

QUALITY ASSURANCE SAMPLING PLAN
FOR
HURRICANE IDA COMMUNITY AIR MONITORING AND SAMPLING
FOURCHON, GARYVILLE, LAPLACE, NORCO, AND NEW ORLEANS
LAFOURCHE, ST. JOHN THE BAPTIST, ST. CHARLES, AND ORLEANS
PARISHES, LOUISIANA



Prepared for

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1. INTRODUCTION

Weston Solutions, Inc. (WESTON®), the Superfund Technical Assessment and Response Team (START), has been tasked by the U.S. Environmental Protection Agency (EPA) Region 6 under Contract Number EP-S5-17-02, Technical Direction Document (TDD) Number 0004/21-423, to perform air monitoring and sampling activities within communities affected by Hurricane Ida. The site is comprised of four parishes (Lafourche, St. John the Baptist, St. Charles, and Orleans) within southeast Louisiana. A Site Location Map is provided as Figure 1-1. START has prepared this Quality Assurance Sampling Plan (QASP) to describe the technical scope of work to be completed at the site as part of the response.

1.1 PROJECT OBJECTIVES

START is providing technical assistance to EPA Region 6 with the objectives of the following:

- Determine if potential contaminants associated with industrial facilities restarting process operations after the effects of Hurricane Ida, including loss of electricity and flaring of materials from production lines, is being emitted into the atmosphere and affecting human health and the environment within the surrounding communities.
- Determine if damages caused by Hurricane Ida have caused potential contaminants to be released from industrial facilities or other sources via spills/leaks/emissions and affecting human health and the environment within the surrounding communities.
- Determine if the site situation poses a threat to public health or welfare of the United States or the environment in accordance with *40 Code of Federal Regulations (CFR) 300.415*.

These objectives will be achieved by evaluating air sampling and monitoring data obtained during the field activities from selected locations.

EPA Regional Screening Levels (RSLs) for residential air have been selected as the threshold exposure guidance concentration for volatile organic compounds (VOCs) and tentatively identified compounds (TICs) evaluated. If a RSL is not available for a particular analyte, either the OSHA Permissible Exposure Limit (PEL) or the National Institute of Occupational Safety and Health (NIOSH) Threshold Limit Value (TLV) will be used as the most conservative exposure guidance level.

Guidance Exposure Threshold Definitions:

- EPA Regional Screening Levels (RSLs): Risk-based concentrations derived from standardized equations combining exposure information assumptions with the latest EPA toxicity data. RSLs are considered by EPA Toxicologists to be protective for humans (including sensitive groups) over a lifetime. The RSLs will be adjusted for an appropriate exposure scenario which has been reached in consensus with LDEQ toxicologists.
- Occupational Safety and Health Act (OSHA) Permissible Exposure Limit (PEL): Maximum allowable amount in a workroom during an 8-hour workday in a 40-hour work week.
- National Institute of Occupational Safety and Health (NIOSH): The Threshold Limit Value (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) is the level to which a worker can be exposed day after day for a working lifetime without adverse effects.

1.2 PROJECT TEAM

The Project Team will consist of David Bordelon as the START Project Leader (PTL), Erik Hadwin as the START Field Safety Officer (FSO), and Robert Sherman, Larry Howard, and Keith Delhomme as air monitoring/sampling scientists. Additional staff may be added to the field team or to support the project remotely as needed. The PTL will be responsible for the technical quality of work performed in the field and will serve as the START liaison to EPA Region 6 during site activities. The PTL will also be responsible for providing the EPA On-Scene Coordinators (OSC) Eric Delgado and Anish Patel with updates of progress and estimated costs expended.

1.3 QASP FORMAT

This QASP has been organized in a format that is intended to facilitate and effectively meet the objective of the assessment. The QASP is organized in the following sections:

- Section 1 – Introduction
- Section 2 – Site Background
- Section 3 – Sampling Approach and Procedures
- Section 4 – Analytical Methods
- Section 5 – Data Validation

- Section 6 – Quality Assurance

All figures are provided as separate Portable Document Format (PDF) files. Appendices are attached with the following information.

Appendix A Site-Specific Data Quality Objectives

Appendix B Standard Operating Procedures

Appendix C TO-15 Targeted Compounds

2. SITE BACKGROUND

Information regarding the site location, description, and site history are included in the following subsections.

2.1 SITE LOCATION AND DESCRIPTION

The Hurricane Ida Community Air Monitoring and Sampling project area consists of all or parts of the storm damaged parishes previously described in this document. The team will focus its efforts on the industrial corridors located within the project area. Industry within these corridors consists of petrochemical plants, oil and gas refineries, oil production support companies, and associated service industries. In general, the majority of the facilities are located along the Mississippi River.

The project area is located in southeast Louisiana, and ranges from New Orleans to the east, LaPlace to the North, Garyville to the west, and Fourchon to the south. The area is low lying and subject to flooding and high winds associated with hurricanes.

2.2 SITE HISTORY

Hurricane Ida was a deadly and destructive Category 4 Atlantic hurricane that became the second-most damaging and intense hurricane to strike the state of Louisiana on record. On August 26, a tropical wave developed into a tropical depression, which organized further and became Tropical Storm Ida later that day, near Grand Cayman. Amid favorable conditions, Ida intensified into a hurricane on August 27, just before moving over western Cuba. A day later, the hurricane underwent rapid intensification over the Gulf of Mexico and reached its peak intensity as a strong Category 4 hurricane while approaching the northern Gulf Coast, with maximum sustained winds of 150 and a minimum central pressure of 929 millibars. On August 29, Ida made landfall near Port Fourchon, Louisiana. Ida weakened steadily over land, becoming a tropical depression on August 30, as it turned northeastward.

Extreme damage was recorded in Southeast Louisiana, with a very large number of houses and industrial facilities being damaged or destroyed, and storm surge and rain causing widespread flooding and water damage. Power outages were extensive through the southeastern portion of

the state. Industrial facilities were forced to shut in production and utilize generators to power all necessary operations. Upon resumption of operations, many of the facilities utilize flaring of materials during start up to incinerate feed stock and intermediary products which may have been negatively compromised during the shutdown. Identification and quantification of releases resulting from incomplete or complete combustion of these materials, as well as other emissions, spills, and leaks due to the storm effects will be the objective for which the air monitoring and sampling program has been designed.

3. SAMPLING APPROACH AND PROCEDURES

Samples collected by START will be used to quantitatively determine the concentrations of potential VOCs and to determine if contaminants of concern (CoCs) are present. Specific sampling locations and field investigation activities are described in the following subsections.

3.1 OVERVIEW OF SAMPLING ACTIVITIES

The objective of this sampling event is to determine the potential threat that CoCs may pose to human health. Therefore, ambient air samples will be collected at locations of potential exposure on surrounding properties. The air samples will be delivered to subcontracted laboratories (Pace, Inc. in Mt. Juliet Tennessee and ERG, Inc. in Morrisville, North Carolina) for analysis of TO-15 VOCs and TICs. A Data Quality Objective (DQO), as well as an overview of the health and safety and field activities required to complete these tasks, are presented in the following subsections.

3.1.1 Data Quality Objective

3.1.1.1 Air sampling

The objective of air sampling is to determine the presence and concentration of CoCs in ambient air. To accomplish this, a DQO for determining the concentration of CoCs in air is included as Appendix A. The DQO presented was developed using the seven-step process set out in the *Guidance for Data Quality Objectives Process: EPA QA/G-4*. Air sample locations will be selected based on wind direction and site observations.

Table 3-1 summarizes the air sample collection and rationale.

3.1.2 Health and Safety Plan Implementation

START field activities will be conducted in accordance with the site-specific Health and Safety Plan (HASP). The Field Safety Officer will be responsible for the HASP implementation during field activities. The START field team will be required to conduct work according to the guidelines and requirements of the HASP.

3.1.3 Field Activities Review Meeting

The PTL will conduct a meeting with the entire field team to familiarize them with the project scope of work, discuss the planned field activities, rule, and responsibilities, and review the project HASP and other relevant SOPs. This meeting will be conducted prior to beginning any site activities.

3.2 SAMPLING/MONITORING APPROACH

3.2.1 Air Sampling with Summa Canisters

Summa canister air sampling will be conducted in general accordance with the U.S. EPA Scientific, Engineering, Response and Analytical Services (SERAS) Standard Operating Procedure (SOP) Number 1704, Revision 1.0 for Summa Canister Sampling, and WESTON SOPs. Relevant SOPs for field sampling methods are included as Appendix B. A total of 8 summa canisters per day will be used to collect air samples of approximately 6 liters in volume for each canister. Summa canister air samples will be collected at 8 locations from a typical breathing zone of between 3 and 5 feet above ground surface. All air samples will be delivered to the participating laboratory for VOC analysis by EPA Method TO-15. TICs will be determined as part of the TO-15 method. Relevant observations and information will be recorded in the field logbook(s).

3.2.1.1 Summa Canister Sample Locations

Site-specific sample locations will be identified in the field, with concurrence of the EPA OSC and any appropriate stakeholders. Eight sites have been selected for sampling locations at this time; however, locations may be moved or added/subtracted as conditions dictate. Any changes to the original designations will be captured within a QASP addendum. Sample locations will be selected after reviewing wind and weather data, facility operations, proximity to residential properties, as well as sites identified by the response stakeholders. Sites with industrial facilities in the vicinity will have upwind and downwind sample locations. See Figure 3-1 for approximate sample locations.

3.2.1.2 Sampling Equipment

Samples will be collected using certified clean, 6-liter summa canisters and flow control regulators provided by the analytical laboratory. All canisters will be secured in the field by a cable and lock to a fixed object which will not interfere with the sampling effort. All canisters will be labeled with the laboratory information.

All regulators and summa canisters will be leak checked prior to deployment by shutting in the system, applying a negative pressure from the canister, and monitoring the observed pressure on the regulator gauge. If the gauge loses more than 2" Hg of pressure within one minute the system has failed the leak check. All connections will be reassessed and tightened. If the canister cannot pass the leak check, the canister will be voided and returned to the laboratory. If the flow control regulator is determined to be the point at which the leak occurs that device will be returned to the laboratory.

3.2.1.3 Sample Duration and Flow Rate

The summa canister flow control regulators will be calibrated to collect a sample of approximately 6 liters in volume over a 24-hour period. The beginning internal pressure will be approximately -30 mm/Hg. After the 24-hour collection time, the pressure in the canister should read approximately -3 mm/Hg. The sample intakes will be held at approximately 3-5 ft above the ground for the duration of the sampling. Once sampling is complete, relevant data will be documented and the summa canisters capped and packed securely for shipment.

3.2.2 Air Monitoring for VOCs

Telemetry enabled meters equipped with a PID detector will be deployed to every sampling station to gather and display data in "real time". Relevant observations and information will be recorded in the field logbook(s).

Monitoring locations will be collocated with the summa canister sampling locations. These locations will be identified on project maps and electronic visualization tools. It is anticipated that locations with industrial facilities in the proximity of the area of concern will have upwind

and downwind locations. Two areas are anticipated to have only one sampling location. See Figure 3-1 for approximate sample locations.

3.2.3 Air Monitoring for PM_{2.5}

Telemetry enabled meters equipped with a PM_{2.5} detector will be deployed to every sampling station to gather and display concentrations of particulates which are less than 2.5 microns (um) in diameter. This data will be captured and displayed in “real time” for approved personnel. The action level for PM_{2.5} will be 35 ug/m³.

Monitoring locations will be collocated with the summa canister sampling locations. These locations will be identified on project maps and electronic visualization tools. It is anticipated that locations with industrial facilities in the proximity of the area of concern will have upwind and downwind locations. Two areas are anticipated to have only one sampling location. See Figure 3-1 for approximate sample locations.

3.2.4 Investigation-Derived Wastes (IDW)

It is anticipated that IDW such as personal protective equipment (PPE), and disposable sampling equipment will be generated during the project. IDW will be double bagged and disposed following applicable regulations with other waste generated during removal activities.

3.2.5 Quality Assurance/Quality Control Samples

START will collect one field duplicate for summa canister samples per 20 samples collected.

3.3 SAMPLE MANAGEMENT

Specific sampling nomenclature will be used by START based on Weston SOP 0110.04 for onsite sampling nomenclature. This will provide a consistent means of facilitating the sampling and overall data management for the project (Refer to Appendix B). The general nomenclature consists of the following components:

Sample Site – Sample Approach – Sample Location – Date – QA/QC Type

Example: IDA-SUM-001-YYYYMMDD-1

- Sample Approach
 - SUM for SUMMA Sampling
- Sample Location ID
- Date (YYYYMMDD)
- QA/QC type (1 for normal, 2 for duplicate, 3 for media blanks).

Sample locations will be identified sequentially in the field, as each location is sampled. The sample location number does not correspond to the physical location/address of the sample.

3.4 DECONTAMINATION

Decontamination of sampling equipment is not anticipated for this sampling event. Only disposable sampling equipment will be used, and new sampling tubing and sorbent tubes will be used.

3.5 SAMPLE PRESERVATION, CONTAINERS, AND HOLD TIMES

Sample preservation, containers, media, and holding times utilized during this sampling event will be consistent with analytical methods and laboratory media requirements as provided in Table 3-1. Once collected, samples will be securely stored while at the site and until the samples are submitted for analyses. Samples that have been analyzed will be disposed of by the designated laboratory in accordance with the laboratory SOPs.

Table 3-1
Sample Collection and Analysis Summary
Hurricane Ida Community Air Monitoring and Sampling
Southeast Louisiana

Sample Locations	Sample Collection Method	No. of Samples	Rationale	NIOSH Analytical Method
On-site and upwind/downwind of site	SERAS SOP Number 1704 Rev 1.0 for Summa Canister Sampling.	8/day	Determine presence, composition, and concentrations of CoCs.	TO-15 (VOC) + TICs

Table 3-2
Requirements for Containers, Preservation Techniques,
Sample Volumes, and Holding Times
Hurricane Ida Community Air Monitoring and Sampling
Southeast Louisiana

Name	Analytical Methods	Matrix	Container/Media	Preservation	Maximum Holding Time
VOCs	TO-15	Air	6 Liter Summa Canister	NA	30 days

4. ANALYTICAL METHODS

Due to the logistics of obtaining enough Summa Canisters to support an on-going sampling effort, START has subcontracted Summa Canisters and analytical services from two laboratories.

Air samples collected for VOCs by EPA methods TO-15, will be submitted to:

Pace Analytical National Center for Testing and Innovation
12065 Lebanon Rd.
Mt. Juliet, TN 37122
Jared Starkey – Project Manager
615-773-9698

Eastern Research Group
601 Keystone Park Dr., STE 700
Morrisville, NC 27560
Julie Swift – Program Manager
919-468-7924

Deliverables will include preliminary data via email in pdf format. The final data deliverable will include Level II data package (Narrative, Form-1s and QC Summaries) in PDF format and a final Electronic Data Deliverable (EDD) in excel format. Data deliverables will be based on a 2-business day Turn-around Time (TAT), unless otherwise directed by the EPA OSC. The TAT criteria will be initiated when the sample group is received by the laboratory and continues until the data deliverable is submitted to the START contractor. If START is directed by EPA to receive a full Level IV data package (includes all raw data), the Level IV data deliverable will be submitted by the laboratory based on a 10-business day TAT.

5. DATA VALIDATION

START will validate the analytical data generated by the subcontract laboratories using modified EPA-approved data validation procedures in accordance with the EPA Contract Laboratory Program *National Functional Guidelines for Organic Superfund Data Review – November 2020* (EPA 540-R-20-005). Laboratory data packages will be verified and validated using a Stage 2B validation, as described in the EPA *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (January 2009). A summary of the data validation findings will be presented in Data Validation Summary Reports as part of the final report. START will evaluate the following (if applicable) to verify that the analytical data is within acceptable QA/QC tolerances:

- The completeness of the Laboratory Reports, verifying that all required components of the report are present and that the samples indicated on the accompanying chain-of-custody are addressed in the report.
- The calibration and tuning records for the laboratory instruments used for the sample analyses.
- The results of internal standards analyses.
- The results of laboratory blank analyses.
- The results of laboratory control sample (LCS) analyses.
- The results of matrix spike/matrix spike duplicate (MS/MSD) analyses.
- The results of surrogate recovery analyses.
- Compound identification and quantification accuracy.
- Laboratory precision by reviewing the results for blind field duplicates.

Variances from the QA/QC objectives will be addressed as part of the Data Validation Summary Reports.

6. QUALITY ASSURANCE

Quality assurance will be conducted in accordance with the WESTON Corporate Quality Management Manual, dated October 2016 and the WESTON START Quality Management Plan, dated August 2017. The START PTL will be responsible for QA/QC of the field investigation activities. The designated laboratory utilized during the investigation will be responsible for QA/QC related to the analytical work. START will also collect media blank samples to verify that laboratory QA/QC is consistent with the required standards and to validate the laboratory data received.

6.1 SAMPLE CUSTODY PROCEDURES

Because of the evidentiary nature of sample collection, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. After sample collection and identification, samples will be maintained under the chain-of-custody procedures. Sample labels completed with the same information as that on the original sample container will be attached to each of the samples. All personnel required to package and ship coolers containing potentially hazardous material will be trained accordingly.

A typical chain-of-custody record will be completed each time a sample or group of samples is prepared for shipment to the laboratory. The record will repeat the information on each sample label and will serve as documentation of handling during shipment. A copy of this record will remain with the shipped samples at all times, and another copy will be retained by the member of the sampling team who originally relinquished the samples.

Samples relinquished to the participating laboratories will be subject to the following procedures for transfer of custody and shipment:

- Samples will be accompanied by the chain-of-custody record. When transferring possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time of the sample transfer on the record. This custody record documents transfer of sample custody from the sampler to another person or to the laboratory.

- Samples will be properly packed for shipment and dispatched to the appropriate laboratory for analysis with separate, signed custody records enclosed in each sample box or cooler. Sample shipping containers will be custody-sealed for shipment to the laboratory. The preferred procedure includes use of a custody seal wrapped across filament tape that is wrapped around the package at least twice. The custody seal will then be folded over and stuck to the seal to ensure that the only access to the package is by cutting the filament tape or breaking the seal to unwrap the tape.
- If sent by common carrier, a bill of lading or air bill will be used. Bill of lading and air bill receipts will be retained in the project file as part of the permanent documentation of sample shipping and transfer.

6.2 PROJECT DOCUMENTATION

All documents will be completed legibly and in ink and by entry into field logbooks. SCRIBE Enterprise is designed to give SCRIBE users the ability to synchronize the SCRIBE field data to the RRC-EDMS Web Hub. This allows analytical data managers and data validators access to data to perform reviews from anywhere with an Internet connection. SCRIBE Enterprise is designed to take the analytical data management functionality of the EPA SCRIBE software and make it available for multiple users to access on one site.

6.2.1 Field Documentation

Field documentation will be maintained as described in the following subsections.

6.2.1.1 Field Logbook

The field logbook is a descriptive notebook detailing site activities and observations so that an accurate, factual account of field procedures may be reconstructed. All entries will be signed by the individuals making them. Entries should include, at a minimum, the following:

- Site name and project number.
- Names of personnel on-site.
- Dates and times of all entries.
- Description of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather conditions.

- Site observations.
- Identification and description of samples and locations.
- Subcontractor information and names of on-site personnel.
- Dates and times of sample collections and chain-of-custody information.
- Records of photographs.
- Site sketches.

6.2.1.2 Sample Labels

Sample labels will be securely affixed to the sample container. The labels will clearly identify the particular sample and include the following information:

- Site name and project number.
- Date and time the sample was collected.
- Sample preservation method.
- Analysis requested.
- Sampling location.

6.2.1.3 Chain-of-Custody Record

A chain-of-custody will be maintained from the time of sample collection until final deposition. Every transfer of custody will be noted and signed for and a copy of the record will be kept by each individual who has signed it. The chain-of-custody is discussed in Subsection 6.1 Sample Custody Procedures.

6.2.1.4 Custody Seal

Custody seals demonstrate that a sample container has not been tampered with or opened. The individual who has custody of the samples will sign and date the seal and affix it to the container in such a manner that it cannot be opened without breaking the seal.

6.2.1.5 Photographic Documentation

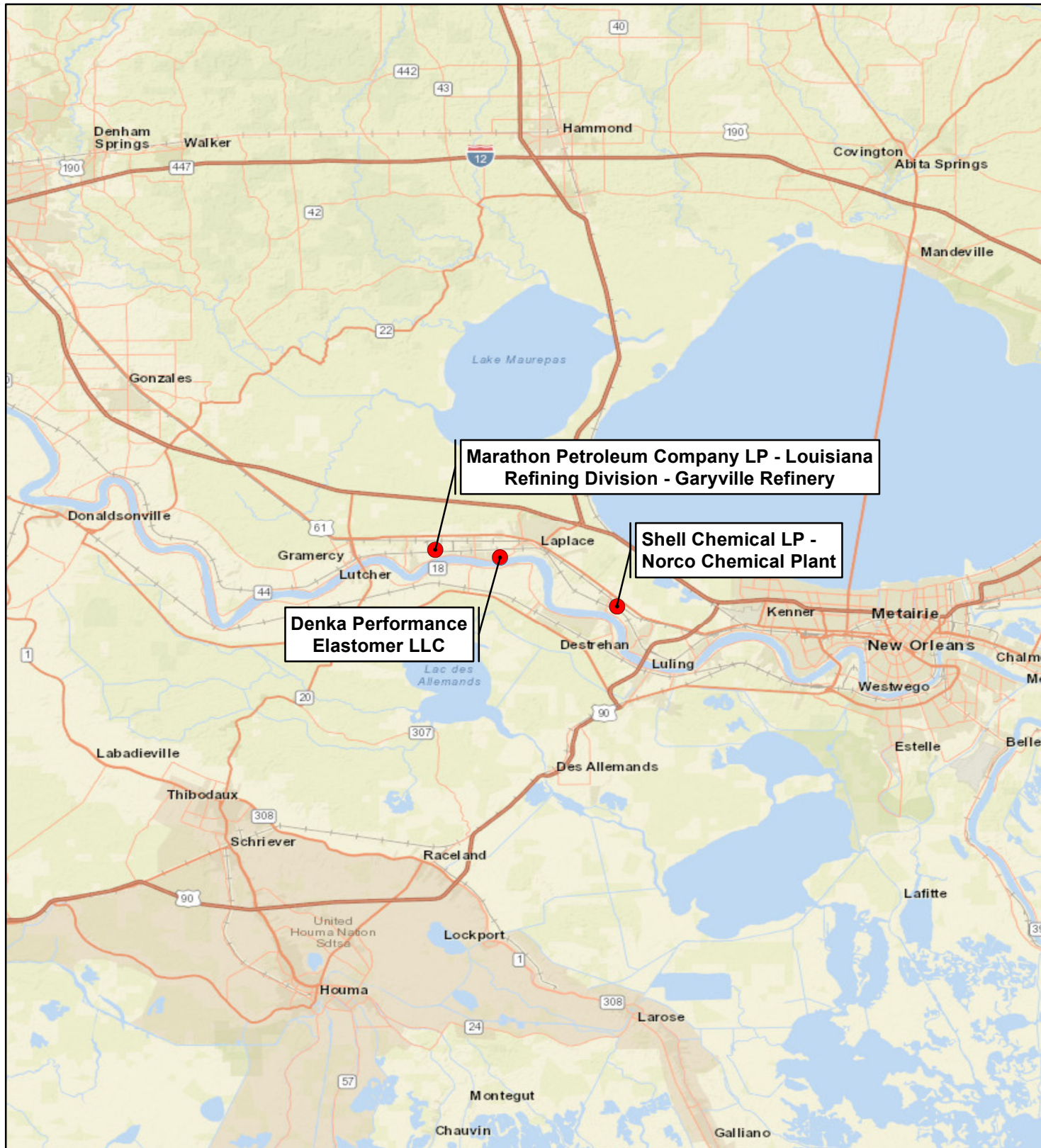
START will take photographs to document site conditions and activities as site work progresses. Initial conditions should be well documented by photographing features that define the site-

related contamination or special working conditions. Representative photographs should be taken of each type of site activity. The photographs should show typical operations and operating conditions as well as special situations and conditions that may arise during site activities. Site final conditions should also be documented as a record of how the site appeared at completion of the work.

All photographs should be taken with a digital camera capable of recording the date on the image. Each photograph will be recorded in the logbook with the location of the photographer, direction of view in the photograph, the subject of the photograph, and its significance (i.e., captured information in photograph). Where appropriate, the photograph location, direction, and subject will also be shown on a site sketch.

6.2.2 Report Preparation

At the completion of the project, START will review and validate the laboratory data and prepare a draft report of field activities and analytical results for EPA OSC review. Draft deliverable documents will be uploaded to the EPA TeamLink website for OSC review and comment.



LEGEND

● SITE LOCATION



0 10 20
MILES



USEPA REGION 6

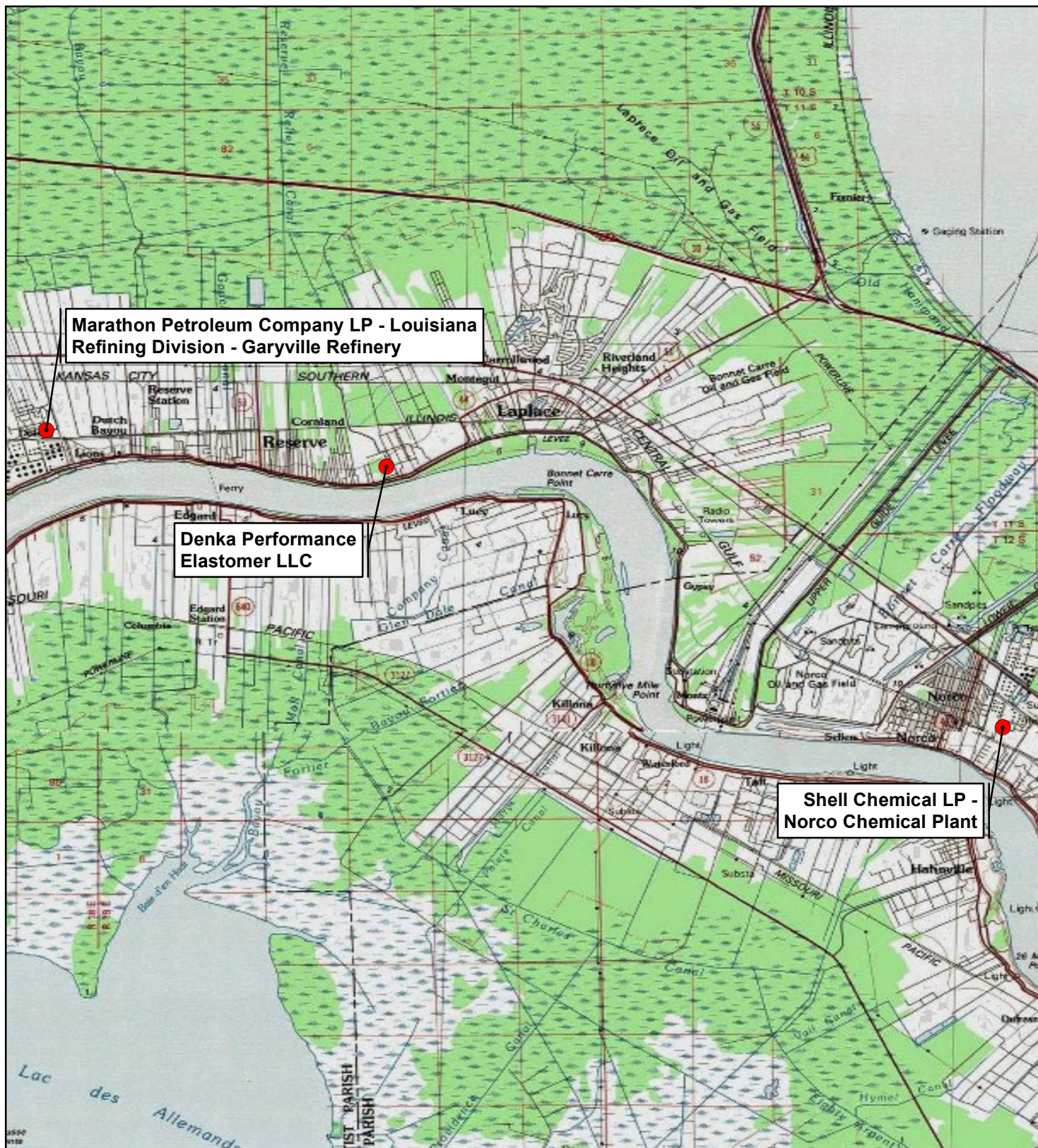
FIGURE 1-1
SITE LOCATION MAP
HURRICANE IDA COMMUNITY
AIR MONITORING
LOUISIANA

DATE
SEPTEMBER 2021

PROJECT NO
xxxxx.xxx.xxx.xxx

SCALE
AS SHOWN

SOURCE: WORLD STREETS MAP; ESRI



LEGEND

● SITE LOCATION



0 10,000 20,000

FEET

SOURCE: USA TOPO MAPS; ESRI



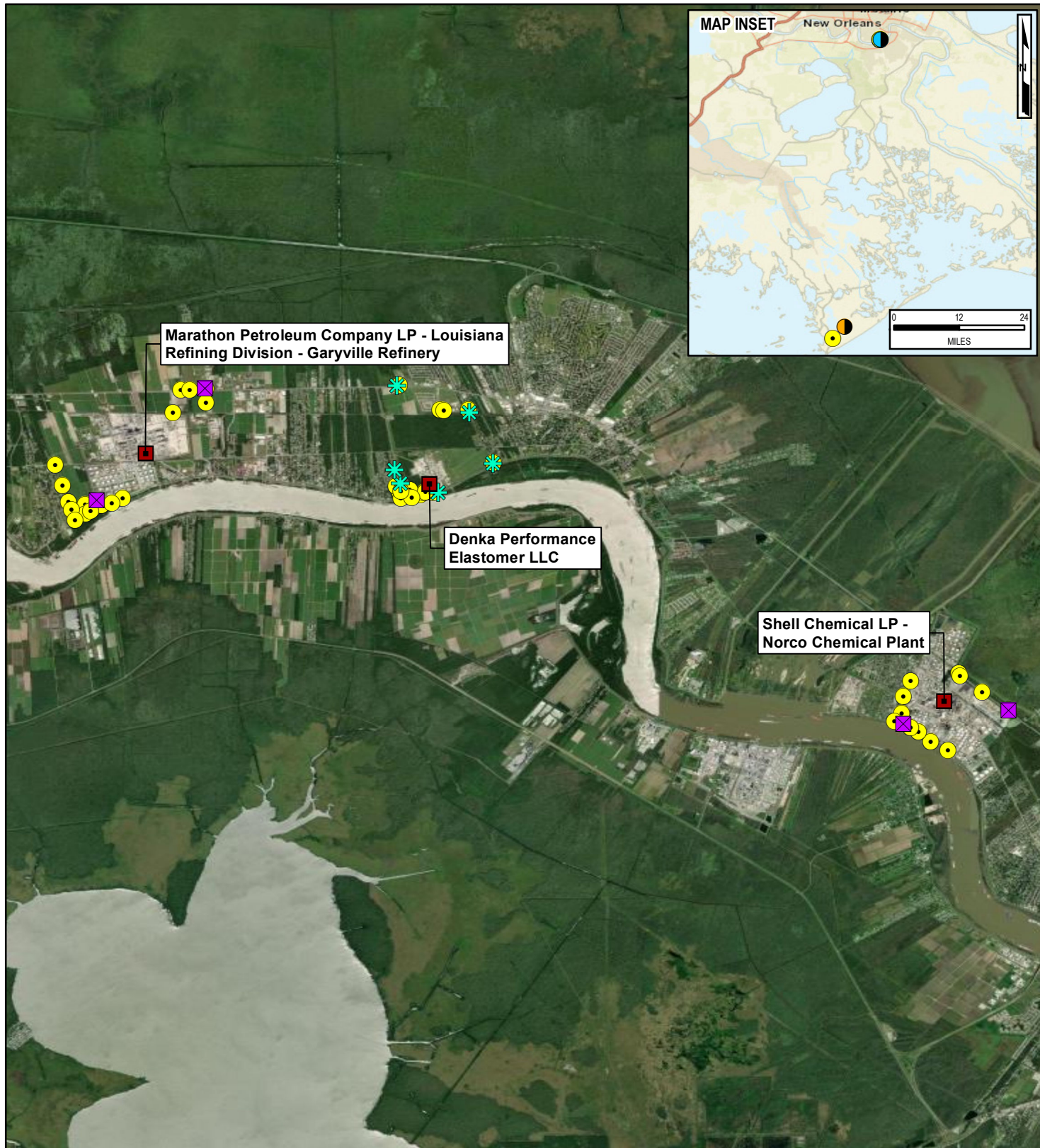
USEPA REGION 6

FIGURE 2-1
SITE AREA MAP
HURRICANE IDA COMMUNITY
AIR MONITORING
LOUISIANA

DATE
SEPTEMBER 2021

PROJECT NO
xxxxx.xxx.xxx.xxx

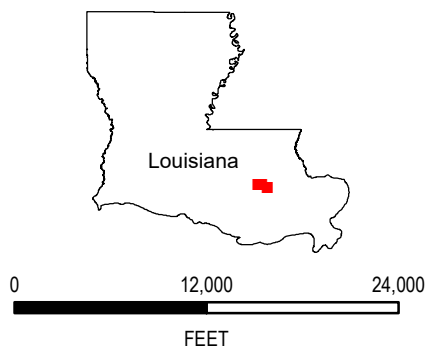
SCALE
AS SHOWN



LEGEND

- ROVING AIR MONITORING LOCATION
- SUMMA CANISTER LOCATION
- ✱ DENKA SPODS LOCATION
- IRISH CHANNEL
- PORT FOURCHON
- FACILITY LOCATION

SOURCE: USA TOPO MAPS; ESRI



USEPA REGION 6

FIGURE 3-1
SAMPLING LOCATION MAP
 HURRICANE IDA COMMUNITY
 AIR MONITORING
 LOUISIANA

DATE
 SEPTEMBER 2021

PROJECT NO
 xxxxxx.xxxx.xxxx

SCALE
 AS SHOWN

APPENDIX A

SITE-SPECIFIC DATA QUALITY OBJECTIVES

DATA QUALITY OBJECTIVE NO. 1
HURRICANE IDA COMMUNITY AIR MONITORING
MEDIA OF CONCERN: AIR

STEP 1. STATE THE PROBLEM	
To determine if potential contaminants are present in and around the Hurricane Ida effected areas of southeast Louisiana and determine if the situation poses a threat to public health or welfare of the United States or the environment.	
STEP 2. IDENTIFY THE DECISION	
Air samples will be collected from 8 locations within and around the Hurricane Ida effected areas to determine whether contaminants of concern (CoCs) are present.	
IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS.	<ul style="list-style-type: none"> If concentrations of CoCs in air exceed the EPA Residential RSLs, OSHA PELs, or NIOSH TLVs, whichever is the most conservative exposure guidance level, then that sample will be considered contaminated and require additional attention. If concentrations of CoCs in the air samples do not exceed the EPA Residential RSLs, OSHA PELs, or NIOSH TLVs, whichever is the most conservative exposure guidance level, then the media represented by that sample will not require additional attention.
STEP 3. IDENTIFY INPUTS TO THE DECISION	
IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION.	Contaminant concentrations in the air samples collected from Hurricane Ida effected areas.
IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS.	Analytical results from parameters listed in Section 3 of the QASP.
BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS.	EPA Residential RSLs, OSHA PELs, or NIOSH TLV, whichever is the most conservative exposure guidance level.
IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS.	<ul style="list-style-type: none"> Air samples will be collected from 8 locations depicted on the site map (SERAS SOP# 1074; 2121). See analyses listed in Section 3 of the QASP.
STEP 4. DEFINE THE BOUNDARIES OF THE STUDY	
DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY.	The Hurricane Ida effected areas and surrounding areas as appropriate.
SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST.	Contaminant concentration in air within and around the Hurricane Ida effected areas in southeast LA.
DEFINE THE SCALE OF DECISION MAKING.	Results of air sampling will be used to evaluate the CoCs within Hurricane Ida effected areas and surrounding areas.
DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY.	The data will apply until the site media, represented by the air samples, receives appropriate response actions.
DETERMINE WHEN TO COLLECT DATA.	Samples will be collected during the EPA Team emergency response field effort.
IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION.	<ul style="list-style-type: none"> Inclement weather. Access not attainable. Equipment malfunction.

DATA QUALITY OBJECTIVE NO. 1
HURRICANE IDA COMMUNITY AIR MONITORING
MEDIA OF CONCERN: AIR

STEP 5. DEVELOP A DECISION RULE	
SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST.	Detection of CoCs in the air samples by analytical testing to confirm concentrations in the pathway that exceed the EPA Residential RSLs, OSHA PELs, or NIOSH TLV, whichever is the most conservative exposure guidance level.
SPECIFY THE ACTION LEVEL FOR THE DECISION.	EPA Residential RSLs, OSHA PELs, or NIOSH TLV, whichever is the most conservative exposure guidance level.
STEP 6. SPECIFY LIMITS ON DECISION ERRORS	
DEVELOP A DECISION RULE.	If any result in the air sample is above the most conservative exposure guidance level, then the area represented by that air sample will require additional attention; otherwise, the sampled area does not require additional attention.
DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST.	Contaminant concentrations may range from 0 ppm to more than the contaminant specific action level.
DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH.	<p><u>Type I Error:</u> Deciding that the specified area represented by the air sample does not exceed the specified assessment level when, in truth, the concentration of the contaminant exceeds its specified assessment level (False Negative). The consequence of this decision error is that remedial efforts in the area may not be undertaken, possibly endangering human health and the environment. This decision error is more severe.</p> <p><u>Type II Error:</u> Deciding that the specified area represented by the air sample does exceed the specified assessment level when, in truth, it does not (False Positive). The consequences of this decision error are that remediation of the area will continue and unnecessary costs will be incurred.</p>
ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION RULE.	<p>The true state of nature when the air is decided to be below the specified assessment levels when in fact, it is not below the specified assessment levels, is that the area does need remedial action.</p> <p>The true state of nature when the air is decided to be above the specified assessment levels when in fact, it is not above the specified assessment levels, is that the area does not need remedial action.</p>

DATA QUALITY OBJECTIVE NO. 1
HURRICANE IDA COMMUNITY AIR MONITORING
MEDIA OF CONCERN: AIR

STEP 6. SPECIFY LIMITS ON DECISION ERRORS (Continued)	
DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS (H_0) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS (H_a).	<p>H_0: The air represented by the sample is above the specified action level.</p> <p>H_a: The air represented by the sample is below the specified action level.</p>
ASSIGN THE TERMS “FALSE POSITIVE” AND “FALSE NEGATIVE” TO THE PROPER DECISION ERRORS.	<ul style="list-style-type: none"> False Positive Error = Type II False Negative Error = Type I
ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS.	To be assigned based on discussions with EPA OSC.
STEP 7. OPTIMIZE THE DESIGN	
REVIEW THE DQOs.	Due to insufficient historical data, determination of the standard deviation was not possible. Therefore, sample size calculation using the traditional statistical formula may not be the optimal design. In order to select the optimal sampling program that satisfies the DQOs and is the most resource effective, other elements were considered.
<p>DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN.</p> <p>START will collect approximately 8 air samples from in and around Hurricane Ida effected areas in southeast LA. The samples will be shipped for laboratory analysis and methodology consistent with EPA Region 6 protocols. The samples will be analyzed for VOCs and TICs by EPA Methods TO-15.</p>	

APPENDIX B
STANDARD OPERATING PROCEDURES

SOP 0110.05

SAMPLE NOMENCLATURE

SOP	0110.05				
GROUP	Database Management System				
SUB-GROUP	Data Collection and Acquisition				
TITLE	Sample Nomenclature				
DATE	04/01/2010	FILE	0110.05.docx	PAGE	1 of 2

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the sample nomenclature for analytical samples that will generate unique sample names compatible with most data management systems. The sample nomenclature is based upon specific requirements for the reporting of these results. A site specific data management plan should be prepared prior to sample collection.

PROCEDURE

SAMPLE NOMENCLATURE – SOIL AND SEDIMENT

Area of Concern – ID – Depth - Collection Type + QC Type

Where:

Area of Concern: A four-digit identifier used to designate the particular Area of Concern (AOC) that the location where the sample was collected.

ID: A three letter &/or digit identifier used to designate the particular location (i.e. grid A01, P06, or 055) in the AOC from which the sample was collected or the center of the composite sample.

Depth: A two-digit code used to designate what depth of sample was collected:

code	Assessment	Confirmation
00	0 to 0 Surface	N/A
03	0 to 3 inches	3 inches below original ground surface
06	3 to 6 inches	6 inches below original ground surface
12	6 to 12 inches	12 inches below original ground surface

Collection Type: A one-digit code used to designate what type of sample was collected:

1	Surface Water	6	Oil
2	Ground Water	7	Waste
3	Leachate	8	Other
4	Field QC/water sample	9	Drinking Water
5	Soil/Sediment		

QC Type: A one-digit code used to designate the QC type of the sample:

1	Normal
2	Duplicate
3	Rinsate Blank
4	Trip Blank
5	Field Blank
6	Confirmation, Normal
7	Confirmation, Duplicate

Examples:

- **2054-055-06-51:** Represents the normal soil sample collected from AOC 2054 at location 055 from 3 to 6 inches of depth.
- **2054-055-06-52:** Represents the duplicate soil sample collected from AOC 2054 at location 055 from 3 to 6 inches of depth.

SOP	0110.05				
GROUP	Database Management System				
SUB-GROUP	Data Collection and Acquisition				
TITLE	Sample Nomenclature				
DATE	04/01/2010	FILE	0110.05.docx	PAGE	2 of 2

- **2054-000-00-43:** Represents the rinsate sample from AOC 2054
- **2054-055-06-56:** Represents the normal soil sample collected from AOC 2054 at location 055 after 6 inches of material has been removed as the confirmation sample during removal.
NOTE: The depth is in relation to the original ground surface.
- **2054-055-06-43:** Represents the rinsate water sample collected after the last sample of the day if last sample was collected from AOC 2054 at location 055 from 3 to 6 inches of depth.

SAMPLE NOMENCLATURE – WATER (from fixed station or location to be sampled more than once)

WELL OR STATION – YYYYMMDD - Collection Type + QC Type

Where:

Well or Station: For Wells and boreholes always assume there will be 10 or more so Monitoring Well 1 becomes designated MW01 or MW-01. If it is anticipated that there will be over 100 wells designate Monitoring Well 1 as MW001 or MW-001.

YYYYMMDD: A four-digit year + two-digit month + two-digit day

Collection Type: A one-digit code used to designate what type of sample was collected and are shown on page 1.

QC Type: A one-digit code used to designate the QC type of the sample and are shown on page 1.

Examples:

- **MW01-20090226-21:** Represents the normal groundwater sample collected from Monitoring Well 1 on 26 February 2009.
- **MW01-20090226-44:** Represents the trip blank in the same ice chest as the groundwater sample in the previous collected from Monitor Well 1 on 02/26/2009. All trip blanks must have a sample ID and they must be unique and on the Chain-of -Custody.

SOP 1101.01

SAMPLING HANDLING

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	1 of 4

INTRODUCTION

The following Standard Operating Procedure (SOP) presents procedures for maintaining sample chain of custody (COC) during activities where samples are collected.

PROCEDURE

Sample custody is defined as being under a person's custody if any of the following conditions exist:

- it is in their possession,
- it is in their view, after being in their possession,
- it was in their possession and they locked it up, or
- it is in a designated secure area.

A designated field sampler will be personally responsible for the care and custody of collected samples until they are transferred to another person or properly dispatched to the laboratory. To the extent practicable, as few people as possible will handle the samples.

Sample tags or labels will be completed and applied to the container of each sample. When the tags or labels are being completed, waterproof ink will be used. If waterproof ink is not used, the tags or labels will be covered by transparent waterproof tape. Sample containers may also be placed in Ziploc-type storage bags to help keep them clean in the cooler. Information typically included on the sample tags or labels will include the following:

- Project Code
- Station Number and Location
- Sample Identification Number
- Date and Time of Sample Collection
- Type of Laboratory Analysis Required
- Preservation Required, if applicable
- Collector's Signature
- Priority (optional)
- Other Remarks

Additional information may include:

- Anticipated Range of Results (Low, Medium, or High)
- Sample Analysis Priority

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
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A COC form will be completed each time a sample or group of samples is prepared for transfer to the laboratory. The form will repeat the information on each of the sample labels and will serve as documentation of handling during shipment. The minimum information requirements of the COC form are listed in Table 1101.01-A. An example COC form is shown in Figure 1101.01-A. The completed COC must be reviewed by the Field Team Leader or Site Manager prior to sample shipment. The COC form will remain each sample shipping container at all times, and another copy will be retained by the member of the sampling team who originally relinquished the samples or in a project file.

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	3 of 4

TABLE 1101.01-A CHAIN OF CUSTODY FORM

INFORMATION	COMPLETED BY	DESCRIPTION
COC	Laboratory	enter a unique number for each chain of custody form
SHIP TO	Field Team	enter the laboratory name and address
CARRIER	Field Team	enter the name of the transporter (e.g., FedEx) or handcarried
AIRBILL	Field Team	enter the airbill number or transporter tracking number (if applicable)
PROJECT NAME	Field Team	enter the project name
SAMPLER NAME	Field Team	enter the name of the person collecting the samples
SAMPLER SIGNATURE	Field Team	signature of the person collecting the samples
SEND RESULTS TO	Field Team	enter the name and address of the prime contractor
FIELD SAMPLE ID	Field Team	enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)
DATE	Field Team	enter the year and date the sample was collected in the format M/D (e.g., 6/3)
TIME	Field Team	enter the time the sample was collected in 24 hour format (e.g., 0900)
MATRIX	Field Team	enter the sample matrix (e.g., water, soil)
PRESERVATIVE	Field Team	enter the preservative used (e.g., HNO3) or "none"
FILTERED/ UNFILTERED	Field Team	enter "F" if the sample was filtered or "U" if the sample was not filtered
CONTAINERS	Field Team	enter the number of containers associated with the sample
MS/MSD	Field Team or Laboratory	enter "X" if the sample is designated for the MS/MSD
ANALYSES REQUESTED	Field Team	enter the method name of the analysis requested (e.g., SW6010A)
COMMENTS	Field Team	enter comments
SAMPLE CONDITION UPON RECEIPT AT LABORATORY	Laboratory	enter any problems with the condition of any sample(s)
COOLER TEMPERATURE	Laboratory	enter the internal temperature of the cooler, in degrees C, upon opening
SPECIAL INSTRUCTIONS/COMMENTS	Laboratory	enter any special instructions or comments
RELEASED BY (SIG)	Field Team and Laboratory	enter the signature of the person releasing custody of the samples
COMPANY NAME	Field Team and Laboratory	enter the company name employing the person releasing/receiving custody
RECEIVED BY (SIG)	Field Team and Laboratory	enter the signature of the person receiving custody of the samples
DATE	Field Team and Laboratory	enter the date in the format M/D/YY (e.g., 6/3/96) when the samples were released/received
TIME	Field Team and Laboratory	enter the date in 24 hour format (e.g., 0900) when the samples were released/received

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	4 of 4

FIGURE 1101.01-A CHAIN OF CUSTODY FORM

SOP 1102.01

SAMPLE HANDLING

SOP	1102.01				
GROUP	Sample Handling				
SUB-GROUP	Sample Shipping				
TITLE	Sample Shipping				
DATE	11/19/2001	FILE	1102-01.DOC	PAGE	1 of 1

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the procedures for sample shipping that will be implemented during field work involving sampling activities.

TERMS

COC - Chain-of-Custody

PROCEDURE

Prior to shipping or transferring custody of samples, they will be packed according to D.O.T. requirements with sufficient ice to maintain an internal temperature of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ during transport to the laboratory. Samples relinquished to the participating laboratories will be subject to the following procedures for transfer of custody and shipment:

1. Samples will be accompanied by a COC record. When transferring possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time of the sample transfer on the record. If sent by common carrier, a bill of lading or airbill should be used. Bill of lading and airbill receipts will be retained in the project file as part of the permanent documentation of sample shipping and transfer. This custody record documents transfer of sample custody from the sampler to another person or to the laboratory. The designated laboratory will accept custody in the field upon sample pick-up or at the laboratory if the samples are delivered via field personnel or a courier service.
2. Samples will be properly packed in approved shipping containers for laboratory pick-up by the appropriate laboratory for analysis, with separate, signed custody records enclosed in each sample box or cooler. Sample shipping containers will be padlocked or custody-sealed for transfer to the laboratory. The preferred procedure includes use of a custody seal wrapped across filament tape that is wrapped around the package at least twice. The custody seal will then be folded over and stuck to itself so that the only access to the package is by cutting the filament tape or breaking the seal to unwrap the tape. The seal will then be signed. The designated laboratory will accept custody of the samples upon receipt.
3. Whenever samples are split with state representatives or other parties, the COC record will be marked to indicate with whom the samples were split.
4. The field sampler will call the designated laboratory to inform them of sample shipment and verify sample receipt as necessary.

SOP 1201.01

SAMPLING EQUIPMENT DECONTAMINATION

SOP	1201.01				
GROUP	Decontamination				
SUB-GROUP	Sampling Equipment Decontamination				
TITLE	Sampling Equipment Decontamination				
DATE	11/19/2001	FILE	1201-01.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the methods used for minimizing the potential for cross-contamination, and provides general guidelines for sampling equipment decontamination procedures.

PROCEDURE

As part of the Health and Safety Plan (HASP), develop and set up a decontamination plan before any personnel or equipment enter the areas of potential exposure. The decontamination plan should include the following:

- The number, location, and layout of decontamination stations
- Which decontamination apparatus is needed
- The appropriate decontamination methods
- Methods for disposal of contaminated clothing, apparatus, and solutions

Decontamination Methods

Personnel, samples, and equipment leaving the contaminated area of a site will be decontaminated. Various decontamination methods will be used to either physically remove contaminants, inactivate contaminants by disinfection or sterilization, or both. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing/scrubbing the surface containing the contaminant. This method includes mechanical and wet blasting methods.

Mechanical cleaning methods use brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.

Cleaning can also be accomplished by water blasting which is also referred to as steam cleaning and pressure washing. Pressure washing utilizes high-pressure that is sprayed from a nozzle onto sampling equipment to physically remove soil or (potentially) contaminated material. Steam cleaning is a modification of pressure washing where the water is heated to temperatures approaching 100°C to assist in removing organic constituents from equipment.

SOP	1201.01				
GROUP	Decontamination				
SUB-GROUP	Sampling Equipment Decontamination				
TITLE	Sampling Equipment Decontamination				
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Disinfection/Rinse Methods

Disinfectants are a practical means of inactivating chemicals or contaminants of concern. Standard sterilization methods involve heating the equipment which is impractical for large equipment. Rinsing removes contaminants through dilution, physical attraction, and solubilization.

The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be target analyte free. Tap water may be used from any municipal water treatment system for mixing of decontamination solutions. An untreated potable water supply is not an acceptable substitute for tap water. Acids and solvents are occasionally utilized in decontamination of equipment to remove metals and organics, respectively, from sampling equipment. Other than ethanol, these are avoided when possible due to the safety, disposal, and transportation concerns associated with them.

Equipment or apparatuses that may be selected for use include the following:

- Personal protective clothing
- Non-phosphate detergent
- Selected solvents for removal of polar and nonpolar organics (ethanol, methanol, hexane)
- Acid washes for removal of metals (nitric acid)
- Long-handled brushes
- Drop cloths or plastic sheeting
- Paper towels
- Galvanized tubs or buckets
- Distilled, deionized, or tap water (as required by the project)
- Storage containers for spent wash solutions
- Sprayers (pressurized and non-pressurized)
- Trash bags
- Safety glasses or splash shield

Field Sampling Equipment Cleaning Procedures

The following procedures should be followed:

1. Where applicable, follow physical removal procedures previously described (pressure wash, scrub wash)
2. Wash equipment with a non-phosphate detergent solution
3. Rinse with tap water
4. Rinse with distilled or deionized water
5. Rinse with 10% nitric acid if the sample will be analyzed for metals/organics
6. Rinse with distilled or deionized water
7. Use a solvent rinse (pesticide grade) if the sample will be analyzed for organics
8. Air dry the equipment completely
9. Rinse again with distilled or deionized water

SOP	1201.01				
GROUP	Decontamination				
SUB-GROUP	Sampling Equipment Decontamination				
TITLE	Sampling Equipment Decontamination				
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10. Place in clean bag or container for storage/transport to subsequent sampling locations.

Selection of the solvent for use in the decontamination process is based on the contaminants present at the site. Solvent rinses are not necessarily required when organics are not a contaminant of concern and may be eliminated from the sequence specified below. Similarly, an acid rinse is not required if the analyses do not include inorganics. Use of a solvent is required when organic contamination is present on-site. Typical solvents used for removal of organic contaminants include acetone, ethanol, hexane, methanol, or water. An acid rinse step is required if metals are present on-site. If a particular contaminant fraction is not present at the site, the ten-step decontamination procedure listed above may be modified for site specificity.

Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing before commencement of sampling and between sampling locations. Plastic tubing should not be reused.

SOP 2008

GENERAL AIR SAMPLING GUIDELINES



GENERAL AIR SAMPLING GUIDELINES

SOP#: 2008
DATE: 11/16/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) provides guidance in developing and implementing sampling plans to assess the impact of hazardous waste sites on ambient air. It presents the United States Environmental Protection Agency/Environmental Response Team's (U.S. EPA/ERT's) approach to air sampling and monitoring and identifies equipment requirements. It is not within the scope of this SOP to provide a generic air sampling plan. Experience, objectives, site characteristics, and chemical characteristics will dictate sampling strategy. This SOP does not address indoor air sampling.

Two basic approaches can be used to assess ambient air (also referred to as air pathway assessments): modeling and measurements. The modeling approach initially estimates or measures the overall site emission rate(s) and pattern(s). These data are input into an appropriate air dispersion model, which predicts either the maximum or average air concentrations at selected locations or distances during the time period of concern. This overall modeling strategy is presented in the first three volumes of the Air Superfund National Technical Guidance Series on Air Pathway Assessments^(1,2,3). Specific applications of this strategy are presented in several additional Air Superfund Technical Guidance documents⁽⁴⁾.

The measurement approach involves actually measuring the air impact at selected locations during specific time periods. These measurements can be used to document actual air impacts during specific time intervals (i.e., during cleanup operations) or to extrapolate the probable "worst case" concentrations at that and similar locations over a longer time period than was sampled.

This SOP addresses issues associated with this second assessment strategy. This SOP also discusses the U.S. EPA/ERT's monitoring instruments, air sampling

kits, and approach to air sampling and monitoring at hazardous waste sites.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, depending on site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Air monitoring is defined as the use of direct-reading instruments and other screening or monitoring equipment and techniques that provide instantaneous (real-time) data on the levels of airborne contaminants. The U.S. EPA/ERT maintains numerous monitors for real-time measurements. Examples of air monitoring equipment are hand-held photoionization detectors (PID), flame ionization detectors (FID), oxygen/combustible gas detectors, and remote optical sensors.

Air sampling is defined as those sampling and analytical techniques that require either off- or on-site laboratory analysis and therefore do not provide immediate results. Typically, air sampling occurs after use of real-time air monitoring equipment has narrowed the number of possible contaminants and has provided some qualitative measurement of contaminant concentration. Air sampling techniques are used to more accurately detect, identify and quantify specific chemical compounds relative to the majority of air monitoring technologies.

In the Superfund Removal Program, On-Scene Coordinators (OSCs) may request the U.S. EPA/ERT to conduct air monitoring and sampling during the

following situations: emergency responses, site assessments, and removal activities. Each of these activities has a related air monitoring/sampling objective that is used to determine the potential hazards to workers and/or the community.

C Emergency Response

Emergency responses are immediate responses to a release or threatened release of hazardous substances presenting an imminent danger to public health, welfare, or the environment (i.e., chemical spills, fires, or chemical process failures resulting in a controlled release of hazardous substances). Generally these situations require rapid on-site investigation and response. A major part of this investigation consists of assessing the air impact of these releases.

C Removal Site Assessment

Removal site assessments (referred to as site assessments) are defined as any of several activities undertaken to determine the extent of contamination at a site and which help to formulate the appropriate response to a release or threatened release of hazardous substances. These activities may include a site inspection, multimedia sampling, and other data collection.

C Removal Actions

Removal actions clean up or remove hazardous substances released into the environment. Removal actions include any activity conducted to abate, prevent, minimize, stabilize, or eliminate a threat to public health or welfare, or to the environment.

Personal risk from airborne contaminants can be determined by comparing the results of on-site monitoring and sampling to health-based action levels such as the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) and the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). Residential risk can be determined by comparing the results of off-site monitoring or sampling to health-based action levels such as those developed by the Agency for Toxic Substance and

Disease Registry (ATSDR).

The extent to which valid inferences can be drawn from air monitoring/sampling depends on the degree to which the monitoring/sampling effort conforms to the objectives of the event. Meeting the project's objectives requires thorough planning of the monitoring/sampling activities, and implementation of the most appropriate monitoring/sampling and analytical procedures. These issues will be discussed in this SOP.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Preservation, containers, handling and storage for air samples are discussed in the specific SOPs for the technique selected. In addition, the analytical method (i.e., U.S. EPA, National Institute for Occupational Safety and Health [NIOSH], and OSHA Methods) may be consulted for storage temperature, holding times and packaging requirements. After sample collection, the sampling media (i.e., cassettes or tubes) are immediately sealed. The samples are then placed into suitable containers (i.e., whirl bags, resealable bags or culture tubes) which are then placed into a shipping container.

Use bubble wrap or styrofoam peanuts when packing air samples for shipment. DO NOT USE VERMICULITE.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Upwind sources can contribute to sample concentration. Natural sources, such as biological waste, can produce hydrogen sulfide and methane which may contribute to the overall contaminant level. Extraneous anthropogenic contaminants (i.e., burning of fossil fuels; emissions from vehicular traffic, especially diesel; volatile compounds from petrochemical facilities; and effluvia from smoke stacks) may also contribute. Air sampling stations should be strategically placed to identify contributing sources.

Photoreactivity or reaction of the parameters of concern may occur with nonrelated compounds [i.e., nitrogen compounds and polyaromatic hydrocarbons

(PAHs)]. Some sorbent media/samples should not be exposed to light during or after sampling due to photochemical effects (i.e., PAHs).

Various environmental factors, including humidity, temperature and pressure, also impact the air sampling methodology, collection efficiency and detection limit. Since the determination of air contaminants is specifically dependent on the collection parameters and efficiencies, the collection procedure is an integral part of the analytical method.

Detection limits depend on the contaminants being investigated and the particular site situation. It is important to know why the data are needed and how the data will be used. Care should be taken to ensure the detection limits are adequate for the intended use of the final results.

Some equipment may be sensitive to humidity and temperature extremes.

5.0 EQUIPMENT/APPARATUS

5.1 Direct Reading Instruments (Air Monitoring Instruments)

There are two general types of direct reading instruments: portable screening devices and specialized analytical instruments. Generally all these techniques involve acquiring, for a specific location or area, continuous or sequential direct air concentrations in either a real-time or semi-real-time mode. None of these instruments acquires true time-weighted average concentrations. In addition, these instruments are not capable of acquiring simultaneous concentration readings at multiple locations, although several are able to sequentially analyze samples taken remotely from different locations. The document, "Guide to Portable Instruments for Assessing Airborne Pollutants Arising from Hazardous Waste Sites⁽⁵⁾," provides additional information about air sampling and monitoring. The hazard levels for airborne contaminants vary. See the ACGIH TLVs and the OSHA PELs for safe working levels. Common screening devices and analytical instruments are described in Appendix A.

5.2 Air Sampling Equipment and Media/Devices

The U.S. EPA/ERT uses the following analytical

methods for sampling: *NIOSH Manual of Analytical Methods*⁽⁶⁾, *American Society for Testing and Materials (ASTM) Methods*⁽⁷⁾, *U.S. EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*^(8,9), and *OSHA Methods*⁽¹⁰⁾. Additional air sampling references include *Industrial Hygiene and Toxicology* (3rd Ed.)⁽¹¹⁾ and *Air Sampling Instruments for Evaluation of Atmospheric Contaminants*⁽¹²⁾. These methods typically specify equipment requirements for sampling. Since air sampling is such a diverse technology, no single method or reference is best for all applications. Common sampling equipment and media/devices are described in Appendix B.

5.3 Tools/Material and Equipment List

In addition to equipment and materials identified in Appendices A and B, the following equipment and materials may be required to conduct air sampling and monitoring at hazardous waste sites:

- C Camera
- C Site logbook
- C Clipboard
- C Chain of custody records
- C Custody seals
- C Air sampling worksheets
- C Sample labels
- C Small screwdriver set
- C Aluminum foil
- C Extension cords
- C Glass cracker
- C Multiple plug outlet
- C Whirl bags or culture tubes
- C Teflon tape
- C Calibration devices
- C Tygon and/or Teflon^R tubing
- C Surgical gloves
- C Lint-free gloves
- C Ice
- C Sample container

Use the following additional equipment when decontaminating glassware on site:

- C Protective equipment (i.e., gloves, splash goggles, etc.)
- C Appropriate solvent(s)
- C Spray bottles
- C Liquinox (soap)
- C Paper towels

C	Distilled/deionized water
C	Five-gallon buckets
C	Scrub brushes and bottle brushes

6.0 REAGENTS

Impinger sampling involves using reagents contained in a glass vial to absorb contaminants of concern (for example, NIOSH Method 3500 for formaldehyde uses 1% sodium bisulfite solution). Impinger solutions vary and are method-dependent.

Reagents such as acetone and hexane are required to decontaminate glassware and some air sampling equipment. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP.

7.0 PROCEDURES

7.1 Air Monitoring Design

7.1.1 Initial Surveys

In general, the initial survey is considered to be a relatively rapid screening process for collecting preliminary data at hazardous waste sites. However, initial surveys may require many hours to complete and may consist of more than one entry.

Some information is generally known about the site; therefore, real-time instrumentation for specific compounds (i.e., detector tubes and electrochemical sensors) can be used to identify hot spots. Sufficient data should be obtained with real-time instruments during the initial entry to screen the site for various contaminants. When warranted, intrinsically safe or explosion-proof instruments should be used. An organic vapor analyzer (OVA) is typically used during this survey. These gross measurements may be used on a preliminary basis to (1) determine levels of personal protection, (2) establish site work zones, and (3) map candidate areas for more thorough qualitative and quantitative studies involving air sampling.

In some situations, the information obtained may be sufficient to preclude additional monitoring. Materials detected during the initial survey may call for a more comprehensive evaluation of hazards and analyses for specific compounds. Since site activities and weather conditions change, a continuous program to monitor the ambient atmosphere must be established.

7.1.2 Off-Site Monitoring

Typically, perimeter monitoring with the same instruments employed for on-site monitoring is utilized to determine site boundaries. Because air is a dynamic matrix, physical boundaries like property lines and fences do not necessarily delineate the site boundary or area influenced by a release. Whenever possible, atmospheric hazards in the areas adjacent to the on-site zone should be monitored with direct-reading instruments. Monitoring at the fenceline or at varying locations off site provides useful information regarding pollutant migration. Three to four locations downwind of the source (i.e., plume) at breathing-zone height, provide a basic fingerprint of the plume. Negative instrument readings off site should not be interpreted as the complete absence of airborne toxic substances; rather, they should be considered another piece of information to assist in the preliminary evaluation. The interpretation of negative readings is instrument-dependent. The lack of instrument readings off site should not be interpreted as the complete absence of all airborne toxic substances; rather, it is possible that the particular compound or class of compounds to which the monitoring instrument responds is not present or that the concentration of the compound(s) is below the instrument's detection limit.

7.2 Air Sampling Design

7.2.1 Sampling Plan Design

The goal of air sampling is to accurately assess the impact of a contaminant source(s) on ambient air quality. This impact is expressed in terms of overall average and/or maximum air concentrations for the time period of concern and may be affected by the transport and release of pollutants from both on- and off-site sources. The location of these sources must be taken into account as they impact the selection of sampling locations. Unlike soil and groundwater concentrations, air concentrations at points of interest can easily vary by orders of magnitude over the period of concern. This variability plays a major role in designing an air sampling plan.

Downwind air concentration is determined by the amount of material being released from the site into the air (the emission rate) and by the degree that the contamination is diluted as it is transported. Local

meteorology and topography govern downwind dilution. Contaminant emission rates can also be heavily influenced by on-site meteorology and on-site activities. All of these concerns must be incorporated into an air sampling plan.

A sampling strategy can be simple or complex, depending on the sampling program objectives. Programs involving characterization of the pollutant contribution from a single point source tend to be simple, whereas sampling programs investigating fate and transport characteristics of components from diverse sources require a more complex sampling strategy. In addition, resource constraints may affect the complexity of the sampling design.

An optimal sampling strategy accounts for the following site parameters:

- C Location of stationary as well as mobile sources
- C Analytes of concern
- C Analytical detection limit to be achieved
- C Rate of release and transport of pollutants from sources
- C Availability of space and utilities for operating sampling equipment
- C Meteorological monitoring data
- C Meteorological conditions in which sampling is to be conducted

The sampling strategy typically requires that the concentration of contaminants at the source or area of concern as well as background contributions be quantified. It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks, as well as various other types of QA/QC samples, can be utilized to determine other sources. The impact of extraneous sources on sampling results can frequently be accounted for by placing samplers upwind, downwind and crosswind from the subject source. The analytical data from these different sampling locations may be compared to determine statistical differences.

7.2.2 Sampling Objectives

The objectives of the sampling must be determined prior to developing the sampling plan. Does the sampling plan verify adequate levels of protection for on-site personnel, or address potential off-site impacts

associated with the site or with site activities? In addition, the assumptions associated with the sampling program must be defined. These assumptions include whether the sampling is to take place under "typical," "worst case," or "one-time" conditions. If the conditions present at the time of sampling are different from those assumed during the development of the sampling plan, then quality of the data collected may be affected. The following definitions have been established:

- C Typical: routine daily sampling or routine scheduled sampling at pre-established locations.
- C Worst case: sampling conducted under the worst meteorological and/or site conditions which would result in elevated ambient concentrations.
- C One-time: only one chance is given to collect a sample without regard to time or conditions.

Qualitative data acquired under these conditions are usually applicable only to the time period during which the data were collected and may not provide accurate information to be used in estimating the magnitude of an air impact during other periods or over a long time interval.

The sampling objectives also dictate the detection limits. Sampling methods for airborne contaminants will depend upon the nature and state (solid, liquid or gas) of the contaminant. Gases and vapors may be collected in aqueous media or adsorbents, in molecular sieves, or in suitable containers. Particulates are collected by filters or impactors. The volume of sample to be collected is dependent upon an estimate of the contaminant concentration in the air, the sensitivity of the analytical method, and the standard or desired detection limit. A sufficient amount of sample must be collected to achieve the desired detection limit without interference from other contaminants. In addition, the selected method must be able to detect the target compound(s).

7.2.3 Location and Number of Individual Sampling Points

Choose the number and location of sampling points according to the variability, or sensitivity, of the

sampling and analytical methods being utilized, the variability of contaminant concentration over time at the site, the level of precision required and cost limitations. In addition, determine the number of locations and placement of samplers by considering the nature of the response, local terrain, meteorological conditions, location of the site (with respect to other conflicting background sources), size of the site, and the number, size, and relative proximity of separate on-site emission sources and upwind sources. The following are several considerations for sampler placement:

- C Location of potential on-site emission sources, as identified from the review of site background information or from preliminary on-site inspections.
- C Location of potential off-site emission sources upwind of the sampling location(s). Review local wind patterns to determine the location of off-site sources relative to wind direction.
- C Topographic features that affect the dispersion and transport of airborne toxic constituents.

Avoid natural obstructions when choosing air sampling station locations, and account for channelization around those obstructions.

- C Large water bodies, which affect atmospheric stability and the dispersion of air contaminants.
- C Roadways (dirt or paved), which may generate dust that could mask site contaminants.
- C Vegetation, such as trees and shrubs, which stabilizes soil and retards subsurface contaminants from becoming airborne. It also affects air flow and scrubs some contaminants from the air. Sometimes thick vegetation can make an otherwise ideal air monitoring location inaccessible.

Consider the duration of sampling activities when choosing the location and number of samples to be collected. For example, if the sampling period is limited to a few hours, one or two upwind and several downwind samples would typically be adequate,

especially around major emission sources.

A short-term monitoring program ranges from several days to a few weeks and generally includes gathering data for site assessments, removal actions, and source determination data (for further modeling). Activities involved in a short-term sampling strategy must make the most of the limited possibilities for data collection. Consider moving upwind/downwind locations daily based on National Oceanic and Atmospheric Administration (NOAA) weather forecasts. Weather monitoring becomes critical where complex terrain and local meteorological effects frequently change wind direction. Often, a number of alternatives can fulfill the same objective.

Prevailing winds running the length of a valley usually require a minimum number of sampler locations; however, a complex valley may require more sampler locations to account for the wide variety of winds. Ocean/lake effects may require a radical plan to collect enough samples to reach a low detection limit. Two sets of samplers may be placed next to each other: one set would be activated during the sea breeze while the other set is turned off, and vice versa when there is no sea breeze. After the sampling event, the respective upwind and downwind samples would be combined. Another alternative for sampling near a large body of water may be to use automatic, wind-vector-operated samplers, which turn the sampler on only when the wind comes from a specified vector. At sites located on hillsides, wind will move down a valley and produce an upward fetch at the same time. Sampling locations may have to ring the site to measure the wind's impact.

Off-site sources may affect on-site monitoring. In this case, on-site meteorological data, concurrent with sampling data, is essential to interpreting the acquired data. Also, additional upwind sampling sites may be needed to fully characterize ambient background contaminant levels. Multiple off-site sources may require several monitoring locations, but if the sources are at a sufficient distance, only one monitoring location is needed.

Topography and weather are not the only factors in sampler location; the sampling sites must be secure from vandals and mishap. Secure all sampling locations to maintain chain of custody, and to prevent tampering with samples or loss of sampling units. High-volume sampling methods often require the use of 110 VAC electric power. When portable

generators are used, the power quality may affect sampler operation. Also, be aware that the generators themselves could be a potential pollution source if their placement is not carefully considered.

Air quality dispersion models can be used to place samplers. The models incorporate source information, surrounding topography, and meteorological data to predict the general distance and directions of maximum ambient concentrations. Modeling results should be used to select sampling locations in areas of maximum pollutant concentrations.

7.2.4 Time, Duration and Frequency of Sampling Events

After choosing appropriate sampling or monitoring locations, determine the sampling frequency and the number of samples to be collected. The time of day, duration and frequency of sampling events is governed by:

- C The effects of site activities and meteorology on emission rates
- C The diurnal effect of the meteorology on downwind dispersion
- C The time period(s) of concern as defined by the objective
- C The variability in the impact from other non-site-related sources
- C If defined, the degree of confidence needed for either the mean or maximum downwind concentrations observed
- C The precision requirements for single measurements
- C Cost and other logistical considerations

The duration of the removal action and the number of hours per day that site work is conducted determine the time, duration, and frequency of samples. Short-term sampling programs may require daily sampling, while long-term programs may require 24-hour sampling every sixth or twelfth day. If the site will be undergoing removal activities 24 hours a day, continuous air sampling may be warranted. However, if the site activities will be conducted for only eight hours a day, and there are no emissions likely to occur during the remaining 16 hours, then sampling would be appropriate prior to the start of daily activities, would continue during operations, and end at the conclusion of the daily activities. An off-peak sample collection can ensure that emissions are not persisting

after the conclusion of daily cleanup activities. For some sites, emissions are still a factor several hours after daily site activities have been completed. Because of the typically decreased downwind dispersion in the evening, higher downwind concentrations than were present during daytime site activities may be detected. For sites where this is possible, the sampling duration needs to be lengthened accordingly.

Sampling duration and flow rate dictate the volume of air collected, and to a major degree, the detection limit. The analytical method selected will provide a reference to flow rate and volume. Flow rates are limited to the capacity of the pumps being employed and the contact time required by the collection media.

The duration or period of air sampling is commonly divided into two categories (1) samples collected over a brief time period are referred to as "instantaneous" or "grab" samples and are usually collected in less than five minutes and (2) average or integrated samples are collected over a significantly longer period of time. Integrated samples provide an average concentration over the entire sampling period. Integrated samples are not suited to determining cyclical releases of contaminants because periodic or cyclical events are averaged out by the proportionally long sampling duration.

Air quality dispersion models can predict the maximum air contaminant concentration expected from a source. The meteorological and site conditions expected to cause the highest concentration are known as worst-case conditions and can be identified by analyzing the modeling results. Depending upon the objective, one may sample when the model predicts worst-case conditions will exist.

7.2.5 Meteorological and Physical/Chemical Considerations

A meteorological monitoring program is an integral part of site monitoring activities. Meteorological data, which define local terrain impacts on air flow paths, are needed to interpret air concentration data. Meteorological data may be available from an existing station located near the site (i.e., at a local airport), otherwise a station should be set up at the site. This data will document the degree that samples actually were downwind and verify whether other worst-case assumptions were met. Meteorological parameters to

be monitored are, at a minimum, wind speed, wind direction, and sigma theta (which is the horizontal wind direction standard deviation and an indicator of atmospheric stability). The remaining parameters primarily affect the amount of a contaminant available in the air.

C Wind Speed

When the contaminant of concern is a particulate, wind speed is critical in determining whether the particulate will become airborne, the quantity of the particulate that becomes airborne, and the distance the particulate will travel from the source. Wind speed also contributes to the volatilization of contaminants from liquid sources.

C Wind Direction

Wind direction highly influences the path of airborne contaminants. In addition, variations in wind direction increase the dispersion of pollutants from a given source.

C Atmospheric Stability

Atmospheric stability refers to the degree to which the atmosphere tends to dampen vertical and horizontal motion. Stable atmospheric conditions (i.e., evenings) result in low dispersion, and unstable atmospheric conditions (i.e., hot sunny days) result in higher dispersion.

C Temperature

Higher temperatures increase the rate of volatilization of organic and some inorganic compounds and affect the initial rise of gaseous or vapor contaminants. Therefore, worst-case emission of volatiles and semivolatiles occurs at the hottest time of day, or on the hottest day.

C Humidity

High humidity affects water-soluble chemicals and particulates. Humid conditions may dictate the sampling media used to collect the air sample, or limit the volume of air sampled and thereby increase

the detection limit.

C Atmospheric Pressure

Migration of landfill gases through the landfill surface and through surrounding soils are governed by changes in atmospheric pressure. Atmospheric pressure will influence upward migration of gaseous contaminants from shallow aquifers into the basements of overlying structures.

In many cases, the transport and dispersion of air pollutants is complicated by local meteorology. Normal diurnal variations (i.e., temperature inversions) affect dispersion of airborne contaminants. Terrain features can enhance or create air inversions and can also influence the path and speed of air flow, complicating transport and dispersion patterns.

The chemical characteristics of a contaminant (i.e., molecular weight, physical state, vapor pressure, aerodynamic size, temperature, reactive compounds, and photodegradation) affects its behavior and can influence the method used to sample and analyze it.

8.0 CALCULATIONS

Volume is obtained by multiplying the sample time in minutes by the flow rate. Sample volume should be indicated on the chain of custody record. Adjustments for temperature and pressure differences may be required.

Results are usually provided in parts per million (ppm), parts per billion (ppb), milligrams per cubic meter (mg/m³) or micrograms per cubic meter (µg/m³).

Refer to the analytical method or regulatory guidelines for other applicable calculations.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

The manufacturer's instructions should be reviewed prior to instrument use. Instruments must be utilized in accordance with manufacturer's instructions. Equipment checkout and calibration activities must

occur prior to and after monitoring and sampling and must be documented.

9.1 QA/QC Samples

QA/QC samples provide information on the variability and usability of environmental sample results. Various QA/QC samples may be collected to detect error. QA/QC samples are submitted with the field samples for analysis to aid in identifying the origin of analytical discrepancies; then a determination can be made as to how the analytical results should be used. Collocated samples, background samples, field blanks, and lot blanks are the most commonly collected QA/QC field samples. Performance evaluation (PE) samples and matrix spikes provide additional measures of data QA/QC control. QA/QC results may suggest the need for modifying sample collection, preparation, handling, or analytical procedures if the resultant data do not meet site-specific QA or data quality objectives.

9.2 Sample Documentation

All sample and monitoring activities should be documented legibly, in ink. Any corrections or revisions should be made by lining through the incorrect entry and by initialing the error. All samples must be recorded on an Air Sampling Worksheet. A chain of custody record must be maintained from the time a sample is taken to the final deposition of the sample. Custody seals demonstrate that a sample container has not been opened or tampered with during transport or storage of samples.

10.0 DATA VALIDATION

Results for QA/QC samples should be evaluated for contamination. This information should be utilized to qualify the environmental sample results accordingly with data quality objectives.

11.0 HEALTH AND SAFETY

Personal protection equipment (PPE) requirements identified in federal and/or state regulations and 29 Code of Federal Regulations (CFR) 1910.120 for hazardous waste site work must be followed.

The majority of physical precautions involved in air sampling are related to the contaminant sampled. Attention should be given when sampling in

potentially explosive, flammable or acidic atmospheres. On rare occasions, the collection media may be hazardous; for example, in the instance where an acidic or basic solution is utilized in an impinger.

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

12.0 REFERENCES

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APPENDIX A

Portable Screening Devices and Specialized Analytical Instruments

PORTABLE SCREENING DEVICES

Where possible, a datalogger should be used to minimize the length of time required for site personnel to be in a potentially contaminated area. Datalogger cable is available from manufacturers for linear output instruments and some nonlinear output instruments. U.S. EPA ERT/REAC has output cables for organic vapor analyzers (i.e., HNU and OVA), toxic gas analyzers (i.e., monitox) and real-time aerosol monitors (i.e., RAM and miniram).

C Total Hydrocarbon Analyzers

Total hydrocarbon analyzers used to detect a variety of volatile organic compounds (VOCs) at hazardous waste sites principally employ either a photoionization detector (PID) or a flame ionization detector (FID). Compounds are ionized by a flame or an ultraviolet lamp. PIDs depend on the ionization potential of the compounds. PIDs are sensitive to aromatic and olefinic (unsaturated) compounds such as benzene, toluene, styrene, xylenes, and acetylene. Greater selectivity is possible by using low-voltage lamps. The ionization potential of individual compounds can be found in the NIOSH Pocket Guide to Chemical Hazards. These instruments are not compound-specific and are typically used as screening instruments. FIDs are sensitive to volatile organic vapor compounds such as methane, propanol, benzene and toluene. They respond poorly to organic compounds lacking hydrocarbon characteristics.

C Oxygen and Combustible Gas Indicators

Combustible Gas Indicators (CGIs) provide efficient and reliable methods to test for potentially explosive atmospheres. CGI meters measure the concentration of a flammable vapor or gas in air and present these measurements as a percentage of the

lower explosive limit (LEL).

The measurements are temperature-dependent. The property of the calibration gas determines sensitivity.

LELs for individual compounds can be found in the NIOSH Pocket Guide to Chemical Hazards. If readings approach or exceed 10% of the LEL, extreme caution should be exercised in continuing the investigation. If readings approach or exceed 25% LEL, personnel should be withdrawn immediately.

CGIs typically house an electrochemical sensor to determine the oxygen concentration in ambient air. Normally, air contains approximately 20.9% oxygen by volume. Oxygen measurements are of particular importance for work in enclosed spaces, low-lying areas, or in the vicinity of accidents that have produced heavier-than-air vapors which could displace ambient air. The meters are calibrated for sea level and may indicate a false negative (i.e., O₂ content) at higher altitudes. Since the air has been displaced by other substances, these oxygen-deficient areas are also prime locations for taking additional organic vapor and combustible gas measurements. Oxygen-enriched atmospheres increase the potential for fires by their ability to contribute to combustion or to chemically react with flammable compounds and promote auto-ignition.

C Toxic Atmosphere Analyzers

The toxic atmosphere analyzer is a compound-specific instrument, designed and calibrated to identify and quantify a specific compound or class of compounds in either gaseous or vapor form. Cross-sensitivity to air pollutants not of interest may be lead to erroneous results.

U.S. EPA/ERT has the following toxic atmosphere analyzers: carbon monoxide, phosgene, nitrous oxide, hydrogen cyanide, sulfur dioxide, hydrogen sulfide, and chlorine gas.

C Aerosol/Particulate Monitors

A Real-Time Aerosol/Particulate Monitor (RAM) displays readings for total particulates. The instrument employs a pulse light emitting diode which generates a narrow band emission in conjunction with a photovoltaic cell to detect light scattered from particulates.

The U.S. EPA/ERT uses the RAM when the contaminant of concern is associated with particulates, and when responding to fires involving hazardous materials, to identify plume levels. The instrument is very useful in determining the presence of a plume when it is not visible. The U.S. EPA/ERT typically uses RAMs on tripods to obtain particulate concentrations at the breathing zone level. Personal dataloggers are used with the RAMs to document minimum, average and maximum concentrations. This provides real-time data without requiring those in personal protective equipment to be constantly present in the plume.

C Chemical Detector Tubes (Colorimetric Tubes)

A chemical detector tube is a hollow, tube-shaped, glass body containing one or more layers of chemically impregnated inert material. To use, the fused ends are broken off and a manufacturer-specified volume of air is drawn through the tube with a pump to achieve a given detection limit. The chemicals contained within the packing material undergo a chemical reaction with the airborne pollutant present, producing a color change during the intake of each pump stroke. The concentration of a pollutant is indicated by the length of discoloration on a calibrated scale printed on the detector tube.

C Radiation Meters

Radiation meters determine the presence and level of radiation. The meters use a gas or solid ion detection media which becomes ionized when radiation is present. The meters are normally calibrated to one probe. Meters that detect alpha, beta, and gamma radiation are available.

C Gold Film (Hydrogen Sulfide and Mercury Vapor) Monitors

Hydrogen sulfide (H₂S) and Mercury (Hg) monitors operate on the principle that electric resistivity increases across a gold film as a function of H₂S and Hg concentration. The monitors provide rapid and relatively low detection limits for H₂S and Hg in air. After extensive sampling periods or high concentrations of H₂S and Hg, the gold film must be heated to remove contamination and return the monitor to its original sensitivity.

C Infrared Detectors

Infrared detectors such as the Miniature Infrared Analyzer (MIRAN) use infrared (IR) absorption as a function of specific compounds. MIRAN instruments apply to situations where the contaminants are identified but concentrations are not. MIRAN instruments generally require AC power.

SPECIALIZED ANALYTICAL INSTRUMENTS

The continuous monitors described above provide qualitative measurement of air contaminants. Quantitative measurements in the field can be obtained using more sophisticated instruments, such as portable Gas Chromatographs, to analyze grab samples.

C Direct Air Sampling Portable Gas Chromatographs (GCs)

Portable GCs use gas chromatography to identify and quantify compounds. The time it takes for a compound to move through a chromatographic column is a function of that specific compound or group of compounds. A trained technician with knowledge of the range of expected concentrations of compounds can utilize a portable GC in the field to analyze grab samples. GCs generally require AC power and shelter to operate. This method is limited by its reliance on a short-term grab sample to be representative of the air quality at a site.

C

Remote Optical Sensing

This technique, also referred to as long-path or open-path monitoring, involves transmitting either an infrared or ultraviolet light beam across a long open path and measuring the absorbance at specific wavelengths. The technique is capable of analyzing any preselected organic or inorganic volatile compound that can be resolved from compounds naturally occurring in ambient air. Current projected removal applications include perimeter monitoring during site cleanups and measurement of emission source strengths during site assessments.

C

TAGA Direct Air Sampling Mass Spectrometer/Mass Spectrometer

The Trace Atmospheric Gas Analyzer (TAGA), which is operated by the U.S. EPA/ERT, is capable of real-time detection of preselected organic compounds at low parts-per-billion concentrations. The instrument has been successfully used by the U.S. EPA/ERT for isolating individual emission plumes and tracking those plumes back to their sources.

APPENDIX B

Air Sampling Equipment and Media/Devices

AIR SAMPLING EQUIPMENT

C High-Volume, Total Suspended Particulate (TSP) Samplers

High-volume TSP samplers collect all suspended particles by drawing air across an 8- by 10-inch glass-quartz filter. The sample rate is adjusted to 40 cubic feet per minute (CFM), or 1134 liters per minute (L/min), and it is held constant by a flow controller over the sample period. The mass of TSPs can be determined by weighing the filter before and after sampling. The composition of the filter varies according to the analytical method and the detection limit required.

C PM-10 Samplers

PM-10 samplers collect particulates with a diameter of 10 microns or less from ambient air. Particulates of this size represent the respirable fraction, and thus are of special significance. PM-10 samplers can be high-volume or low-volume. The high-volume sampler operates in the same manner as the TSP sampler at a constant flow rate of 40 CFM; it draws the sample through a special impactor head which collects particulates of 10 microns or less. The particulate is collected on an 8- by 10-inch filter. The low-volume sampler operates at a rate of approximately 17 L/min. The flow must remain constant through the impactor head to maintain the 10-micron cut-off point. The low-volume PM-10 collects the sample on 37-mm Teflon filters.

C High-Volume PS-1 Samplers

High-volume PS-1 samplers draw a sample through polyurethane foam (PUF) or a combination foam and XAD-2 resin plug, and a glass quartz filter at a rate of 5-10 CFM (144 to 282 L/min). This system is

excellent for measuring low concentrations of semivolatiles, PCBs, pesticides, or chlorinated dioxins in ambient air.

C Area Sampling Pumps

These pumps provide flow-rate ranges of 2-20 L/min and have a telescopic sampling mast with the sampling train. Because of the higher volume, this pump is suitable for sampling low concentrations of airborne contaminants (i.e., asbestos sampling). These pumps are also used for metals, pesticides and PAH sampling which require large sample volumes.

C Personal Sampling Pumps

Personal sampling pumps are reliable portable sampling devices that draw air samples through a number of sampling media including resin tubes, impingers, and filters. Flow rates are usually adjustable from 0.1 to 4 L/min (or 0.01 to .75 L/min with a restrictive orifice) and can remain constant for up to 8 hours on one battery charge or continuously with an AC charger/converter.

C Canister Samplers

Evacuated canister sampling systems use the pressure differential between the evacuated canister and ambient pressure to bleed air into the canister. The sample is bled into the canister at a constant rate over the sampling period using a critical orifice, a mechanically compensated regulator, or a mass flow control device until the canister is near atmospheric pressure.

Pressure canister sampling systems use a pump to push air into the canister. To maintain a higher, more controlled flow, the pump typically controls the pressure differential across a critical orifice at the

inlet of the canister, resulting in a pressurized canister at the completion of sampling.

AIR SAMPLING MEDIA/DEVICES

If possible, before employing a specific sampling method, consult the laboratory that will conduct the analyses. Many of the methods can be modified to provide better results or a wider range of results.

C Summa^R Canisters

Summa canisters are highly polished passivated stainless steel cylinders. The Summa polishing process brings chrome and nickel to the surface of the canisters, which results in an inert surface. This surface restricts adsorption or reactions that occur on the canister's inner surface after collection. At the site, the canister is either placed in a sampler to control sample collection rate, or opened to collect a grab sample. Samples can be collected by allowing air to bleed into or be pumped into the canister. U.S. EPA/ERT uses 6-liter Summa canisters for VOC and permanent gas analysis.

C Passive Dosimeters

Passive dosimeters are clip-on vapor monitors (samplers) in which the diffused contaminants are absorbed on specially prepared active surfaces. Industrial hygienists commonly use dosimeters to obtain time-weighted averages or concentrations of chemical vapors, as they can trap over 130 organic compounds. Selective dosimeters have also been developed for a number of chemicals including formaldehyde, ethylene oxide, hydrogen sulfide, mercury vapor, nitrogen dioxide, sulfur dioxide, and ozone. Dosimeters must be sent to a laboratory for analysis.

C Polyurethane Foam (PUF)

PUF is a sorbent used with a glass filter for the collection of semivolatile organic compounds such as pesticides, PCBs, chlorinated dioxins and furans, and PAHs. Fewer artifacts (chemical changes that occur

to collected compounds) are produced than with some other solid sorbents. PUF is used with the PS-1 sampler and U.S. EPA Method TO13. PUF can also be used with personal sampling pumps when sampling for PAHs using the Lewis/McCloud method. Breakthrough of the more volatile PCBs and PAHs may occur when using PUF.

C Sampling Bags (Tedlar^R)

Sampling bags, like canisters, transport air samples to the laboratory for analysis. Samples are generally pumped into the bags, but sometimes a lung system is used, in which a pump creates a vacuum around the bag in a vacuum box. Then the sample flows from a source into the bag. This method is used for VOCs, fixed gases (CO₂, O₂, and N₂) and methane.

C Impingers

An impinger allows an air sample to be bubbled through a solution, which collects a specific contaminant by either chemical reaction or absorption. For long sampling periods, the impinger may need to be kept in an ice bath to prevent the solution from evaporating during sampling. The sample is drawn through the impinger by using a sampling pump or more elaborate sampling trains with multiple impingers.

C Sorbent Tubes/Cartridges

A variety of sampling media are available in sorbent tubes, which are used primarily for industrial hygiene. A few examples are carbon cartridges, carbon molecular sieves, Tenax tubes and tube containing the XAD-2 polymer. Depending upon the sorbent material, tubes can be analyzed using either a solvent extraction or thermal desorption. The former technique uses standard laboratory equipment and allows for multiple analyses of the same sample. The latter technique requires special, but readily available, laboratory equipment and allows only one analysis per sample. In addition, thermal desorption typically allows for lower detection limits by two or more orders of magnitude. Whenever sorbent tubes are

being used for thermal desorption, they should be certified as "clean" by the laboratory doing the analysis.

Thermally Desorbed Media

During thermal desorption, high-temperature gas streams are used to remove the compounds collected on a sorbent medium. The gas stream is injected and often cryofocused into an analytical instrument, such as a GC, for compound analysis:

C Tenax Tubes

Tenax tubes are made from commercially available polymer (p-phenylene oxide) packed in glass or stainless steel tubes through which air samples are drawn or sometimes pumped. These tubes are used in U.S. EPA Method TO1 and VOST for volatile nonpolar organic, some polar organic, and some of the more volatile semivolatile organics. Tenax is not appropriate for many of the highly volatile organics (with vapor pressure greater than approximately 200 mm Hg).

C Carbonized Polymers

The carbonized molecular sieve (CMS), a carbonized polymer, is a commercially available, carbon sorbent packed in stainless-steel sampling tubes through which air samples are drawn or sometimes pumped. These are used in U.S. EPA Method TO2 for highly volatile nonpolar compounds which have low-breakthrough volumes on other sorbents. When high-thermal desorption temperatures are used with CMS, more variability in analysis may occur than with other sorbents.

C Mixed Sorbent Tubes

Sorbent tubes can contain two type of sorbents. Combining the advantages of each sorbent into one tube increases the possible types of compounds to be sampled. The combination of two sorbents can also reduce the chance that highly volatile compounds will break through the sorbent media. An example of a mixed sorbent tube is the combination of Tenax and charcoal with a

carbonized molecular sieve. A potential problem with mixed sorbent tubes is the breakthrough of a compound from an earlier sorbent to a later sorbent from which it cannot be desorbed.

Solvent-Extracted Media

Solvent-extracted media use the principle of chemical extraction to remove compounds collected on a sorbent media. The chemical solvent is injected into an instrument, such as a GC, for analysis of compounds. Examples of solvent-extracted media follow:

C Chemically Treated Silica Gel

Silica gel is a sorbent which can be treated with various chemicals. The chemically treated silica gel can then be used to sample for specific compounds in air. Examples include the DNPH-coated silica gel cartridge used with U.S. EPA Method TO11.

C XAD-2 Polymers

XAD-2 polymers usually are placed in tubes, custom-packed sandwich-style with polyurethane foam, and prepared for use with U.S. EPA Method TO13 or the semi-VOST method. The polymers are used for the collection of semivolatile polar and nonpolar organic compounds. The compounds collected on the XAD-2 polymer are chemically extracted for analysis.

C Charcoal Cartridges

Charcoal cartridges, consisting of primary and backup sections, trap compounds by adsorption. Ambient air is drawn through them so that the backup section verifies that breakthrough of the analytes on the first section did not occur, and the sample collection was therefore quantitative. Quantitative sample collection is evident by the presence of target chemicals on the first charcoal section and the absence on the second section. Next, the adsorbed compounds must be eluted, usually with a solvent extraction, and analyzed by GC with a detector, such as a Mass Spectrometer (MS).

C Tenax Tubes

Cartridges are used in OSHA and NIOSH methods in a manner similar to charcoal cartridges but typically for less volatile compounds.

Particulate Filters

Particulate filters are used by having a sampling pump pass air through them. The filter collects the particulates present in the air and is then analyzed for particulate mass or chemical or radiological composition. Particulate filters are made from different materials which are described below.

C Mixed Cellulose Ester (MCE)

MCE is manufactured from mixed esters of cellulose which are a blend of nitro-cellulose and cellulose acetate. MCE filters are used often for particulate sampling.

C Glass Fiber

Glass fiber is manufactured from glass fibers without a binder. Particulate filters with glass fiber provide high flow rates, wet strength, and high, solid holding capacity. Generally, the filters are used for gravimetric analysis of particulates.

C Polyvinyl Chloride

Particulate filters with polyvinyl chloride are resistant to concentrated acids and alkalis. Their low moisture pickup and light tare weight make them ideal for gravimetric analysis.

C Teflon

Teflon is manufactured from polytetrafluorethylene (PTFE). Particulate filters with Teflon are easy to handle and exceptionally durable. Teflon filters are used for metal collection.

C Silver

Particulate filters manufactured from pure silver have high collection efficiency and uniform pore size. These filters are used for mercury collection and analysis.

C Cellulose

Particulate filters with cellulose contain less than 0.01% ash. These filters are used to collect particulates.

SOP 2121

HIGH VOLUME POLYURETHANE FOAM SAMPLING



HIGH VOLUME POLYURETHANE FOAM SAMPLING

SOP#: 2121
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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to outline the protocol for collection of air samples for organochlorine and organophosphate compounds (i.e., dioxins and polychlorinated biphenyls) using the polyurethane foam (PUF) sampling medium. The PUF sampling system is designed to simultaneously collect suspended airborne particulates and to trap airborne pesticide vapors.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, depending on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Ambient air is drawn into a covered housing then through a glass fiber filter and PUF plug by a high-flow-rate pump operating at approximately 250 liters/minute (L/m) (approximately nine cubic feet/minute [ft³/m]). This allows total suspended particulates (TSP) to collect on the filter surface. The PUF plug allows collection of vapor which might be stripped from the particulates on the filter.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Prior to sampling, determine whether pre- and post-filter weighing is appropriate based on project needs or client requirements. In addition, obtain pre-cleaned PUF plugs from the analytical laboratory.

After sampling, the PUF plug and filter should be stored in an 8-oz. glass jar. The PUF plug should occupy the bottom portion of the jar and the filter should be folded into quarters and placed on top of the plug. The jar is then wrapped with aluminum foil (shiny side out).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Humidity - Glass fiber filters are comparatively insensitive to changes in relative humidity; however, collected particulate matter can be hygroscopic.

Photosensitivity - PUF plugs are white and turn yellow upon exposure to light. They should be stored in a dark place (i.e., a black trash bag or a cooler) prior to and after sampling.

5.0 EQUIPMENT/APPARATUS

5.1 Sampling Media (Sorbents)

Polyurethane Foam - polyether-type polyurethane foam (density No. 3014, 0.0225 grams/cm³, or equivalent). This is the type of foam generally used for furniture upholstery, pillows, and mattresses (General Metals Work's part number GPS-116 is recommended, three inch PUF plug, although one and two inch pieces are also available).

Glass Fiber Filter - 102-mm diameter.

5.2 Sampling Equipment

- PS-1 PUF Samplers or Equivalent (platform, legs, motor, magnehelic panel, tubing, venturi, and ball valves)
- Sample modules
- Calibration orifice
- Manometer
- Plastic bags
- Tweezers

- Aluminum foil
- Hexane
- Surgical gloves
- Solvex gloves
- Sample jars
- Trash bags
- Calibration Worksheets
- Air Sampling Worksheets (PUF)
- Logbook
- Computer or calculator to perform calculations
- Calibrated scale (if weighing is required)
- Source of electricity (AC/DC): an electrical source of 100 volts, 15 amps is required

6.0 REAGENTS

Reagents are not used for the preservation of PUF samples. Hexane is required for decontaminating PUF glassware. No other decontamination solutions are required.

7.0 PROCEDURES

7.1 Calibration of Elapsed-Time Meters and Calibration Orifices

Elapsed-Time Meter

Every six months the elapsed-time meter should be checked against a timepiece of known accuracy, either on site or in the laboratory. A gain or loss of >2 min/24-hr period warrants adjustment or replacement of the indicator. The results of these checks should be recorded in the calibration logbook.

Calibration Orifices

Upon receipt and at one-year intervals, calibration orifices should be certified with a positive displacement standard volume meter (such as a Rootsmeter) traceable to the National Bureau of Standards (NBS). This certification will be performed by the manufacturer. Calibration orifices should be visually inspected for signs of damage before each use, and they should be recalibrated if the inspection reveals any nicks or dents in the orifice.

7.2 General Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and

the types and amounts of equipment and supplies needed.

2. Obtain and organize the necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, client, and regulatory agency, if appropriate.
5. Perform a general site survey prior to site entry, in accordance with the site specific Health and Safety Plan.
6. Use stakes or flagging tape to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7.3 Sample Module Preparation

1. Pre-clean all sampling equipment with hexane prior to use.
2. Check the lower canister to ensure that the upper and lower orange silicone gaskets are in place (Figure 1, Appendix A).
3. Using tweezers, load the glass cartridge with a pre-cleaned PUF plug, making sure the foam is evenly distributed throughout the cartridge, and install in the lower canister.
4. Screw the filter holder support onto the lower canister, after ensuring that the silicone rubber gasket is in place.
5. Screw the filter holder with support screen onto the filter holder support, after ensuring that the silicone rubber gasket is in place.
6. Install the lower Teflon gasket in the filter holder.
7. Using tweezers to handle the filter, place glass fiber filter (rough side up) into the filter holder.
8. Install the upper Teflon gasket.

9. Ensure that the silicone rubber gasket is present and then install the filter retaining ring and tighten the swing bolts.
 10. Ensure that all fittings are snug, yet not overtight (Overtightening will distort the gaskets.).
 11. Cover the sample module with the metal cover and place in a cooler.
 12. Assemble a field blank in the same manner and store in the same cooler.
6. Connect the calibration orifice to the sample module (Figure 2, Appendix A). Ensure that no

It is recommended that two sampling modules are prepared for each sampling system so that the filter and PUF plug exchange may take place in the clean zone. The second set of modules is used for the subsequent sampling round.

7.4 Field Calibration of the Sampler

Calibration of the PUF sampler is performed *without* a PUF plug and *without* the glass fiber filter in the sampling module. However, the empty glass cartridge *must remain* in the module to ensure a good seal through the module.

Calibration of the PUF sampler is performed prior to using the sampling system in the field and after repair or replacement of major components of the sampling system (i.e., motor repair).

1. Assemble the sample module, as described in Section 7.2, without the PUF plug and without the glass fiber filter.
2. Assemble the sampling system by attaching the legs and the magnehelic panel to the platform. Connect the motor to the platform, making sure that the gasket is placed between the motor and the platform.
3. Plug the motor into the timer located on the magnehelic panel.
4. Connect the magnehelic to the venturi with tubing.
5. Place the sampling module into the quick-release fitting and engage by locking the two levers down securely.

leaks exist between the orifice unit and the sampler.

7. Fill the manometer with colored water and connect it to the calibration orifice pressure tap with tubing.
8. Set the manometer to "zero" as shown in Figure 3 (Appendix A). This is done by sliding the scale either up or down so the "zero" is level with the bottom of the meniscuses.
9. Connect the sampling system to the power source and fully open the ball valve by pushing the red lever up to the "on" position.
10. Fully open the voltage variator by using a screwdriver to turn the screw on the magnehelic gauge panel clockwise.
11. Operate the sampling system for at least 15 minutes to establish thermal equilibrium prior to calibration.
12. Conduct a five point calibration in the range of the desired flow rate as follows:
 - a. Adjust the voltage variator (located on the magnehelic gauge panel) and/or the ball valve to obtain a reading of 70 (arbitrary) inches on the magnehelic gauge.
 - b. The magnehelic gauge number, 70, is pre-recorded on the Field Calibration Work Sheet (Column #5, Attachment 1, Appendix B). Read and record (Column #4 on the Field Calibration Work Sheet) the total distance between the two meniscuses on the manometer (Figure 3, Appendix A). This is a measure of the pressure drop across the calibration orifice.
 - c. Move the ball valve (red lever) to adjust the magnehelic gauge down to 60 (arbitrary) inches. Let the sampler run for at least two minutes to re-establish the run temperature conditions. Repeat step 12 b.

- d. Using the above procedure (steps 12 b. and c.), adjust the ball valve for readings at 50, 40, and 30 inches.
13. Measure the barometric pressure and ambient temperature.
14. Record all data on the Field Calibration Work Sheet (Attachment 1, Appendix B). Perform calculations as described in Sections 8.1, 8.2, 8.3, and 8.4 of this SOP and record the appropriate results on the Field Calibration Work Sheet.
15. Adjust the ball valve to the magnehelic reading required to achieve the target volumetric flow rate as requested by the Work Assignment Manager.

7.5 Sampling

1. Verify that the sampler has been calibrated as described in Section 7.4.
2. Transport the sampler to the desired location. The PUF sampler must be operated in the breathing zone or it may be elevated. The sampler should be located in an unobstructed area, at a distance of twice the height of any obstruction to air flow, if possible, but no closer than two meters to the obstacle. In urban or congested areas, it is recommended that the sampler be placed on the roof of a single story building.
3. If it is not already set up, assemble the sampling system as described in Section 7.4 (Steps 2 to 4). Adjust the exhaust hose so that it faces downwind of the sampler.
4. Put on clean surgical gloves.
5. Place the loaded sampling module into the quick release fitting and engage by locking the two levers down securely. Refer to Figure 4 (Appendix A) for the complete set-up of the sampling system.
6. Remove the metal cover.
7. Record the following information on the Air Sampling Worksheet (Attachment 2, Appendix B): high volume pump number,

direction from site, location, sample start time, time/counter (start).

8. Plug in the unit.
9. If necessary adjust the magnehelic gauge to the reading required to achieve the target flow rate by turning the ball valve.
10. Wait approximately two minutes for the magnehelic reading to stabilize.
11. Allow the sampling system to operate for the duration determined by the Work Assignment Manager.
12. If the sampling system is to be in use for an extended period of time (i.e., the duration of sampling is greater than 24 hours), the initial calibration should be audited every 24 hours. This audit is accomplished by checking one point in the calibration curve using the field calibration procedure described in Section 7.4 and using a fully assembled sample module *with* the PUF plug and glass fiber filter installed. If the result of this check is greater than $\pm 7\%$ of the initial calibration value, the sampling system must be recalibrated.

7.6 Unit Shutdown and Sample Collection

1. Record the following information on the Air Sampling Worksheet (Attachment 2, Appendix B): sample stop time, time/counter (stop), the ending magnehelic reading, and whether or not there was a pump fault. Measure the ambient temperature and barometric pressure at the end of the sampling period. This information and the ending magnehelic gauge reading should be recorded on the Field Calibration Work Sheet.
2. Unplug the sampler and remove the sample module.
3. Cover the sample module with the metal cover. Keep the sample module in a vertical position at all times.

4. Place the sample module in a cooler for transport back to the command post. The field blank should also be stored in the same cooler.
5. If additional sampling is scheduled, perform a field calibration audit as described in Section 7.5, #12. The unit must be decontaminated with hexane and chem wipes prior to initiating additional sampling activities. Install a new sampling module and begin sampling as described in Section 7.5. If no additional sampling is scheduled, secure the unit.
6. Wearing surgical gloves and using tweezers, remove the PUF plug and place it in a clean 8-oz. glass jar. Fold the glass fiber filter into quarters and place it on top of the PUF plug. Label the jar appropriately and cover it with aluminum foil (shiny side out). Prepare the sample for transport to the laboratory for analysis, as necessary.
7. Calculate the post-sampling flow rate, the average flow rate, and the total volume sampled (Sections 8.5 and 8.6).

should be recorded in the appropriate location on the Field Calibration Work Sheet.

8.0 CALCULATIONS

The total volumes calculated for each sampling unit are corrected to standard conditions (760 millimeters of mercury [mm Hg] and 298 kelvin [K]). This is necessary for reporting the concentrations in a manner consistent with method requirements. The first step in the calibration process is to determine the slope (m) and the y-axis intercept (b) from the Factory Calibration Work Sheet. This is based on the formula $y=mx+b$. This is calculated either graphically (5-point calibration curve) or by a regression analysis of the data provided on the Factory Calibration Work Sheet. Once the slope and intercept are calculated for the factory calibration data, a calibration curve is developed for each of the sampling units. The important data elements needed to complete this task are the pressure drop readings for each of the arbitrary values (I) (Section 7.4), ambient temperature and ambient pressure. *If the sampling unit calibration results will be provided in mm Hg instead of inches of water, then Section 8.1 may be skipped because the manufacturer has already calculated the slope (m) and intercept (b) and provided them on the Factory Calibration Work Sheet. This information*

8.1 Determining the Slope (m) and Y-Axis Intercept (b) of the Factory Calibration

1. Obtain the current Factory Calibration Work Sheet from manufacture's calibration kit or Air Team Calibration File. See Figure 5 (Appendix A) for an example.
2. Copy columns #6 & #7 from the Q_{std} section of the Factory Calibration Work Sheet to column #1 & #2, respectively, on the Field Calibration Work Sheet (Attachment 1, Appendix B). Record the ambient temperature, ambient pressure at which the factory orifice calibration was performed, and orifice serial number from the Factory Calibration Work Sheet in the respective locations on the Field Calibration Work Sheet. Return the Factory Calibration Work Sheet to the calibration kit or the proper file.
3. Solve the following formula for every calibration orifice static pressure found in column #1 of the Field Calibration Work Sheet. Record results in column #3 of the Field Calibration Work Sheet. The units of the results are arbitrary. There should be at least five computations.

Equation:

$$\text{y-axis equation orifice} = [\Delta H(P_a/760)(298/T_a)]^{1/2}$$

Where:

ΔH = Calibration orifice static pressure in inches of water ("H₂O) (Field Calibration Work Sheet, column #1).

P_a = Ambient pressure at which the factory orifice calibration was performed in mm Hg.

T_a = Ambient temperature at which the factory orifice calibration was performed in K.

Example:

$$\Delta H = 2.0 \text{ "H}_2\text{O}, P_a = 760.5 \text{ mm Hg}, T_a = 295 \text{ K}$$

$$\text{y-axis equation orifice} = [(2.0 \text{ "H}_2\text{O})(760.5 \text{ mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})]^{1/2}$$

$$\text{y-axis equation orifice} = [2.02]^{1/2}$$

$$\text{y-axis equation orifice} = 1.42$$

4. Graph the results in column #2 of the Field Calibration Work Sheet on the x-axis against the data presented in column #3 of the Field Calibration Work Sheet on the y-axis or perform a regression analysis of the data to determine the slope and (m) and the y-axis intercept (b). Record in the appropriate location on the Field Calibration Work Sheet.

Example: Regression analysis from Lotus 123:

Regression Output:

Constant	- 0.03
Std Err of Y Est	0.00246358
R Squared	0.99999508
No. of Observations	6
Degrees of Freedom	4

X Coefficient(s)	9.52
Std Err of Coef.	0.01055231

Where:

$$\begin{aligned} \text{Constant} &= \text{y-Axis intercept (b)} \\ \text{X Coefficient(s)} &= \text{Slope (m)} \end{aligned}$$

8.2 Determining the Slope (m) and a Y-Axis Intercept (b) of the Field Calibration

1. Obtain pressure drop readings from the water manometer and the matching arbitrary magnehelic values (I = 70, 60, 50, 40, 30) from Section 7.4 and record the data on a Field Calibration Work Sheet in columns #4 and #5, respectively. Record the ambient temperature and ambient pressure at which each unit calibration was performed.

2. Solve the y-axis equation using the formula below and using the data found in column #4 on the Field Calibration Work Sheet. Record the results in column #6 of the Field Calibration Work Sheet. The units of the results are arbitrary. There should be at least five computations.

Equation:

$$\text{y-axis equation sampling unit} = [\Delta H(P_a/760)(298/T_a)]^{1/2}$$

Where:

ΔH = Static pressure of the sampling unit in "H₂O (column #4 of the Field Calibration Work Sheet).

P_a = Ambient pressure in mm Hg at time of unit calibration.

T_a = Ambient temperature in K at time of unit calibration.

Example:

$$\Delta H = 6.0 \text{ "H}_2\text{O}, P_a = 756.92 \text{ mm Hg}, T_a = 295 \text{ K}$$

$$\text{y-axis equation sampling unit} = [(6.0 \text{ "H}_2\text{O})(756.92 \text{ mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})]^{1/2}$$

$$\text{y-axis equation sampling unit} = [6.06]^{1/2}$$

$$\text{y-axis equation sampling unit} = 2.46$$

3. Determine the volumetric flow rate (Q_{STD}) for each calibration point using the following equation. Record the results in column #7 of the Field Calibration Work Sheet.

Equation:

$$Q_{STD} = 1/m \{ [\Delta H(P_a/760)(298/T_a)]^{1/2} - b \}$$

Where:

m = Slope from the Factory Calibration Work Sheet graph or regression analysis (Step #4, Section 8.1).

ΔH = Pressure drop in "H₂O recorded on Field Calibration Work Sheet (column #4).

P_a = Ambient pressure in mm Hg at time of field calibration.
 T_a = Ambient temperature in K at time of field calibration.
 b = y-Axis intercept from the Factory Calibration Work Sheet graph or regression analysis (Step #4, Section 8.1).

Example:

$m = 9.52$, $\Delta H = 6.0$ "H₂O, $P_a = 756.92$ mm Hg, $T_a = 295$ K, $b = -0.03$

$Q_{STD} = 1/9.52 [(6.0 \text{ "H}_2\text{O} (756.92 \text{ mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})]^{1/2} - (-0.03)]$

$Q_{STD} = 1/9.52 [2.46]$

$Q_{STD} = 0.26 \text{ m}^3/\text{min}$

4. Determine the Y_{value} for each calibration point. Record in column #8 on the Field Calibration Work Sheet. The units of the results are arbitrary.

Equation:

$Y_{value} \text{ of each calibration point} = [I(P_a/760)(298/T_a)]^{1/2}$

Where:

I = Arbitrary value located in column #5 on the Field Calibration Work Sheet.

P_a = Ambient pressure in mm Hg at time of unit field calibration.

T_a = Ambient temperature in K at time of unit field calibration.

Example:

$I = 70$, $P_a = 756.92$ mm Hg, $T_a = 295$ K

$Y_{value} \text{ of each calibration point} = [70(756.92 \text{ mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})]^{1/2}$

$Y_{value} \text{ of each calibration point} = 8.39$

5. Graph the results in column #7 of the Field Calibration Work Sheet on the x-axis against

the data presented in column #8 from the Field Calibration Work Sheet on the y-axis or perform a regression analysis to determine the slope (m) and the y-axis intercept (b). Record in the appropriate location on the Field Calibration Work Sheet.

Example: Regression analysis from Lotus 123:

Regression Output:

Constant	1.64
Std Err of Y Est	0.057770455
R Squared	0.998738313
No. of Observations	6
Degrees of Freedom	4

X Coefficient(s)	25.66
Std Err of Coef.	0.45593301

Where:

Constant = y-axis intercept (b)

X Coefficient(s) = Slope (m)

8.3 Checking the Linearity of the Calibration

1. Calculate Y_{cal} to determine if the calibration is within the limits of linearity ($\pm 5\%$) using the following formulas. Record the results in column #9 of the Field Calibration Work Sheet.

Equation: $Y_{cal} = mQ_{STD} + b$

Where:

m = Slope of the field calibration curve from the regression analysis of columns #7 & #8.

Q_{STD} = Volumetric flow rate calculated on the Field Calibration Work Sheet (column #7).

b = y-Axis intercept of the field calibration curve from the regression analysis of columns #7 and #8.

Example:

$m = 25.66$, $Q_{STD} = 0.26$, $b = 1.64$

$$Y_{cal} = [(25.66)(0.26)] + 1.64$$

$$Y_{cal} = 8.31$$

2. Calculate %-difference of the Y_{value} and Y_{cal} . Record the results in column #10 of the Field Calibration Work Sheet. If the results are not within $\pm 5\%$ recheck your calculations or recalibrate.
Equation:

$$\% \text{-difference} = ((Y_{value} - Y_{cal})/Y_{cal})(100)$$

Where:

Y_{value} = Y_{value} in column #8 of the Field Calibration Work Sheet.

Y_{cal} = Value from previous calculation recorded in column #9 of the Field Calibration Work Sheet.

Example:

$$\% \text{-difference} = ((8.39 - 8.31)/8.31)100$$

$$\% \text{-difference} = 0.96\%$$

8.4 Determining Pre-Sampling Volumetric Flow Rate

1. Determine the volumetric flow rate at each calibration point using the following equation and recording the data in column #11 of the Field Calibration Work Sheet.

Equation:

$$Q = (1/m)[\{I(P_a/760)(298/T_a)\}^{1/2} - b]$$

Where:

I = Arbitrary magnehelic reading recorded on Field Calibration Work Sheet (column #5).

P_a = Ambient pressure in mm Hg at which the sampling unit was calibrated.

T_a = Ambient temperature in K at which the sampling unit was calibrated.

b = y-Axis intercept from the field calibration graph or regression analysis of columns #7 & #8.

m = Slope from the field calibration curve graph or regression analysis of columns #7 & #8.

Example:

$$I = 70, P_a = 756.92 \text{ mm Hg}, T_a = 295 \text{ K}, m = 25.66, b = 1.64$$

$$Q = (1/25.66)[\{70(756.92 \text{ mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})\}^{1/2} - 1.64]$$

$$Q = 0.26 \text{ m}^3/\text{min}$$

2. Determine the arbitrary set point for a target volumetric flow rate, as follows.

- a. Obtain the target volumetric flow rate in m^3/min from the Work Assignment Manager.

- b. Obtain the ambient barometric pressure and the ambient temperature at the start of the sampling event and record on the Field Calibration Work Sheet.

- c. Using the following equation calculate your arbitrary set point for each sampler. Record in the appropriate location on the Field Calibration Work Sheet.

Equation:

$$I = [\{(Q_{target})(m)\} + b]^2 / [(P_a/760)(298/T_a)]$$

Where:

Q_{target} = Desired volumetric flow rate (m^3/min .)

m = Slope of the field calibration as determined by the regression of columns #7 & #8.

b = y-Axis intercept of the field calibration as determined by the regression of columns #7 & #8.

P_a = Ambient pressure at which the sample is being taken (mm Hg)

T_a = Ambient temperature at which the sample is being taken (K)

Example:

What is the manometric set point (I) for the target flow rate of 0.25 m³/min.?

$m = 25.66$, $b = 1.64$, $P_a = 756.92$ mm Hg, $T_a = 295$ K

$$I = \frac{[(0.25 \text{ m}^3/\text{min.})(25.66) + 1.64]^2}{[(756.92/760)(298/295)]}$$

$$I = 64.49$$

3. Determine the initial flow rate, as follows.

- a. Set the magnehelic set point (I) as determined by the previous step.
- b. Use the following equation to check the set point to determine if is the correct set point for the desired flow rate.

Equation:

$$Q = (1/m)[\{I(P_a/760)(298/T_a)\}^{1/2} - b]$$

Where:

- Q = Volumetric flow rate at set point (I).
I = Magnehelic set point (I).
P_a = Ambient pressure at the start of the sampling event.
T_a = Ambient temperature in K at the start of the sampling event.
b = y-Axis intercept from the field calibration graph or regression analysis of column #7 & #8.
m = Slope from the field calibration curve graph or regression analysis of column #7 & #8.

Example:

I = 64.49, P_a = 756.9mm Hg, T_a = 295 K, m = 25.66, b = 1.64

$$Q = 1/25.66[\{64.49(756.9\text{mmHg}/760\text{mmHg})(298\text{ K}/295\text{ K})\}^{1/2} - 1.64]$$

$$Q = 0.25\text{ m}^3/\text{min}.$$

8.5 Determining Post-Sampling Volumetric Flow Rate

1. Obtain the ambient barometric pressure and the ambient temperature at the end of the sampling event and record on the Field Calibration Work Sheet.
2. Obtain the set point (I) of the magnehelic at the end of the sampling event and record on the Field Calibration Work Sheet.
3. Use the following equation to determine the

volumetric flow rate.

Equation:

$$Q = (1/m)[\{I(P_a/760)(298/T_a)\}^{1/2} - b]$$

Where:

- Q = Volumetric flow rate at set point (I).
I = Magnehelic set point (I) at the end of the sampling event.
P_a = Ambient pressure at the end of the sampling event.
T_a = Ambient temperature in K at the end of the sampling event.
b = y-Axis intercept from the field calibration graph or regression analysis of columns #7 & #8.
m = Slope from the field calibration curve graph or regression analysis of columns #7 & #8.

Example:

I = 50, P_a = 758.9 mm Hg, T_a = 299 K, m = 25.66, b = 1.64

$$Q = 1/25.66[\{50(758.9\text{mmHg}/760\text{mmHg})(298\text{ K}/299\text{ K})\}^{1/2} - 1.64]$$

$$Q = 0.21\text{ m}^3/\text{min}.$$

8.6 Determining Total Volume

Average the pre- and post-volumetric flow rates and multiply by the time sampled to determine the volume sampled. Record all information on the Field Calibration Work Sheet.

Example:

$$((0.25\text{m}^3/\text{min} + 0.21\text{m}^3/\text{min})/2)480\text{ min} = 110.4\text{ m}^3$$

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Provide one field blank per sampling period or one field blank for every 20 samples, whichever is greater. A field blank is treated exactly as a sample except that air is not drawn through the media. PUF plugs should be submitted to the laboratory for cleaning prior to field sampling. If the PUF plugs were cleaned in

house, one or two clean plugs should be sent to the laboratory which will be analyzing the samples. Sample spiking may be necessary for pesticide and PCB samples; consult with the Work Assignment Manager.

10.0 DATA VALIDATION

Results of the quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results in accordance with the data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials follow U.S. EPA, OSHA, and corporate health and safety practices.

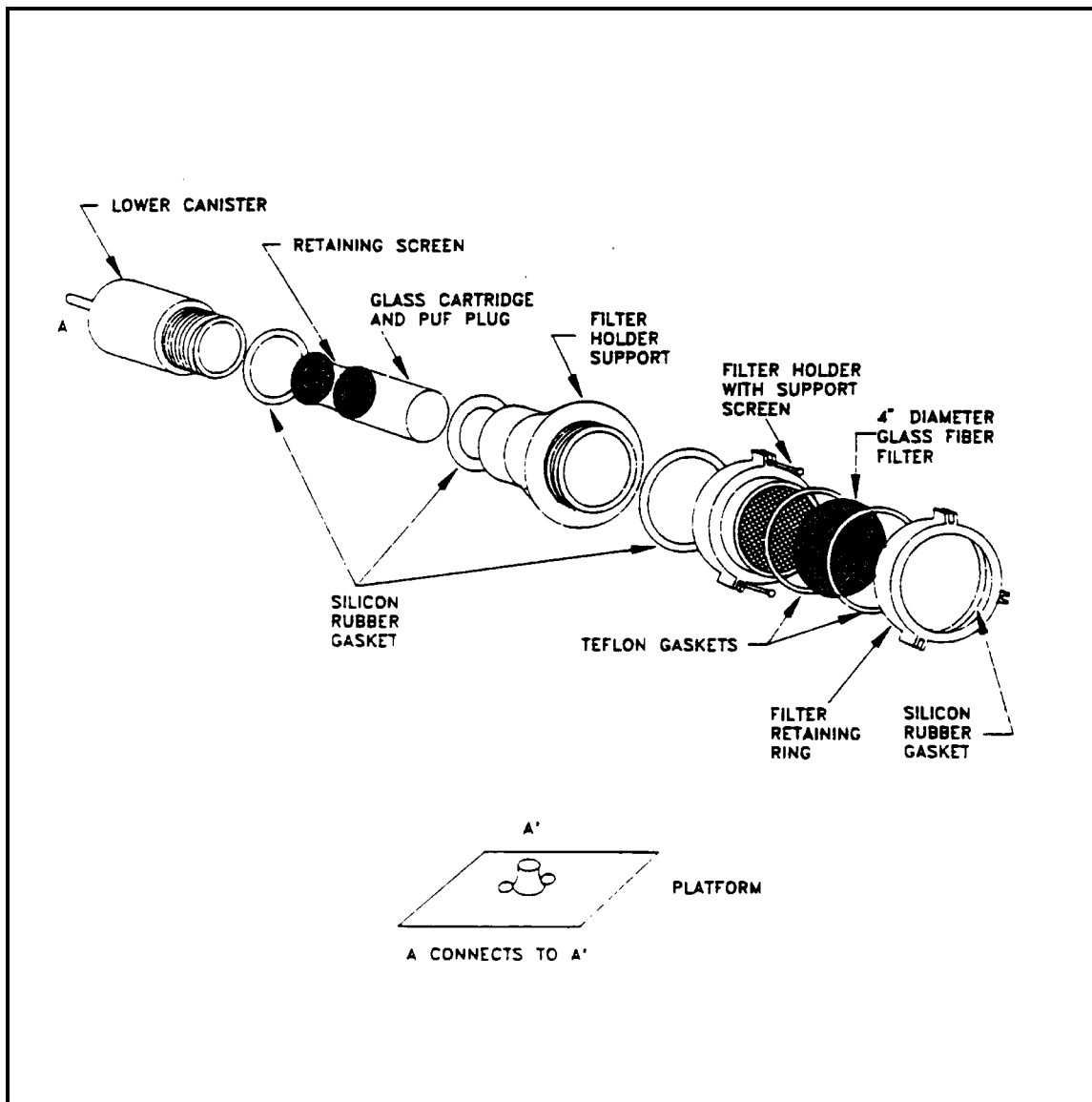
12.0 REFERENCES

Method TO4, Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air, Revision 1.0, April, 1984.

APPENDIX A

Figures

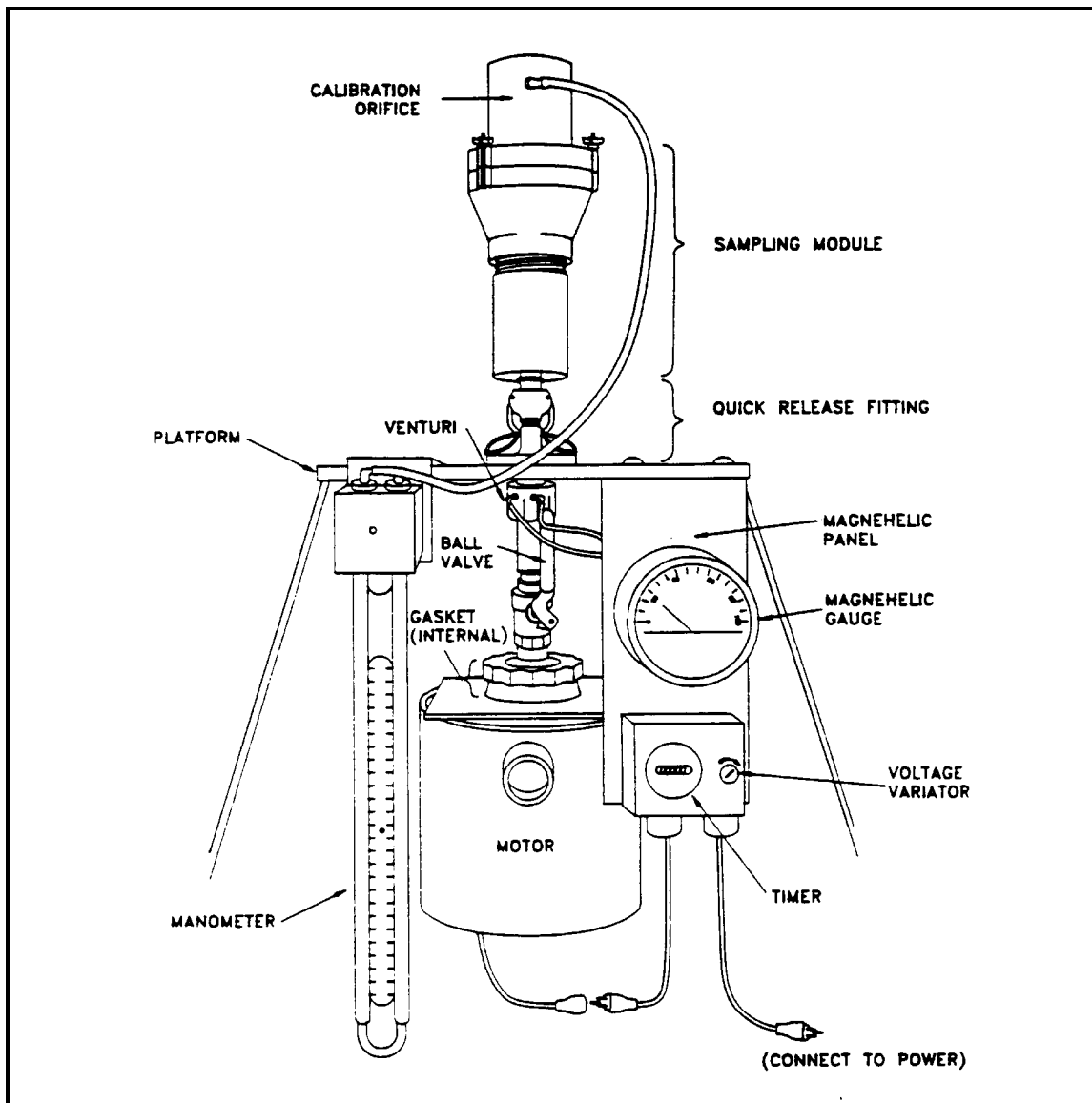
FIGURE 1. Sample Module



APPENDIX A (Cont'd)

Figures

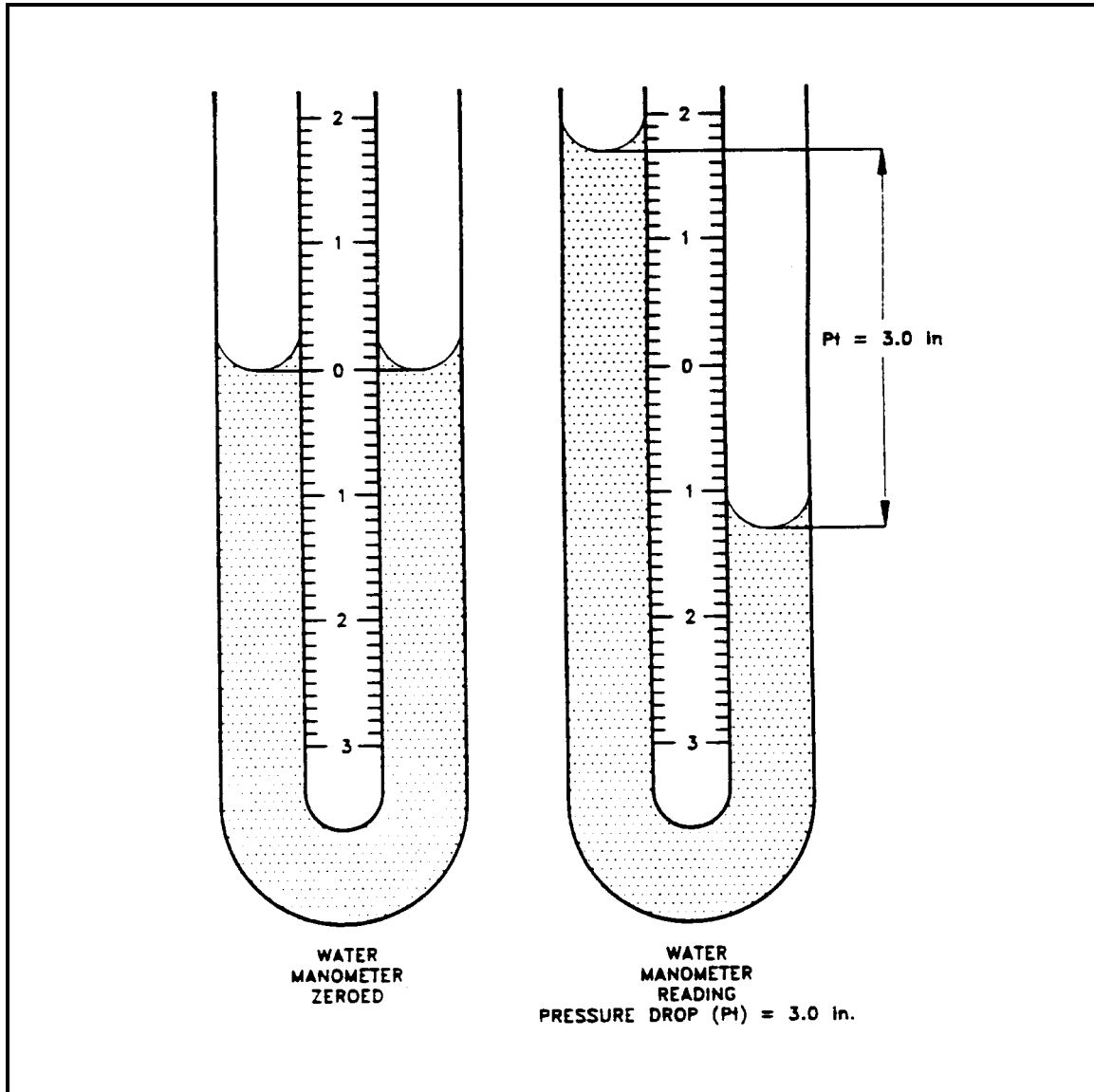
FIGURE 2. Calibration of the PUF Sampler



APPENDIX A (Cont'd)

Figures

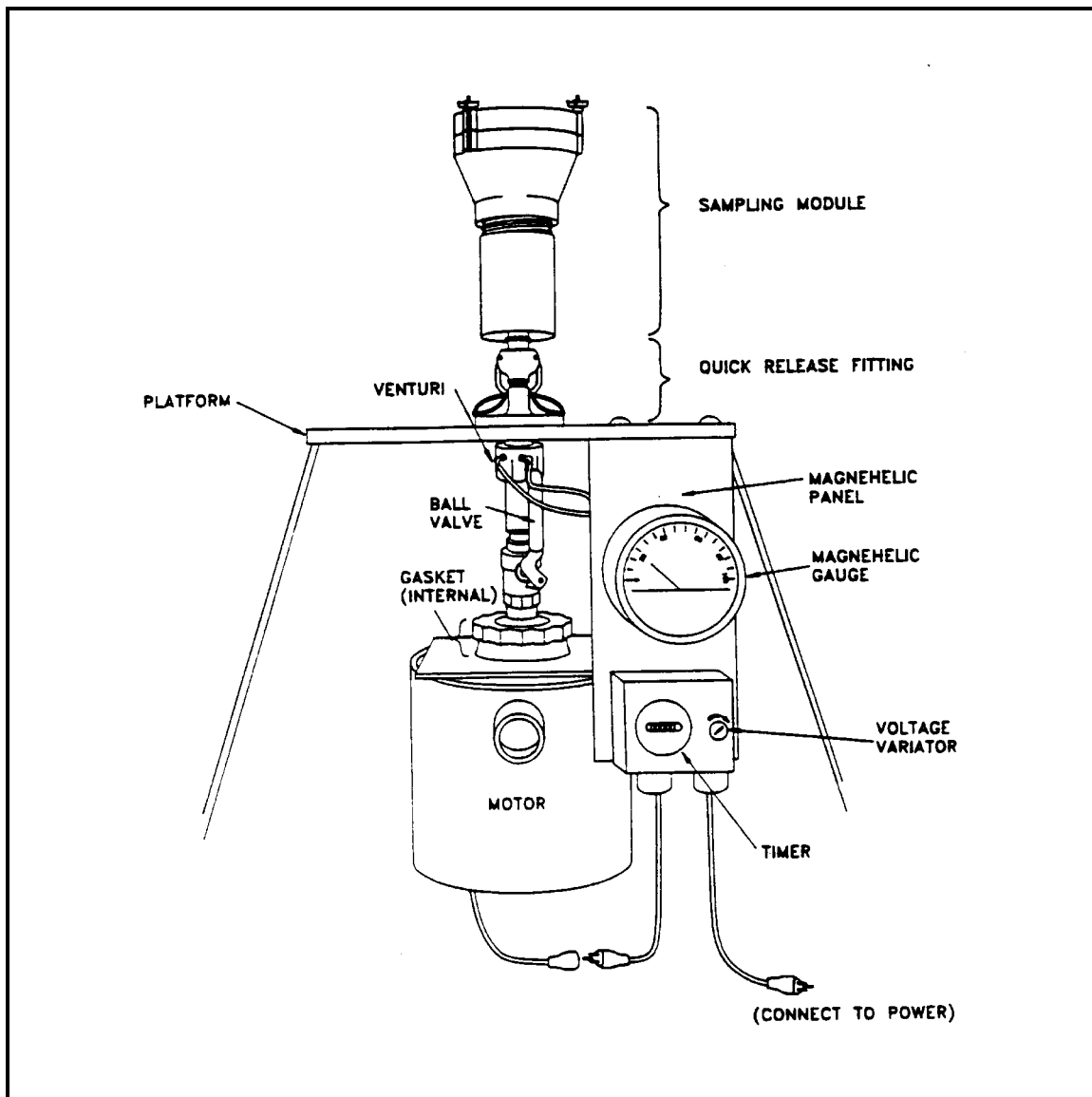
FIGURE 3. Manometer



APPENDIX A (Cont'd)

Figures

FIGURE 4. PUF Sampler



APPENDIX A (Cont'd)

Figures

FIGURE 5. Factory Calibration Work Sheet

GRASEBY/ GMW
145 South Miami Avenue
Cleveland, OH 45002
Tel. (513) 941-2229

High Volume Orifice Calibration Certificate

Pa: 748.8 mm of Hg	Roots Meter Serial No.: 7509364	Calibration Performed by: S.BUTLER
Ta: 22.0 °C	Calibrator Orifice Model No.: 40A	Calibration Date: 29SEP94
RH: 57 %	Calibrator Orifice Serial No.: 77C	Date placed in service: _____

Q Standard Calibration Data

(1) Run Point No.	(2) Elapsed Time-Δt Min.	(3) Initial Volume Vm M ³	(4) Meter Inlet Static Pressure-ΔP mm of Hg	(5) Standard Volume Vstd M ³	(6) Calibrator Orifice Static Pressure-ΔH in. of H ₂ O	(7) X Metric Flow Rate Qstd M ³ /min.	(8) English Flow Rate Qstd ft ³ /min.	(9) Y $\sqrt{\Delta H \left(\frac{Pa}{760} \right) \left(\frac{298.16}{Ta} \right)}$
1	6.434	1	3.3	0.991	2.0	3.74	0.154	1.411
2	3.898	1	9.7	0.982	5.5	10.27	0.252	2.340
3	3.126	1	15.1	0.975	8.5	15.87	0.312	2.909
4	2.661	1	20.6	0.968	11.5	21.48	0.364	3.383
5	2.355	1	26.0	0.961	14.5	27.08	0.408	3.799
6	2.203	1	29.6	0.956	16.5	30.82	0.434	4.052
Slope(m): 9.41		Intercept(b): -0.035310		Correlation Coefficient(r): 0.999985				

Q Actual Calibration Data

(1) Run Point No.	(2) Elapsed Time-Δt Min.	(3) Initial Volume Vm M ³	(4) Meter Inlet Static Pressure-ΔP mm of Hg	(5a) Actual Volume Va M ³	(6) Calibrator Orifice Static Pressure-ΔH in. of H ₂ O	(7a) X Metric Flow Rate Qa M ³ /min.	(9a) Y $\sqrt{\Delta H \left(\frac{Pa}{760} \right) \left(\frac{Ta}{298.16} \right)}$
1	6.434	1	3.3	0.996	2.0	3.74	0.155
2	3.898	1	9.7	0.987	5.5	10.27	0.253
3	3.126	1	15.1	0.980	8.5	15.87	0.314
4	2.661	1	20.6	0.973	11.5	21.48	0.366
5	2.355	1	26.0	0.966	14.5	27.08	0.410
6	2.203	1	29.6	0.961	16.5	30.82	0.436
Slope(m): 5.89		Intercept(b): -0.021285		Correlation Coefficient(r): 0.999985			

Equations:

$$Vstd(5) = Vm(3) \frac{(Pa-\Delta P) Tstd}{Pstd \times Ta}$$

$$Qstd = \frac{Vstd}{\Delta t}$$

$$Va(5a) = Vm(3) \frac{(Pa-\Delta P)}{Pstd}$$

$$Qa = \frac{Va}{\Delta t}$$

Standard Conditions:

Tstd= 25°C= 298.15°K
Pstd= 760mm of Hg

For additional information consult:

1. The Federal Register, Vol.47, No. 234, pp. 54896-54921, December 6, 1982.
2. Quality Assurance Handbook, Vol.II (EPA 600/4-77-277a), Section 2.11.
3. Graseby/GMW/Andersen Instruction Manual.

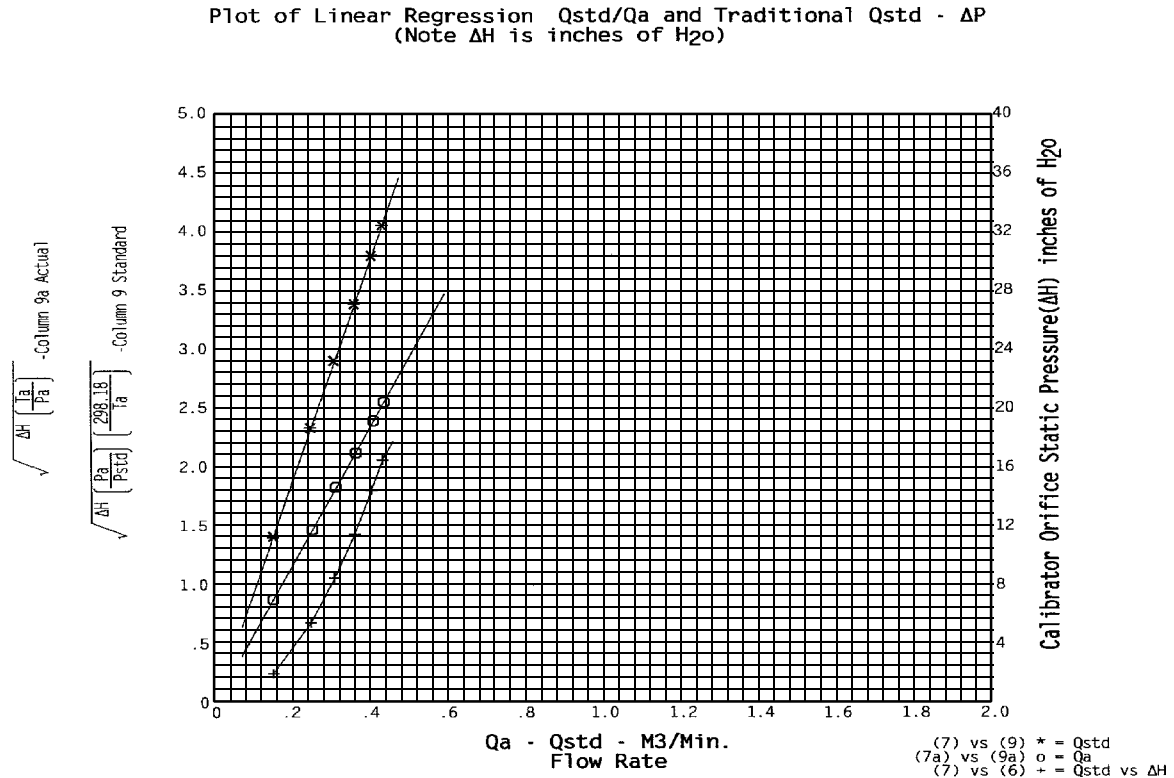
Notes:

1. EPA recommends calibrators should be recalibrated after one year of field use.

APPENDIX A (Cont'd)

Figures

FIGURE 5. Factory Calibration Work Sheet (Cont'd)



Use of Curve for determining Qa or Qstd.

To find Qa calculate:

$$Qa = \left[\frac{\Delta H \cdot Ta}{Pa} \right]^{1/2}$$

To find Qstd calculate:

$$Qstd = \left[\Delta H \cdot \frac{Pa}{760} \cdot \frac{298.18}{Ta} \right]^{1/2}$$

Where:

ΔH= Calibrator Manometer Reading in inches of water.
Ta= Actual Absolute Temperature in degrees Kelvin(°K).
Pa= Actual Barometric Pressure in millimeters(mm) of Mercury(Hg).
b = Intercept
m = Slope

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To find Qa or Qstd by Calculation.

To determine Qa calculate:

$$Qa = \frac{\left[\frac{\Delta H \cdot Ta}{Pa} \right]^{1/2}}{m} - b$$

To determine Qstd calculate:

$$Qstd = \frac{\left[\Delta H \cdot \frac{Pa}{760} \cdot \frac{298.18}{Ta} \right]^{1/2}}{m} - b$$

Certificate for 77c page 2 of 2

APPENDIX B

Attachments

ATTACHMENT 1. Field Calibration Work Sheet



ENVIRONMENTAL RESPONSE TEAM HIGH VOLUME SAMPLER FIELD CALIBRATION WORK SHEET

Page ____ of ____

Site: _____

WA#: _____

Date: _____

Samplers: _____

EPA/ERT WAM: _____

REAC TL: _____

Sampler #: _____

Location/Station: _____

ORIFICE CALIBRATION INFORMATION (Obtained from the Factory Calibration Work Sheet)

Ambient Pressure (mmHg): _____

Ambient Temperature (kelvin): _____

Serial #: _____

Unit Calibration Information

Ambient Pressure (mmHg): _____

Ambient Temperature (kelvin): _____

Calibration Data			Calibration Curve					Linearity of Calibration Curve		
#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Calibrator Orifice Static Pressure (ΔH)	Metric Flow Rate Q_{std} (m^3/min) (x-axis)	y-axis Equation Orifice	ΔH Sampling Unit (H_2O)	Pressure Indicator of the Sampling Unit (l) (arbitrary)	y-axis Equation of the Sampling Unit	Q_{std} Orifice Calibration (x-axis)	y-value of Each Calibration Point (y-axis)	y-cal	% Difference (+/- 5%)	Flow Rate for Each Calibration Point

Slope (m) and y-intercept (b) of columns #2 & #3

m = _____ b = _____

Slope (m) and y-intercept (b) of columns #7 & #8

m = _____ b = _____

APPENDIX B (Cont'd)

Attachments

ATTACHMENT 2. Air Sampling Worksheet



ENVIRONMENTAL RESPONSE TEAM HIGH VOLUME AIR SAMPLING WORK SHEET

Page ____ of ____

Site: _____

WA#: _____

Samplers: _____

EPA/ERT WAM: _____

Date: _____

REAC Task Leader: _____

Sample #					
Location					
Sampler ID					
Media					
Analysis/Method					
Time/Counter (Start)					
Time/Counter (Stop)					
Total Time					
Ambient Temperature (kelvin) Start					
Ambient Barometric Pressure (mmHg) Start					
Ambient Temperature (kelvin) Stop					
Ambient Barometric Pressure (mmHg) Stop					
Magnehelic Reading (Pre)					
Magnehelic Reading (Post)					
Flow Rate (Pre)					
Flow Rate (Post)					
Flow Rate (Average)					
Volume					
MET Station On-site? Y / N					
General Comments:					

APPENDIX C
TO-15 TARGETED COMPOUNDS

TO-15 Targeted Compounds
73 Anlaytes
Hurricane Ida

Analyte	CAS.NO	Units	Residential Air Screening Level
TO-15			
1,1,1-Trichloroethane	71-55-6	ug/m3	5210
1,1,2,2-Tetrachloroethane	79-34-5	ug/m3	12.6
1,1,2-Trichloroethane	79-00-5	ug/m3	11.4
1,1,2-Trichlorotrifluoroethane	76-13-1	ug/m3	52100
1,1-Dichloroethane	75-34-3	ug/m3	456
1,1-Dichloroethene	75-35-4	ug/m3	209
1,2,4-Trichlorobenzene	120-82-1	ug/m3	20.9
1,2,4-Trimethylbenzene	95-63-6	ug/m3	209
1,2-Dibromoethane	106-93-4	ug/m3	1.22
1,2-Dichlorobenzene	95-50-1	ug/m3	2090
1,2-Dichloroethane	107-06-2	ug/m3	28.1
1,2-Dichloropropane	78-87-5	ug/m3	4.17
1,2-Dichlorotetrafluoroethane	76-14-2	ug/m3	
1,3,5-Trimethylbenzene	108-67-8	ug/m3	209
1,3-Butadiene	106-99-0	ug/m3	2.09
1,3-Dichlorobenzene	541-73-1	ug/m3	
1,4-Dichlorobenzene	106-46-7	ug/m3	66.4
1,4-Dioxane	123-91-1	ug/m3	146
2,2,4-Trimethylpentane	540-84-1	ug/m3	
2-Butanone (MEK)	78-93-3	ug/m3	1040
2-Chlorotoluene	95-49-8	ug/m3	834
2-Propanol	67-63-0	ug/m3	7300
4-Ethyltoluene	622-96-8	ug/m3	
4-Methyl-2-pentanone (MIBK)	108-10-1	ug/m3	834
Acetone	67-64-1	ug/m3	32200
Acetonitrile	75-05-8	ug/m3	521
Acrylonitrile	107-13-1	ug/m3	2.09
Allyl chloride	107-05-1	ug/m3	10.4
Benzene	71-43-2	ug/m3	83.4
Benzyl Chloride	100-44-7	ug/m3	4.17
Bromodichloromethane	75-27-4	ug/m3	19.7
Bromoform	75-25-2	ug/m3	664
Bromomethane	74-83-9	ug/m3	104
Carbon disulfide	75-15-0	ug/m3	730
Carbon tetrachloride	56-23-5	ug/m3	122
Chlorobenzene	108-90-7	ug/m3	521
Chloroethane	75-00-3	ug/m3	4170
Chloroform	67-66-3	ug/m3	31.7
Chloromethane	74-87-3	ug/m3	3130
cis-1,2-Dichloroethene	156-59-2	ug/m3	
cis-1,3-Dichloropropene	10061-01-5	ug/m3	
Cyclohexane	110-82-7	ug/m3	18800
Dibromochloromethane	124-48-1	ug/m3	
Dichlorodifluoromethane	75-71-8	ug/m3	1040
Ethanol	64-17-5	ug/m3	
Ethyl acetate	141-78-6	ug/m3	730
Ethyl tert-butyl ether	637-92-3	ug/m3	
Ethylbenzene	100-41-4	ug/m3	292
Heptane	142-82-5	ug/m3	4170
Hexachloro-1,3-butadiene	87-68-3	ug/m3	33.2
Isopropylbenzene	98-82-8	ug/m3	93.9
m&p-Xylene	1330-20-7	ug/m3	417
Methyl Butyl Ketone	591-78-6	ug/m3	31.3
Methyl methacrylate	80-62-6	ug/m3	730
Methylene Chloride	75-09-2	ug/m3	1010
MTBE	1634-04-4	ug/m3	2630
Naphthalene	91-20-3	ug/m3	3.13
n-Hexane	110-54-3	ug/m3	2090
n-Octane	111-65-9	ug/m3	
o-Xylene	95-47-6	ug/m3	104
Propene	115-07-1	ug/m3	3130
Styrene	100-42-5	ug/m3	3130
tert-Amyl Methyl Ether	994-05-8	ug/m3	
Tetrachloroethylene	127-18-4	ug/m3	42.4
Tetrahydrofuran	109-99-9	ug/m3	2090
Toluene	108-88-3	ug/m3	5210
trans-1,2-Dichloroethene	156-60-5	ug/m3	827
trans-1,3-Dichloropropene	10061-02-6	ug/m3	
Trichloroethylene	79-01-6	ug/m3	2.24
Trichlorofluoromethane	75-69-4	ug/m3	1040
Vinyl acetate	108-05-4	ug/m3	36.7
Vinyl Bromide	593-60-2	ug/m3	48.7
Vinyl chloride	75-01-4	ug/m3	2.24

Notes:
RSL = The Residential Air Screening Levels (RSLs) are risk-based concentrations derived using standardized equations which combine the latest EPA toxicity data with exposure assumptions appropriate for hurricane response monitoring. Note: Air screening levels could not be derived for chemicals that do not have toxicity values.
ug/m3 = Micrograms per cubic meter

