingLimitType	Defines the type of reporting limit (PQL, CRQL, etc.).
20	ReportableResult	(YES or NO) Indicates which result is the useable result when results from two or more analyses for the same sample and method (ie dilutions, reanalyses, etc) are reported in the EDD.
21	<b>Filename</b>	File name of the EDD. The same as the LabReportingBatch in the Sample Analysis table (A3).
22	<b>DVModifiedConcentration</b>	ADR modified analyte result due to blank contamination.
23	<b>DVQualTemperature</b>	Data review qualifier for temperature outlier.
24	<b>DVQualPreservation</b>	Data review qualifier for preservation anomaly.
25	<b>DVQualHTSamplingToAnalysis</b>	Data review qualifier for holding time violation from sampling time to analysis time.
26	<b>DVQualHTSamplingToExtraction</b>	Data review qualifier for holding time violation from sampling time to extraction.
27	<b>DVQualHTExtractionToAnalysis</b>	Data review qualifier for holding time violation from extraction time to analysis time.
28	<b>DVQualHoldingTime</b>	Overall data review qualifier for holding time violation.
29	<b>DVQualMethodBlanks</b>	Data review qualifier for contamination in an associated method blank.
30	<b>DVQualSurrogateRecovery</b>	Data review qualifier for surrogate recovery outlier.
31	<b>DVQualMS</b>	Overall data review qualifier for associated MS and MSD recovery and/or RPD outlier.
32	<b>DVQualMSRecovery</b>	Data review qualifier for MS and/or MSD recovery outlier.
33	<b>DVQualMSRPD</b>	Data review qualifier for MS/MSD RPD .outlier.
34	<b>DVQualLCS</b>	Overall data review qualifier for LCS and LCS recovery and/or RPD outlier.
35	<b>DVQualLCSRecovery</b>	Data review qualifier for associated LCS and/or LCSD recovery outlier.
36	<b>DVQualLCSRPD</b>	Data review qualifier for LCS/LCSD RPD outlier.
37	<b>DVQualRepLimits</b>	Data review qualifier for result reported below the reporting limit.
38	<b>DVQualReportingLimits</b>	Data review comment ("OutX") when reporting limit exceeds the project reporting limit.
39	<b>DVQualFieldQC</b>	Overall data review qualifier for Field QC.
40	<b>DVQualFieldBlank</b>	Data review qualifier for contamination in an associated Field Blank.
41	<b>DVQualEquipmentBlank</b>	Data review qualifier for contamination in an associated Equipment Rinsate or Equipment Blank.
42	<b>DVQualTripBlank</b>	Data review qualifier for contamination in an associated Trip Blank.
43	<b>DVQualFieldDuplicate</b>	Data review qualifier for an associated Field Duplicate RPD outlier.
44	<b>DVQualIC</b>	Overall data review qualifier for associated initial calibration outliers.
45	<b>DVQualInitialCalibrationRRF</b>	Data review qualifier for an associated initial calibration relative response

Order	Field Name*	Field Description
		factor outlier.
46	DVQualInitialCalibrationRSD	Data review qualifier for an associated initial calibration relative percent difference outlier.
47	DVQualInitialCalibrationCC	Data review qualifier for an associated initial calibration correlation coefficient outlier.
48	DVQualICV	Overall data review qualifier for an associated initial calibration verification.
49	DVQualInitialCalibrationVerificationRRF	Data review qualifier for an associated initial calibration verification relative response factor outlier.
50	DVQualInitialCalibrationVerificationPD	Data review qualifier for an associated initial calibration verification percent difference outlier.
51	DVQualCCV	Overall data review qualifier for associated continuing calibration outliers.
52	DVQualContinuingCalibrationVerificationRRF	Data review qualifier for an associated continuing calibration relative response factor outlier.
53	DVQualContinuingCalibrationVerificationPD	Data review qualifier for an associated continuing calibration percent difference outlier.
54	DVQualOverall	Overall data review qualifier for all QC and calibration qualifiers.
55	TagLabSampleID (see comment)	Temporary placeholder.
56	TagDetQual01 (see comment)	Temporary placeholder.
57	TagNonDetQual01 (see comment)	Temporary placeholder.
58	TagDetQual02 (see comment)	Temporary placeholder.
59	TagNonDetQual02 (see comment)	Temporary placeholder.
60	surDVQualDet (see comment)	Temporary placeholder.
61	surDVQualNonDet (see comment)	Temporary placeholder.
62	DVQualInstrumentPerformanceCheckRunBatch	Data review qualifier for GC/MS Tune outlier related to initial calibration.
63	DVQualInstrumentPerformanceCheckAnaBatch	Data review qualifier for GC/MS Tune outlier related to continuing calibration.
64	DVQualIPC	Overall data review qualifier for GC/MS tune outliers.
65	DVQualLabDup	Data review qualifier for RPD outlier in laboratory duplicate.
66	DVQualCode	User-defined Reason Code
67	FieldDupRPD	RPD calculated from Field duplicate and parent sample
68	DVQualMergedQualifier	Merged lab and data review qualifiers
69	DVQualMergedResult	Final result (modified concentration if applicable)
70	DVQualPercMoi <sup>1</sup>	Data review qualifier for percent moisture
71	DVQualLabDupNR <sup>1</sup>	Data review qualifier for laboratory duplicate not reported
72	DVQualLcsNR <sup>1</sup>	Data review qualifier for laboratory control sample(s) not reported
73	DVQualDissTotDiff <sup>1</sup>	Data review qualifier for dissolved and total fraction differing by more than 10%
74	Error	Radiochemistry error
75	DVQualSampleDupCount <sup>1</sup>	Data review qualifier for sample count being >20 in a duplicate batch
76	DVQualMsSampleCount <sup>1</sup>	Data review qualifier for sample count being >20 in a matrix spike batch
77	DVQualLcsCount <sup>1</sup>	Data review qualifier for sample count being >20 in a laboratory control sample batch
78	DVQualMbMissing <sup>1</sup>	Data review for missing method blank
79	DVQualPercMoiDissTotDiff <sup>1</sup>	Combined data review qualifier for percent moisture and total vs dissolved difference outliers
80	DVQualInternalStandard <sup>2</sup>	Data review qualifier for internal standard outlier
81	DVQualCalibrationBlank <sup>2</sup>	Data review qualifier for calibration blank contamination
82	DVQualRcm <sup>2</sup>	Data review qualifier for resolution check mixture problem
83	DVQualPem <sup>2</sup>	Data review qualifier for performance evaluation mixture problem
84	DVQualProfessionalJudgement <sup>2</sup>	Data review qualifier for any reason deemed necessary by data-review chemist
85	DOD_MDL	Method detection limit for QSM 4.2

Comment: Fields that contain temporary placeholders hold information contributed during the review process that is used in generating reports. This information is kept with the output file so that if the file is ever imported back into the application, reports can be generated without having to rerun the review module.

\* Field Names in bold font are added to the EDD during review and included in the exported reviewed EDD file

<sup>1</sup> Data review qualifiers in these cases are added for EPA Region II assessment. ADR.Net does not currently perform EPA Region II assessment.

<sup>2</sup> Data review qualifiers in these cases are added manually by the user and not assessed by automated data review.

## Reviewed EDD Export File Specifications - Sample Analysis (A3) Comma Delimited Text File

Order	Field Name*	Field Description
1	RecordID	Record number.
2	ProjectNumber	Project Number assigned by client.
3	ProjectName	Project Name assigned by client.
4	ClientSampleID	Client field sample identifier.
5	Collected	Date and time sample was collected.
6	MatrixID	Sample matrix.
7	LabSampleID	Internal laboratory sample tracking number for samples and lab generated QC.
8	QCType	Identifies the type of quality control sample, regular field samples are null.
9	ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport field samples.
10	Temperature	Temperature in degrees C of the samples as received in the lab.
11	LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 6010B, etc.).
12	<b>PreparationType</b>	Preparation method number (i.e. 3010A, 3510C, etc.).
13	<b>AnalysisType</b>	Defines type of analysis (i.e. dilution, reanalysis, etc.).
14	<b>Prepared</b>	Date and time of sample preparation/extraction.
15	<b>Analyzed</b>	Date and time of sample analysis.
16	<b>LabID</b>	Identifier of laboratory performing analysis.
17	<b>QCLevel</b>	Level of analytical QC associated with analysis (i.e. Level III, etc.).
18	<b>ResultBasis</b>	Indicates if a result is expressed as wet or dry.
19	<b>TotalorDissolved</b>	Indicates if a result is expressed as total or dissolved (for metals only).
20	<b>Dilution</b>	Sample dilution during analysis.
21	<b>HandlingType</b>	Type of leaching procedure, if applicable (i.e. SPLP, TCLP, etc.).
22	<b>HandlingBatch</b>	Unique laboratory identifier for a batch of samples prepared together for a leaching procedure.
23	<b>LeachateDate</b>	Date and time of leaching procedure.
24	<b>PercentMoisture</b>	Percent moisture of sample.
25	<b>MethodBatch</b>	Unique laboratory identifier for a batch of samples with similar matrix and analyzed together by one method. Links samples to matrix spikes and duplicates.
26	<b>PreparationBatch</b>	Unique laboratory identifier for a batch of samples prepared together for analysis by one method. Links samples with method blanks and laboratory control samples.
27	<b>RunBatch</b>	Unique laboratory identifier for a batch of analyses performed on one instrument under the control of on an initial calibration. Links the initial calibration to associated samples.
28	<b>AnalysisBatch</b>	Unique laboratory identifier for a batch of analyses performed on one instrument under the control of a continuing calibration. Links continuing calibrations to associated samples.
29	<b>LabReportingBatch</b>	Unique laboratory identifier for a batch of samples, QC, and calibration standards reported as a group by the lab (i.e. order number, SDG #, etc.).
30	<b>LabReceipt</b>	Date samples received in laboratory.
31	<b>LabReported</b>	Date laboratory hardcopy submitted.
32	DataReviewCompany**	Company running the automated review software.
33	DataReviewDate	Date and time EDD was validated.
34	ValidatedBy**	Person running the automated review.
35	ValidationDate**	Date and time when automated data review qualifiers were reviewed
36	ApprovedBy**	Person performing secondary review of data review flags.
37	ApprovalDate**	Date and time of secondary review by "ApprovedBy".
38	FileName	File name of EDD (same as LabReportingBatch).
39	TagLabSampleID (see comment)	Temporary place holder.
40	TagDetQual (see comment)	Temporary place holder.
41	TagNonDetQual (see comment)	Temporary place holder.
42	TempFlag (see comment)	Temporary place holder.
43	LabMethodCategory	The category of the method, used by EDMS

Comment: Fields that contain temporary placeholders hold values created during the validation process. These values are used in generating reports. This information is kept with the output file so that if the file is ever imported back into the application, reports can be generated without having to rerun the validation module.

\* Field Names in bold font are added to the EDD during automated data review and included in the exported data-reviewed EDD file

\*\* Automated data review does not update these fields with any information but these fields are still part of the exported data-reviewed file. These fields may be populated manually by the user from various forms in the application prior to exporting.

\*\*\* Date/Time format: MM/DD/YYYY hh:mm

## **ATTACHMENT F**

Responses to Comments on the QAPP,  
Volume I, Appendix D, Draft Final Revision 3, Operable Unit 2 Landfills

## Responses to Comments submitted by the Central Coast Regional Water Quality Control Board<sup>1</sup>

**SPECIFIC COMMENT 1:** Section 3.1, Worksheet #10, Conceptual Site Model – Consider adding a section for emerging Potential Contaminants of Concern (PCOCs) and include discussion indicating that perfluorooctanoic (PFOA) and perfluorooctane sulfonate (PFOS) will be analyzed for in groundwater at the OU2 Landfill Area and refer to the recent work plan. Figure 3 provided in the following link shows a conceptual site model for PFAS in landfills which includes air emissions as a potential exposure pathway: [https://pfas-1.itrcweb.org/wp-content/uploads/2018/03/pfas\\_fact\\_sheet\\_fate\\_and\\_transport\\_\\_3\\_16\\_18.pdf](https://pfas-1.itrcweb.org/wp-content/uploads/2018/03/pfas_fact_sheet_fate_and_transport__3_16_18.pdf). Based on this potential exposure pathway and the proximity of the OU2 Landfills to residential areas, it should also be noted in this section that if PFOA and PFOS are detected in groundwater, the need for testing of the thermal treatment unit influent and emissions, and ambient air will be evaluated.

**RESPONSE TO SPECIFIC COMMENT 1:** *Worksheet #10 will not be revised to include information about PFOA and PFOS at this time. The next Operable Unit 2 (OU2) Landfills Quality Assurance Project Plan (QAPP) update (Revision 4) will be initiated in May 2019 after the annual landfill gas monitoring event is completed at the OU2 Landfills. By this time, the draft report presenting the results of groundwater monitoring in the OU2 area for PFOA and PFOS, and recommendations and conclusions, will have been completed. If appropriate, QAPP Revision 4 will include information about PFOA and PFOS based on the recommendations in that report. Regardless, as described in QAPP Revision 3, Section 3.1.5, air emissions are not considered to be a significant exposure pathway at the OU2 Landfills based on ambient air monitoring results and a human health risk assessment completed in 2005. Unlike the conceptual site model depiction of a landfill in Figure 3 of the fact sheet linked to in the comment, the OU2 Landfills have a linear low-density polyethylene (LLDPE) liner over the top of waste, and the landfill gas extraction and treatment system has effectively controlled migration of landfill gas since it began operation in 2001.*

**SPECIFIC COMMENT 2:** Section 3.1.3, Known Contaminants – The QAPP indicates that methane and volatile organic compounds (VOCs) are known contaminants in landfill gas at the OU2 Landfills. Please confirm that 1,2,3-trichloropropane has been ruled out as a contaminant of potential concern at the OU2 Landfills.

**RESPONSE TO SPECIFIC COMMENT 2:** *1,2,3-trichloropropane (TCP) has been ruled out as a contaminant of potential concern at the OU2 Landfills. TCP is not likely to sorb to soil based on its low soil organic carbon-water partition coefficient; therefore, it is likely to either leach from soil into groundwater or evaporate from soil surfaces.<sup>2</sup> However, there are no exposed soil surfaces that TCP could evaporate from; waste in the OU2 Landfills is covered with an impermeable LLDPE liner and the vegetative cover soil is from uncontaminated sources.<sup>3</sup> Additionally, TCP is included in the U.S. Environmental Protection Agency's Third Unregulated Contaminant Monitoring Rule (UCMR 3) and the local potable water*

<sup>1</sup> In a letter dated November 20, 2018 (see Administrative Record No. OU2-702F.3).

<sup>2</sup> U.S. Environmental Protection Agency Technical Fact Sheet – 1,2,3-Trichloropropane (TCP), January 2014 (EPA 505-F-14-007).

<sup>3</sup> See Administrative Record Nos. OU2-629 and OU2-630B.



purveyors, Marina Coast Water District (MCWD) and California American Water (CalAm), have tested their supply wells and TCP was not detected.

**SPECIFIC COMMENT 3:** Section 3.1.5, Potential Receptors and Exposure Pathways – It is stated that “The updated HHRA indicates the OU2 Landfills are not a significant contributor of VOCs in ambient air or a significant risk to downwind receptors.” Please confirm that the OU2 groundwater plume which extends below the nearby residential area has been evaluated for vapor intrusion as a potential exposure pathway and that a comparison of VOC concentrations in groundwater to the U.S. Environmental Protection Agency (EPA) Regional Screening Levels has been performed. Additionally, please include reference to the document where this can be found and/or a footnote indicating this potential exposure pathway has been evaluated and whether or not it was determined to be a risk to receptors.

**RESPONSE TO SPECIFIC COMMENT 3:** *The OU2 groundwater plume was evaluated for migration of VOCs into ambient air as a potential exposure pathway in the Baseline Risk Assessment, Remedial Investigation/Feasibility Study, Site 2 Landfills, Fort Ord, California ([Dames and Moore, 1993](#)). The Baseline Risk Assessment does not specifically address the vapor intrusion pathway; however, the results of a vapor intrusion investigation at the suspected source area for Operable Unit Carbon Tetrachloride Plume (OUCTP) indicated concentrations of VOCs present in indoor air were within the range of background concentrations measured in ambient air ([Shaw, 2004](#)). The OUCTP source area is adjacent to the OU2 groundwater plume, and soil types and depth to groundwater in the OUCTP investigation area are nearly identical to OU2. Additionally, the results of the OUCTP investigation are conservative with respect to OU2 because the OUCTP investigation was conducted in a residential area where VOCs were detected in both groundwater and soil gas. Therefore, a site-specific vapor intrusion assessment for OU2 is unnecessary. This information was not included in the QAPP because the QAPP is specific to sampling and analysis of landfill gas (LFG) and groundwater issues are addressed elsewhere.*

**CLARIFICATION COMMENT 1:** Section 3.2, Worksheet #11: Project/Data Quality Objectives, DQO#1

- a. Bullet Item – “The TTU should be operated and maintained properly to achieve continuous optimum performance and efficiency.” Please provide a reference to the most recent Operations and Maintenance Manual.

**RESPONSE TO CLARIFICATION COMMENT 1a:** *The text was revised to include a reference to the Operations and Maintenance Plan ([Shaw, 2008](#)).*

**CLARIFICATION COMMENT 2:** Section 3.2, Worksheet #11: Project/Data Quality Objectives, DQO#1, DQO#2, DQO#3, and DQO#4, Analytical Approach.

- a. Bullet Item – “The eleven VOCs identified as COCs for groundwater in the OU2 Landfills ROD will remain on the TO-15 target analyte list.” Please consider modifying this sentence to further clarify the analytical approach: The eleven VOCs identified as COCs for groundwater in the OU2 Landfills ROD will remain on the TO-15 target analyte list, regardless of whether they have been non-detect for five consecutive annual monitoring events.

**RESPONSE TO CLARIFICATION COMMENT 2a:** *The text was revised per the comment.*

- b. Bullet Item – “These criteria will be applied retroactively to include VOC analytical data collected since TTU operations began in April 2006.” Please update this sentence to indicate that these

criteria were applied retroactively as part of a previous QAPP revision to include VOC analytical data collected since TTU operations began in April 2006. Additionally, include reference to the QAPP document that these criteria were initially applied in.

**RESPONSE TO CLARIFICATION COMMENT 2b:** *The text was revised per the comment: “These criteria were applied retroactively as part of a previous QAPP revision to include VOC analytical data collected since TTU operations began in April 2006 ([Ahtna, 2016a](#)).”*

**CLARIFICATION COMMENT 3:** Section 3.5, Worksheets #14 and #16: Project Tasks and Schedule. Please add the following note with respect to the frequency of landfill methane monitoring: The landfill methane monitoring frequency may be decreased to annual or discontinued at select monitoring points based on the decision rules presented in Worksheet #11, DQO #4.

**RESPONSE TO CLARIFICATION COMMENT 3:** *A note was added per the comment.*

**CLARIFICATION COMMENT 4:** Section 3.6.3 – It is noted, “Accordingly, 1,1,1-trichloroethane and 1,3-butadiene were removed from the list.” Please also indicate that no VOCs were added to the list per the analytical approach outlined in DQOs #1 and #2. Additionally, please provide clarification on the basis for the modifications to the VOC/TO-15 list of analytes either as a reference to a table of historical results provided in another report or if necessary, compile the historical data for the analytes removed and provide as an appendix in the QAPP.

**RESPONSE TO CLARIFICATION COMMENT 4:** *The note was revised to state no VOCs were added to the list and to reference historical VOC analytical results. Per the DQOs, VOCs can only be added to the list every five years, when the full list of TO-15 VOCs is reported. If an analyte that was previously removed is detected in samples collected during the five-year full TO-15 list reporting cycle, it will be added back to the analyte list the following year, and the same DQOs will be applied (either future removal or remain on the analyte list). The next time the full TO-15 list will be reported is in 2019. Results for VOC analyses are presented in the OU2 Landfills operations and maintenance annual reports. Links to the last three annual reports (also referenced in the QAPP) are provided here:*

[2015](#)

[2016](#)

[2017](#)

**CLARIFICATION COMMENT 5:** Section 3.6.4 – It is noted, “This list required no changes from QAPP Revision 2.” Consider modifying this note as follows: This list required no changes from QAPP Revision 2, in which bromomethane was removed from the list.

**RESPONSE TO CLARIFICATION COMMENT 5:** *The note was not revised per the comment. Reference to previous QAPP revisions is sufficient for QAPP users to determine what analytes have been removed from the list.*

**CLARIFICATION COMMENT 6:** Section 4.2.1 – In the notes section of Worksheet #18, list the monitoring frequency changes that have been made in the QAPP Revision 3 as was done for the analytes added/removed in Worksheet #15 (i.e. SGP-1F – monitoring frequency was changed from annual to not applicable – the probe is no longer monitored per decision criteria presented in Worksheet #11, DQO

#3). Additionally, please provide clarification on the basis for the modifications to the monitoring frequency either as a reference to a table of historical results provided in another report or if necessary, compile the historical data for the monitoring points with frequency changes and provide as an appendix in the QAPP.

**RESPONSE TO CLARIFICATION COMMENT 6:** *The note was not revised per the comment. It is not necessary to include this information in the QAPP with respect to the sampling approach for the future monitoring events the QAPP is intended for.*

*Historical methane measurements are presented in OU2 Landfills operations and maintenance annual reports. Links to the last three annual reports (also referenced in the QAPP) are provided here:*

[2015](#)

[2016](#)

[2017](#)

*Historical data from earlier years can also be queried from the Fort Ord chemistry database on FODIS:*

<http://www.fodis.net/FortOrdChem/>

**MINOR EDITORIAL COMMENT 1:** In the acronym and abbreviation list the abbreviation for the Central Coast Regional Water Quality Control Board is CRWQCB. The abbreviation is also found on Page 3 under approval entities as CCRWQCB, data users as CCRWQCB, and organization partners as CRWQCB; and on Page 9, Worksheet #6 as CRWQCB. Please make the abbreviation for Central Coast Regional Water Quality Control Board consistent throughout the document.

**RESPONSE TO MINOR EDITORIAL COMMENT 1:** *The acronym list and text were revised to use CCRWQCB consistently.*

**MINOR EDITORIAL COMMENT 2:** Minor editorial comments include:

- a. Page 3, Contractor Name: Ahtna Environmental Inc. - from this line down the line spacing needs to be consistent and add a period after Inc.

**RESPONSE TO MINOR EDITORIAL COMMENT 2a:** *The text was revised per the comment.*

- b. Page 3 and Page 5 – several headings need colons at the end (i.e.: Page 3 after Contract Title:, Work Assignment Number:, etc. and Page 5 add a colon after identified below:)

**RESPONSE TO MINOR EDITORIAL COMMENT 2b:** *The text was revised per the comment.*

- c. Page 12, last paragraph – add a comma after LFG extraction wells (EWs).

**RESPONSE TO MINOR EDITORIAL COMMENT 2c:** *The text was revised per the comment.*

- d. Add LFG to clarify type of extraction system and wells – Page 13, first paragraph, first sentence – the LFG extraction and treatment system; and vertical LFG extraction wells; and Page 20, Problem Statement – operations LFG EWs.

**RESPONSE TO MINOR EDITORIAL COMMENT 2d:** *The text was not revised per the comment. Due to the nature and subject matter of the QAPP, it is implicit that references to the extraction and treatment system and extraction wells are specific to LFG.*

- e. Page 16, last paragraph, last sentence – “Therefore, chemicals of concern (COCs) in the A-Aquifer can or may migrate into the Upper 180-Foot Aquifer (Army, 1995).” Please consider replacing can or may with have the potential to.

**RESPONSE TO MINOR EDITORIAL COMMENT 2e:** *The text was revised per the comment.*

- f. Add THC to the following locations throughout the document: Page 18 – stack emissions list (i.e.: **THC**/NMOCs); Page 20 – Sample Parameter table (i.e.: **THC**/CH<sub>4</sub>/NMOC); Page 39 – Analyte table (i.e.: **THC**/Methane/NMOC); and Page 40 – Parameter table (i.e.: **THC**/Outlet CH<sub>4</sub>/NMOC and Speciated VOCs).

**RESPONSE TO MINOR EDITORIAL COMMENT 2f:**

- *Page 18 – THC was added to the Stack Emissions (Effluent) list*
  - *Page 20 – THC was added to the Sample Parameter table*
  - *Page 39 – THC was added to the analyte table*
  - *Page 40 – THC was added to the 2<sup>nd</sup> row of the Parameter table, but was not added to the 3<sup>rd</sup> row because only the mobile laboratory reports THC, not the fixed laboratory.*
- g. Section 4.2.1 – add EW - Extraction Well; VD - Passive Vent in Area D; and VF - Passive Vent in Area F to the list of abbreviations in the notes section.

**RESPONSE TO MINOR EDITORIAL COMMENT 2g:** *The notes were added per the comment.*

## Responses to Comments submitted by the Fort Ord Community Advisory Group (FOCAG)<sup>4</sup>

**COMMENT 1:** The Fort Ord Community Advisor Group (FOCAG) has had the opportunity to review the subject document. We note in Section 3.1.2 (page 14), the statement that no detailed records were kept on the amount or types of waste disposed of at the OU2 Landfills. The document referenced for this statement is listed as Dames & Moore, 1993.

Section 3.1.4 (page 14) reveals groundwater contamination affected the upper three groundwater aquifers. These three aquifers include the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer.

Section 3.1.5, (page 15) reveals “A residential area is located adjacent to OU2 Landfills Area F...There is potential for residents to be exposed to VOC’s from inhalation of vapors in ambient air.

Section 3.1.6 (page 15) Land Use Considerations reveals “The OU2 encompasses approximately 120 acres of land that is undeveloped other than uses as a landfill. A residential housing area for California State University Monterey Bay is located adjacent to OU2 landfills Area F...”

Regarding these statements about the Fort Ord OU2 area, the FOCAG refers you to a letter dated April 2, 2005. It is part of the Fort Ord Clean Up Administrative Record:

[http://docs.fortordcleanup.com/ar\\_pdfs/AR-OU2-630F//OU2-630F Oberweiserletter.pdf](http://docs.fortordcleanup.com/ar_pdfs/AR-OU2-630F//OU2-630F Oberweiserletter.pdf)

The FOCAG emphasis IS, this is a Hazardous Waste Site. It has been, and it still is. It is not a mere “landfill”. Further, the decision to create a CAMU with no liner beneath it turned out to be a disaster.

Please do take the time to read the letter submitted by Mr. Oberweiser (link above). It is as pertinent today as it was in year 2005. Millions and millions of taxpayer dollars have been spent in efforts to clean up contaminated groundwater below former Fort Ord, and adjoining areas.

**RESPONSE TO COMMENT 1:** *The reference to the letter submitted by Mr. Oberweiser is acknowledged. Please see the U.S. Department of the Army (Army) response to Mr. Oberweiser’s letter:*

[http://docs.fortordcleanup.com/ar\\_pdfs/AR-OU2-630F.2//OU2-630F.2.pdf](http://docs.fortordcleanup.com/ar_pdfs/AR-OU2-630F.2//OU2-630F.2.pdf)

*Note that, in accordance with the “Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs)” (2006),<sup>5</sup> CAMU regulations are ARARs for the OU2 Landfills, but the OU2 Landfills themselves are not a CAMU. There is no evidence the OU2 Landfills specifically or the OU2 remedy generally “turned out to be a disaster” as stated in the comment. To the contrary, data collected to date indicate the OU2 remedy continues to be protective of human health and the environment.<sup>6</sup> Remediation waste is being successfully contained in the OU2 Landfills, concentrations of methane and volatile organic compounds (VOCs) in landfill gas (LFG) are declining, LFG is not migrating outside the*

<sup>4</sup> In a letter dated November 19, 2018 (see Administrative Record No. OU2-702F.2).

<sup>5</sup> See Administrative Record No. OU2-656.

<sup>6</sup> See Administrative Record No. BW-2834.

*OU2 Landfills boundary, and concentrations of VOCs in groundwater at OU2 are declining (e.g., see Administrative Record Nos. OU2-710A and OU2-712).*

**COMMENT 2:** This OU2 has a history of being mismanaged. The Army did not do it intentionally, but it happened. The separation of the cleanup issues and the land use issues began almost immediately with the closure of former Fort Ord.

Frankly, the Army never dreamed an Army Infantry Training Base would ever be turned over to civilian control. But it was. Some very bad decisions were made. Completely identifying the clean up issues and the extent of the clean up issues, should have been done BEFORE adopting a civilian Base Reuse plan in 1992.

**RESPONSE TO COMMENT 2:** *The former Fort Ord is a National Priorities List (NPL) site and cleanup activities are being conducted in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Cleanup; therefore, cleanup issues and land use issues are not and cannot be separated. Proposed land use at the former Fort Ord is evaluated in the context of protection of human health and environment, and all property undergoes stringent environmental review by the Army, the U.S. Environmental Protection Agency, the California Department of Toxic Substances Control, and the Central Coast Regional Water Quality Control Board prior to transfer from the Army. The Army and regulatory agencies do not make land use decisions, but they ensure that the cleanup is sufficient to support the planned future use. Additionally, the Base Reuse Plan was adopted in 1997<sup>7</sup> after several investigations and documents addressing the extent of environmental issues at the former Fort Ord were completed, including the Fort Ord Landfills Remedial Investigation/Feasibility Study (1993),<sup>8</sup> the Community Environmental Response Facilitation Act (CERFA) Report (1994),<sup>9</sup> and the Basewide Remedial Investigation/Feasibility Study (1995).<sup>10</sup>*

**COMMENT 3:** Using this OU2 area for anything but permanent open space would be foolish and dangerous to people's health. Don't you agree?

**RESPONSE TO COMMENT 3:** *According to the Base Reuse Plan, the OU2 Landfills are designated as habitat management and open space areas.*

**COMMENT 4:** The bottom of page 19 has a footnote informing the reader that the full TO-15 list of VOC's was last reported in the Final Annual Report ... year 2015. Please include this list in the Draft Final.

**RESPONSE TO COMMENT 4:** *The full TO-15 list is included in Attachment B, Standard Operating Procedure No. 6 of the QAPP. The footnotes on pages 19 and 22 were revised to reference Attachment B.*

**COMMENT 5:** Please reconsider doing extensive testing for PFAS at OU2 and all contaminated groundwater sites on this former Fort Ord military base, and offsite too, as is being done at other bases in the United States.

**RESPONSE TO COMMENT 5:** *As with other military installations and former military installations in the United States, the Army is conducting a PFAS investigation at the former Fort Ord that is commensurate*

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<sup>7</sup> Fort Ord Reuse Plan, <http://b77.402.myftpupload.com/library/reuse-plan/>.

<sup>8</sup> Administrative Record No. OU2-222.

<sup>9</sup> Administrative Record No. BW-1658.

<sup>10</sup> Administrative Record No. BW-1283A.

*with the site history and available data. The Army is sampling and analyzing for per- and polyfluoroalkyl substances (PFAS, specifically perfluorooctanoic acid [PFOA] and/or perfluorooctane sulfonate [PFOS]) in groundwater in the A-Aquifer and the Upper 180-Foot Aquifer that is associated with the Operable Unit 2 (OU2) Landfills. Also, the Army will conduct a basewide review of historical activities at the former Fort Ord that may have resulted in releases of PFOA/PFOS to soil and groundwater. The results of these two activities will be reported in spring 2019, and the spring 2019 document will include recommendations for additional sampling if needed.*