Remedial Action Work Plan Compendium

Lehigh Valley Railroad Derailment Superfund Site
Spill Area Soils (Operable Unit OU-1)
LeRoy, New York
Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared For:

Lehigh Valley Railroad Company

Prepared By:

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

On Behalf
Of

Unicorn Management
Consultants, LLC

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REMEDIAL ACTION WORK PLAN COMPENDIUM

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
SPILL AREA SOILS (OPERABLE UNIT #1)
LEROY, NEW YORK
INDEX No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to

Unicorn Management Consultants, LLC

For

Lehigh Valley Railroad Company

Cincinnati, Ohio

Prepared By:

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REMEDIAL ACTION WORK PLAN COMPENDIUM

LEHIGH VALLEY RAILROAD DERAILMENT SITE
LeRoy, New York

Certification & Authorization

CERTIFICATION:

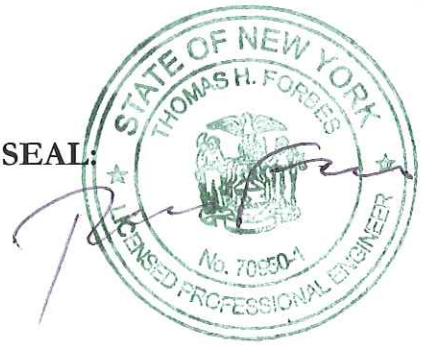
I, Thomas H. Forbes, P.E., certify that I am currently a NYS registered professional engineer and that this Remedial Action Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

6-4-14

Thomas H. Forbes, P.E. **Date**

License No.: 070950-1

Registration State: New York **SEAL:**



AUTHORIZATION

Authorization by Unicorn Management Consultants, LLC on behalf of Lehigh Valley Railroad Company:

Francisco Trejo **Date**
Project Coordinator

REMEDIAL ACTION WORK PLAN COMPENDIUM

LEHIGH VALLEY RAILROAD DERAILMENT SITE

LeRoy, New York

Table of Contents

LIST OF VOLUMES

LIST OF APPENDICES

REMEDIAL ACTION WORK PLAN COMPENDIUM

LEHIGH VALLEY RAILROAD DERAILMENT SITE

LeRoy, New York

Table of Contents

LIST OF FIGURES

INTRODUCTION

Benchmark Environmental Engineering & Science, PLLC, as an EPA approved sub-consultant to Unicorn Management Consultants, LLC (UMC), has prepared this Remedial Action Work Plan (RAWP) Compendium on behalf of the Lehigh Valley Railroad Company (LVRR). LVRR is the respondent to a March 21, 2014 Administrative Order for Remedial Action, Index Number CERCLA-02-2014-2010 for the Lehigh Valley Railroad Derailment Superfund Site (Site) located in Genesee, Monroe, and Livingston Counties, New York (see Figures 1 and 2). The Site history, conceptual model, and remedial design elements are outlined in the July 1999 Superfund Record of Decision and the September 2013 Soil Remedial Design Report.

This Compendium has been drafted in accordance with the Remedial Action Statement of Work included as Appendix B of the Administrative Order to provide supporting details for Remedial Action (RA) implementation. Accordingly, this Compendium contains individual volumes for the Remedial Action Management Plan (RAMP), Construction Quality Assurance/Quality Control Project Plan (CQAPP), Quality Assurance/Quality Control Project Plan (QAPP), Health and Safety Contingency Plan (HSCP), Performance Sampling, Monitoring and Reporting Plan (PSMRP), and Operations Plan. Unless otherwise noted as a volume-specific reference, the RAWP figures and appendices are provided in a single location at the back of the Compendium for ease of reference.

VOLUME 1

REMEDIAL ACTION MANAGEMENT PLAN

REMEDIAL ACTION WORK PLAN COMPENDIUM VOLUME I

REMEDIAL ACTION MANAGEMENT PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LeRoy, New York

Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to
Unicorn Management Consultants, LLC
For
Lehigh Valley Railroad Company
Cincinnati, Ohio

REMEDIAL ACTION MANAGEMENT PLAN

Lehigh Valley Railroad Derailment Site

Table of Contents

Table of Contents

1.0 INTRODUCTION

Benchmark Environmental Engineering & Science, PLLC (Benchmark), as sub-consultant to Unicorn Management Consultants, LLC (UMC), has prepared this Remedial Action Management Plan (RAMP) on behalf of Lehigh Valley Railroad Company (LVRR). LVRR is the respondent to a March 21, 2014 Administrative Order for Remedial Action, Index Number CERCLA-02-2014-2010 (Ref. 1) for the Lehigh Valley Railroad Derailment Superfund Site (Site) located in LeRoy, New York (see Remedial Action Work Plan (RAWP) Figures 1 and 2). This document serves as Volume 1 of the RAWP Compendium. Figures and appendices are provided in a single location within the Compendium and are referenced throughout all volumes.

1.1 Background

The Lehigh Valley Railroad Derailment Superfund Site is the location of a 1970 historical train derailment and chemical spill which occurred east of the Village of LeRoy, New York, along Gulf Road. On December 6, 1970, a portion of an eastbound 114-car freight train operated by the Lehigh Valley Railroad derailed at the Gulf Road crossing. Two tank cars containing trichloroethylene (TCE) ruptured and spilled their contents onto the ground. Approximately 30,000 gallons of TCE were spilled. A third car containing a crystalline form of cyanide was also reported to have partially spilled as well. Newspaper articles from this time period and rhetorical sources indicate that most of the cyanide was recovered shortly after the derailment. The TCE reportedly infiltrated directly into the ground and was not recovered. Nearby residents reported odors in homes and contamination of drinking water wells shortly after the release. In response to the complaints, LVRR constructed a series of ditches and berms at the site of the release and flooded the ditches with approximately one million gallons of water in an attempt to flush away the TCE.

The release and subsequent response actions resulted in contaminated surface soil and bedrock groundwater. As stated in a 1999 EPA Superfund Record of Decision (ROD) (Ref. 2), the soil contamination and bedrock contamination appear to be physically separated from each other and, because techniques for dealing with soil contamination are different from those required for the groundwater, the NYSDEC established two operable units for

administration of the spill. Operable Unit #1 addressed groundwater and Operable Unit #2 addressed overburden soil.

In May 2000, the operable units were redefined by the USEPA as follows:

- Operable Unit #1 addresses a 10 acre "source area" immediately surrounding the bedrock and the contaminated groundwater present in the bedrock (about 3 ½ square miles); 1.5 acres (surface soils) and the contaminated overburden (soil, railroad ballasts, broken rock, fill, etc.)
- Operable Unit #2 addresses a four mile TCE groundwater plume

This report pertains to the contaminated overburden soil now included as a portion of Operable Unit #1 and referred to throughout this document as the "Spill Area". The Spill Area encompasses a portion of Gulf Road, the former Lehigh Valley main line railroad bed, and other adjoining lands.

1.2 Spill Area Remedial Approach

Site investigations indicate that TCE and to a lesser extent 1,2-dichloroethene (1,2-DCE; a breakdown product of TCE) remain at elevated concentration in a portion of the Spill Area soils above the bedrock (Ref. 3 & 4). The remedial activities generally incorporates separate SVE systems on the north and south sides of Gulf Road, including subgrade horizontal extraction points connected to a series of above and below ground manifolds, vertical vacuum observation wells, and trailer-mounted SVE mechanical equipment with granular activated carbon (GAC) emissions controls.

1.3 Purpose and Scope

This RAMP has been prepared in general accordance with the Remedial Action Statement of Work included as Appendix B to the Administrative Order (Ref. 1) as a component of the RAWP. Specifically, this Plan identifies/defines the Remedial Action (RA) team, schedule, pilot testing details, permitting requirements, and method of construction operations. For specific details relative to the remedial design, refer to the September 2013 Soil Remedial Design Report (Ref. 5).

1.4 Remedial Action Project Team

The RA project team shall include the following regulatory, advisory, management, and implementation staff:

Name	Project Responsibility	Affiliation
Michael Infurna (877) 251-4575	USEPA Remedial Project Manager	USEPA Region 2 290 Broadway, 20th Floor New York, NY 10007-1866
Christopher Magee (518) 402-9813	NYSDEC Remedial Project Manager	NYSDEC 625 Broadway Albany, New York 12233-7017
Francisco Trejo (203) 205-9000	Project Coordinator	Unicorn Management Consultants, LLC 52 Federal Road, Suite 2C Danbury, CT 06810
Thomas H. Forbes, P.E. (716) 856-0599	Supervising Contractor Project Manager	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218
Bryan C. Hann (716) 856-0599	Supervising Contractor Quality Assurance Officer	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218
Rick L. Dubisz (716) 856-0599	Supervising Contractor Primary Field Team Leader Health and Safety Officer	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218
John T. Deth (716) 856-0599	Supervising Contractor Secondary Field Team Leader	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218
Michael Perry (585) 288-5380	Laboratory Director	ALS Environmental 1565 Jefferson Rd., Bldg. 300, Suite 360 Rochester, NY 14623
Lisa Reyes (585) 288-5380	Laboratory QA Director	ALS Environmental 1565 Jefferson Rd., Bldg. 300, Suite 360 Rochester, NY 14623
Elizabeth Dickinson (610) 458-0289	Third Party Data Validator	Trillium, Inc. 27 LaFayette Circle Downington, PA 19335

1.5 Schedule

Individual schedules for the remedial action work plan, pilot test, SVE system construction, and post-remedial project are included on RAWP Figures 11a through 11d.

The RA progression will rely on both efficient implementation of all components of the RA as well as effective communication and reporting to both regulatory and advisory staff to aid in expedited review and approval, where necessary.

2.0 PILOT TEST WORK PLAN

As specified in the Remedial Design Report, the pilot test will be completed on the southern portion of the Spill Area as depicted on the RAWP Figure 7. Specific design details for the pilot test are documented in the Soil Remedial Design Report in narrative and in Technical Specifications 02 62 00, Soil Vapor Extraction Pilot Test, and 02 62 16, Soil Vapor Extraction System Equipment provided in Appendix D of the Soil Remedial Design Report (Ref. 5).

2.1 Schedule

The pilot test schedule is depicted on Figure 11b including the preparation, review and approval of the remedial action work plan; and pilot test system installation, implementation, and reporting. All required permits (see Section 4.0) and approvals (see Section 6.0) will be obtained in conjunction with the RAWP drafting process and review period to ensure permits and approvals are in place prior to the start of construction. Once the RAWP has been approved, the pilot test system construction and USEPA inspection will be completed over an approximate three week period. In accordance with the Administrative Order Statement of Work (Ref. 1), at least seven (7) days prior to completion of the pilot test phase, a pre-final inspection will be performed by the USEPA including a walkover of the Site to determine the completeness of the pilot test phase and its consistency with the Soil Remedial Design Report, any amendment to the design, the Administrative Order and Statement of Work, and applicable federal and state laws, rules, and regulations.

Once written authorization to proceed is obtained, the pilot test will be operated over a one week period. The results of the pilot test will be submitted to the USEPA within 120 days from the initiation of the pilot test to include proposed modifications to the full scale remedial design, if necessary, based on the results of the pilot test.

2.2 Objectives

The objective of the SVE pilot test is to evaluate the efficacy and efficiency of:

- SVE application for the removal of chlorinated contaminants from overburden soil/fill across the Spill Area, and

- vapor-phase carbon treatment of extracted vapor for emission controls during SVE operation.

Specific performance measures are specified in Section 2.6, below.

2.3 Equipment

A remedial system flow schematic is depicted on RAWP Figure 8. The pilot test will be completed with a mobile process unit with a minimum blower capacity of 200 scfm at an applied vacuum of 60 inches of water column. The system will be equipped with two 1,000-pound vapor phase GAC vessels for emissions controls. A temporary vapor barrier will be installed across the pilot test footprint to reduce short circuiting through the ground surface.

2.4 Procedures

2.4.1 *Step Tests*

Vacuum step tests will be performed during the feasibility study at two of the South System horizontal extraction points identified as B1 and B2 as depicted on RAWP Figure 7 and Design Plan Set (RAWP Appendix A) Sheets C-3 and C-4. Vacuum influence will be gauged at monitoring points MP-1 through MP-8. Extraction point B-2 will be tested with three vacuum step variations. Following the completion of the step tests at extraction point B-2, the vacuum across the pilot test area will be monitored to ensure pressure equalization before beginning the next set of step tests.

Next, the extraction point B-1 will be tested with one to three vacuum step variations to assess the permeability and efficacy of SVE for materials located in the vicinity of Gulf Road. During each step in the vacuum test, the applied vacuum will be held constant for up to 2 hours before increasing the vacuum to the next successive step. During each step, the following data will be collected:

- Location, date and step test start and stop times,
- System settings for each step test including vacuum and flow at the blower influent and pressure and temperature at the blower effluent.
- Extracted vapor (pre, mid, and post treatment) field PID VOC concentrations collected at the start, midpoint, and end of each step test.

- Flow, vacuum, and field PID VOC concentrations in vapor samples from each extraction point at the approximate midpoint and end of each step test.
- Vacuum and field PID VOC concentrations in vapor samples collected from each monitoring point at the approximate midpoint and end of each step test.
- Condensate production in the vapor-liquid separator.

The vapor samples for VOC screening will be collected in tedlar bags and screened with a field PID calibrated with a 10 ppm(v) TCE standard gas.

A pretreatment sample of extracted vapor will be collected at startup of the pilot test. The sample will be collected in a Summa canister from a sample port located after the system blower and submitted to ALS Environmental for analysis for TCL VOCs by TO-15.

2.4.2 *Constant Rate Vacuum Test*

At the end of the step tests, the data will be evaluated to determine the optimum applied extraction point vacuum and the vacuum across the pilot test area will be monitored for pressure equalization. A constant rate vacuum test will be performed at extraction point B-2. Vacuum influence will be gauged at monitoring points MP-1 through MP-8. The vacuum for the constant rate test at the extraction point will be determined based on the step test results for that extraction point. The point at which any further increase in vacuum does not result in a proportionate increase in flow as compared to prior steps will be used for the constant rate test. The duration of each constant rate test is anticipated to be approximately 48 hours but may be shortened or extended based on responses observed during the test. During each constant rate test, field personnel will collect the following data:

- Location, date and step test start and stop times.
- System settings including vacuum and flow at the blower influents and pressure and temperature at the blower effluents.
- Extracted vapor (pre, mid, and post treatment) field PID VOC concentrations.
- Flow and vacuum collected from the extraction point.
- Field PID VOC concentrations in vapor samples collected from the extraction point.
- Condensate production in the vapor-liquid separator.

Field measurements will be recorded: prior to starting the blower (vacuum measurement only); after 1 hour, 2 hours, 4 hours, and 8 hours of operation; daily thereafter; and immediately prior to shutdown of the constant rate test. During the constant rate test, field personnel will maintain a log sheet of response vacuum and field PID VOC concentrations in vapor samples collected from the monitoring points. Measurements will be recorded: prior to starting the blower, hourly for the first 4 hours of the constant rate test; after 8 hours of operation; at least twice daily thereafter; and immediately prior to shutdown of the constant rate test.

Extracted pre- and post- treatment vapor samples will be collected for chemical analysis following the achievement of steady-state conditions or, where steady-state conditions cannot be confirmed, immediately prior to shutdown of the constant rate vacuum test. Samples will be collected in Summa canisters from sample ports located after the system blower and at the emission controls effluent. The samples will be submitted to ALS Environmental for analysis for TCL VOCs by TO-15. Quality Assurance requirements related to the pilot test are included in the RAWP Compendium Volume 3.

2.5 Performance Measures/ Conditions to be Tested

The performance of the SVE pilot test will be evaluated via trends and correlations in the following parameters:

- Applied vacuum
- Observed vacuum
- Flow
- Soil vapor VOC concentration
- Condensate production
- GAC efficiency
- Blower operational specifications vs. field requirements

Ultimately, the pilot test will provide information to determine whether the proposed blower is capable of creating pressure gradients across the targeted subsurface zone to promote contaminant mobilization and capture. The design extraction point spacing will be evaluated based on the radius of observable influence from the applied vacuum. The pilot test will also evaluate the efficiency of the vapor-phase GAC effluent treatment system and provide

information to evaluate whether condensate production will need to be further addressed with the remedial design.

The USEPA will be provided with a pilot test report detailing findings of the testing and presenting interpretation of the data to support conclusions regarding the efficacy of the full-scale design. Modifications to the South System and design for the North System will be completed as necessary to expedite remedial progress prior to the installation of the full scale system. The USEPA approval of the pilot test system installation, pilot test report, and any modifications to the full scale design (if any) will be obtained as outlined in Section 2.1, above.

3.0 VEHICLE & EQUIPMENT DECONTAMINATION

All vehicles and equipment will be decontaminated on-Site. Self-contained decontamination stations of sufficient size to decontaminate the largest vehicle leaving the Spill Area will be established, one north of Gulf Road and one south of Gulf Road. The decontamination pads will be lined with polyethylene liner and a protective geotextile fabric and filled with washed gravel. The perimeter will be bermed approximately six inches above existing grade and sloped to a sump for collection and pumping of decontamination water. Decontamination will be performed with a high-pressure washer or steam washer located within the decontamination basin. Decontamination water will be pumped directly into the water treatment system holding tank.

In order to minimize the distribution of impacted soils, the equipment decontamination stations will be located at the points of egress along Gulf Road. All vehicles leaving the Site that have been in direct contact with soil/fill in the work area will be required to proceed through the applicable decontamination station for removal of visible material from tires/undercarriage, etc. Vehicles not in significant contact will soil/fill spoils excavations will be inspected prior to leaving the site and decontaminated if necessary.

Equipment that remains at the site during the week and weekends will be left within the temporary fenced areas within the work zone. Alternatively, for security purposes, equipment may be decontaminated and removed from the Spill Area for temporary storage at a secured area (e.g. the Support Zone).

Area streets will also be cleaned as necessary to mitigate dust or mud from vehicles entering/leaving the Spill Area.

4.0 PERMITTING REQUIREMENTS

4.1 Construction Permit

The full scale construction work will require permitting through the Genesee County Highway Department including a right-of-way work permit and driveway permits for the relocation of the access drives. Permitting for the obstruction of one lane of Gulf Road traffic will also be required for the advancement of soil borings within the road way during the post-remedial subsurface investigation. These permits will be obtained prior to the start of the applicable work by Benchmark.

4.2 Environmental Permits

CERCLA activities are exempt from environmental permitting, but will require equivalent conformance with applicable regulations and laws as well as review and approvals from the regulatory agencies (i.e., USEPA & NYSDEC). These agencies have been provided copies of the Soil Remedial Design Report and will be provided supporting documentation as necessary to allow for approval of the environmental controls described herein (i.e., air emission controls and storm water & sedimentation controls).

4.3 Other Permits and Access Approvals

Additional permits and approvals that may be required for construction, including temporary utility connections, transporting materials and wastes, and general construction permits will be obtained by Benchmark, as necessary. UMC will work with affected property owners to obtain required access approvals per Section 6.0.

5.0 CONSTRUCTION OPERATIONS

5.1 Sequencing

Construction operations will be coordinated by the Supervising Contractor in collaboration with the Project Coordinator. The sequencing of the RA is detailed on the schedule included as Figure 11 of the RAWP. In general, the remedial action progression will include the following tasks:

- pilot test SVE system installation,
- the SVE pilot test operation,
- full scale SVE design review and revisions, if required,
- full scale SVE site preparation and installation,
- full scale SVE start up,
- the operation and maintenance of the full scale SVE system with routine optimization,
- the initial subsurface investigation,
- the final subsurface investigation, and
- the system decommissionings (following USEPA approval of Remedial Action Report).

Each phase of construction will be subject to regulatory inspection and/or report review and approval prior to initiating subsequent phases of construction. Details for implementation of each task are outlined in the Soil Remedial Design Report and throughout the RAWP Compendium.

5.2 Site Preparation

Site preparation including security, utilities, decontamination facilities, construction trailers, and equipment storage are detailed below.

5.2.1 *Security*

The Spill Area is located in a rural area of the Town of LeRoy, New York. Accordingly, the RA security will include measures to deter trespassing and to adequately

store and protect remedial system equipment. The existing Support Zone will be used to house the South System. Permanent construction fencing consistent with the existing Support Zone (i.e., six-foot high chain link with barbed wire top) will be constructed to house the North System process unit trailer as depicted on Sheet C-3 of the design plan set in the RAWP Appendix A.

Temporary safety construction fencing (i.e., five-foot high orange plastic) will be placed around the outer perimeter of the work area to distinguish the work zone and discourage trespassing (see Section 5.2.5). No trespassing signs will be posted at 100-foot intervals around the Spill Area perimeter. In addition, a sign will be posted that shows the program name, agencies, and parties involved in the remedial program. Notice will be provided to the local snow mobile and/or ATV clubs that the property will be made inaccessible.

The SVE system trailers will be equipped with trailer entry (security) relays set to trigger a local and remote alarm. Remote notification of alarm conditions will be provided via a wireless process monitor/auto-dialer.

5.2.2 *Utilities*

Electrical service will be coordinated in conjunction with the full scale system installations as pilot testing will be performed with a mobile generator. Single phase power is presently available at the site via existing overhead service. An existing 200 Amp temporary power service currently located within the Support Zone will be modified for operation of the South System. The location of the North System remedial system trailer is depicted on Sheet C-3 of the design plan set and is adjacent to an existing power line. Benchmark will coordinate electrical service with appropriate personnel and authorizations. The electrical power requirements are detailed on Sheet E-1 of the design plan set included in the RAWP Appendix A. A variable frequency drive may be required to energize larger motors with single phase power.

5.2.3 *Decontamination Facilities*

Decontamination facilities are described in Section 3.0, above.

5.2.4 *Construction Trailers*

The existing field trailer located in the Support Zone on the south side of Gulf Road will remain onsite and will serve as a temporary field office during construction operations.

5.2.5 *Equipment Storage*

Temporary safety construction fencing (i.e., five-foot high orange plastic) will be placed around the outer perimeter of the work area to distinguish the work zone and discourage trespassing. Equipment that remains at the site during the week and weekends will be left within the temporary fenced areas within the work zone. Alternatively, for security purposes, the equipment may be decontaminated and removed from the Spill Area for temporary storage at a secured area (e.g. the Support Zone). As detailed in Section 5.2.1, the North and South Systems will be housed within permanently fenced (i.e. six-foot high chain link with barbed wire top) locations depicted on Sheet C-3 of the design plan set in RAWP Appendix A.

5.3 Construction Coordination

Construction activities will be coordinated primarily by the Project Coordinator, Supervising Contractor, Project QA Officer, and Field Contractor. The construction schedule will be set by the Supervising Contractor with specific tasks delegated to the Project QA Officer and Field Contractor. The Project Coordinator will serve as the primary regulatory point of contact throughout the remedial action implementation.

The USEPA will be given a minimum of 14 days advanced notice of all field work or field activities to be performed.

5.4 Site Maintenance

Site maintenance activities will be performed during both construction and operational activities relative to stormwater pollution prevention controls, construction and monitoring equipment, SVE system components (blowers, piping, vapor barrier, effluent treatment, etc.), fencing, decontamination stations, monitoring wells, and access roads. Stormwater pollution prevention will be monitored in accordance with the Stormwater Pollution Prevention Plan (SWPPP – see Section 5.6.2). All other aspects of the remedial

action will be maintained in general accordance with the specifications outlined in the Remedial Design Report and as detailed in the Quality Assurance Project Plans (QAPP) and Construction Quality Assurance Project Plan (CQAPP). Standard forms for the documentation of Site inspection and maintenance activities are provided within the QAPP/CQAPP.

5.5 Local Authorities

All Site activities will be coordinated with local authorities as required and outlined in Section 4.0, Permitting Requirements. The current remedial plan does not require the closure of Gulf Road, however, work is proposed within the highway right-of-way and the partial closure of Gulf Road will be required for the collection of post-remedial soil samples beneath the road. As detailed in Section 4.0, the Genesee County Highway Department will be contacted to obtain permitting and approval for this work. Traffic control will be coordinated by Benchmark and conveyed for approval if necessary to the Highway Department.

The local authorities and emergency service providers will be notified of the project location, general scope, and timeframe prior to the project start date for informational purposes.

5.6 Site Entry

Site entry and access including provisions for decontamination, erosion control and dust control are detailed below.

5.6.1 *Site Access*

Site access will be controlled during construction, pilot testing, and remedial operation. A temporary access road to the Support Zone will be installed prior to pilot testing on the southern portion of the Site. The road will be gated and posted to discourage unauthorized access. Openings, excavations, and other hazardous areas will be barricaded, fenced, and/or labeled with signs as appropriate during construction activities. Once Site work proceeds to full system construction, safety construction fencing (i.e., five-foot high orange plastic) will be placed around the outer perimeter of the work area to distinguish the

work zone and discourage trespassing. The fencing will be maintained throughout remedial action operation. No trespassing signs will be posted at 100-foot intervals around the Spill Area perimeter.

Provisions for decontamination of vehicles and equipment prior to egress from the Spill Area are detailed in Section 3.0.

5.6.2 *Erosion Control*

The full scale remedial construction activities are expected to result in an area of land disturbance equal to or greater than one acre. Accordingly, a SWPPP will be required as part of the final (revised) design package prior to the start of construction in accordance with the Clean Water Act and 40 CFR Part 122-123. In New York State the SWPPP requirements are administered by the NYSDEC through its State Pollutant Discharge Elimination System (SPDES) program under SPDES General Permit GP-0-10-001. However, because the construction is a remedial action it is exempt from formal environmental permit issuance. An informational notice of intent (NOI) permit application will therefore be submitted to the NYSDEC and USEPA by Benchmark in concert with the SWPPP. A Storm Water Management and Erosion Control Plan (SWMECP) identifying minimal storm water and sedimentation control measures has been prepared and incorporated as Appendix I to the Remedial Design Report. The SWMECP includes provisions for: silt fencing, hay baling, mulching, and other measures, as warranted. The requirements of the SWMECP will be incorporated into Benchmark's SWPPP along with any other NYSDEC-required control measures.

5.6.3 *Dust Control*

Dust suppression techniques will be employed as necessary to mitigate fugitive dust from unvegetated or disturbed soil/fill to the extent practicable during construction. Dust suppression techniques will be initiated if the downwind PM-10 particulate level is 100 $\mu g/m^3$ above background (upwind perimeter). Such techniques shall be employed even if the community air monitoring results indicate particulate levels are below action levels. Techniques to be used may include one or more of the following:

- Applying water on haul roads.

- Wetting equipment and excavation faces.
- Spraying water on buckets during excavation and dumping.
- Hauling materials in properly tarped containers or vehicles.
- Restricting vehicle speeds on-site.
- Covering excavated areas and materials after excavation activity ceases.
- Reducing the excavation size and/or number of excavations.

All reasonable attempts will be made to keep visible and/or fugitive dust to a minimum. Area streets will also be cleaned as necessary to mitigate dust or mud from vehicles entering/leaving the Spill Area.

5.7 Off-Site Facilities

The construction and equipment staging area (Support Zone) as well as an additional fenced area for equipment storage north of Gulf Road are depicted on the design plan set Sheet C-2. No off-site facilities are planned.

5.8 Photograph Plan

Photographic evidence of the remedial action implementation will be collected as detailed in Technical Specification Section 01 32 33 in Appendix D of the Soil Remedial Design Report.

6.0 APPROVALS

The remedial activities will require several approvals in addition to the USEPA. The details pertaining to property access agreements and waste disposal are provided below. Construction and environmental approvals/permitting details are provided in Section 4.0.

6.1 Access Agreements

Site access will be granted via Right of Entry Agreements with individual property owners within the Spill Area. The following property owners have been identified and contacted for this purpose:

Hanson Aggregates New York, Inc.
P.O. Box 513
Jamesville, New York 13078

Northwoods Sportsmen's Association
8402 Gulf Road
LeRoy, New York 14482

Independent Explosives, Inc.
103 Old Windsor Road
Bloomfield, Connecticut 06002

Steven Steimer
107 Brittain Circle
Spencerport, New York 14559

A meeting will be held with all involved parties to discuss the proposed access agreements and RA.

6.2 Waste Disposal

The remedial process will generate spent granular activated carbon (GAC) from the SVE effluent treatment system and treatment of liquids generated during equipment/vehicle decontamination and/or condensate recovered by the SVE system. The disposal (via regeneration) of spent GAC will be coordinated with Carbon Activated Corp. located in Blasdell, New York. Analytical testing of the GAC will be performed as required by Carbon Activated Corp. Testing may include pH and Toxicity Characteristic Leaching Potential (TCLP) method analysis for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals.

Bedrock cleaning may generate non-aqueous phase liquid (NAPL) requiring off-site disposal as hazardous waste. In that event the materials will be transported by a licensed hauler to a RCRA permitted treatment storage and disposal facility (TSDF). Hazardous waste manifests will be completed to track all such shipments. Copies will be submitted to New York State by the generator and receiving facility and included in the Remedial Action Report

Solid wastes generated from routine construction and maintenance activities (e.g., polysheeting) will be transported to a permitted Subtitle D landfill facility for disposal.

7.0 REFERENCES

1. Administrative Order for Remedial Action, Lehigh Valley Railroad (LVRR) Derailment Superfund Site, LeRoy, NY. CERCLA 02-2014-2010. United States Environmental Protection Agency, Region 2, March 2014.

2. New York State Department of Environmental Conservation (NYSDEC) Record of Decision (ROD) & Supplemental Memorandum (EPA), LVRR Derailment Superfund Site, LeRoy, NY. March 1997 & May 2002.

3. Spill Site Soil Investigation Report (RI/FS), LVRR Derailment Superfund Site, LeRoy, NY. Rust Environmental & Infrastructure of New York, October 1996.

4. Pre-Remedial Design Soil Data Summary & Addendum, LVRR Derailment Superfund Site, LeRoy, NY. Unicorn Management Consultants, LLC (UMC), December 2010 & January 2011.

5. Soil Remedial Design Report, LVRR Derailment Superfund Site, LeRoy, NY. Benchmark Environmental Engineering & Science, PLLC on behalf of Unicorn Management Consultants, LLC. September 2013.

VOLUME 2

CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PROJECT PLAN

REMEDIAL ACTION WORK PLAN COMPENDIUM VOLUME 2

CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PROJECT PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LeRoy, New York

Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to
Unicorn Management Consultants, LLC
For
Lehigh Valley Railroad Company
Cincinnati, Ohio

TABLE OF CONTENTS

ATTACHMENTS

Worksheet #1
Title Page and Approval Page

Project Identifying Information
Site Name/Project Name Lehigh Valley Railroad Derailment Superfund Site
Site Location Gulf Road, LeRoy, New York
Site Number/Operable Unit EPA ID No. NYD986950251/Operable Unit No. 1 (Overburden Soil)
Lead Organization Project Coordinator: Francisco Trejo, Unicorn Management Consultants, LLC (UMC)
Supervising Contractor Project Manager/CQAPP Preparer: Thomas H. Forbes, P.E. Benchmark Environmental Engineering & Science, PLLC (Benchmark) Address: 2558 Hamburg Turnpike, Suite 300, Buffalo, New York 14218 Telephone Number: (716) 856-0599 E-mail Address: tforbes@benchmarkees.com Primary Field Team Leader/Health and Safety Officer: Richard L. Dubisz, Benchmark Secondary Field Team Leader: John T. Deth, Benchmark Quality Assurance Officer: Bryan C. Hann, Benchmark
Federal Regulatory Agency Remedial Project Manager: Michael Infurna, USEPA
State Regulatory Agency Remedial Project Manager: Christopher Magee, NYSDEC
Previous Documents/Investigations ▪ EPA Settlement Agreement and Order on Consent Index No. CERCLA-02-2006-2006 ▪ NYSDEC ROD, March 28, 1997 ▪ Memorandum, May 15, 2006, Comments/Issues Regarding the March 1997 ROD ▪ Spill Site Investigation Report, Rust Environmental & Infrastructure, October 1996 ▪ Lehigh Valley SVE Pilot Test, International Technology Corporation ▪ UMC RD Work Plan, October 2009 ▪ UMC Letter Response to EPA Comments on RD Work Plan, December 7, 2009 ▪ EPA Letter Approval of UMC RD Work Plan, December 9, 2009 ▪ UMC Soil Boring Logs, June 2010 ▪ Wetland Delineation Report, URS Corporation, October 2010 ▪ Final 35% Soil RD Report, March 2011 ▪ Phase I Cultural Resource Survey, Pratt & Pratt Archaeological Consultants, June 10, 2011 ▪ UMC Pre-RD Soil Data Summary Report and Addendum, December 2010 ▪ Soil Remedial Design Report, Benchmark/UMC, September 2013 ▪ Administrative Order for Remedial Action, Index CERCLA-02-2014-2010, USEPA, March 2014

Approvals

[Thomas Forbes, P.E., Benchmark, CQAPP Preparer]	Date
[Francisco Trejo, UMC, Remedial Project Coordinator]	Date
[Michael Infurna, USEPA Region 2, Remedial Project Manager]	Date
[Raymond Klimcsak, USEPA Region 2, QA Coordinator]	Date
[Christopher Magee, NYSDEC, Remedial Project Manager]	Date
[Bryan C. Hann, Benchmark, Quality Assurance Officer]	Date
[Richard L. Dubisz, Benchmark, Health & Safety Officer]	Date
[John T. Deth, Benchmark, Field Team Lead]	Date
[Michael Perry, ALS Environmental, Laboratory Director]	Date
[Lisa Reyes, ALS Environmental., Quality Assurance Director]	Date
[Elizabeth Dickinson, Trillium, Inc., Third Party Data Validator]	Date

Worksheet #2
CQAPP Identifying Information

This Construction Quality Assurance/Quality Control Project Plan (CQAPP) has been prepared on behalf of Unicorn Management Consultants, LLC (UMC) by Benchmark Environmental Engineering & Science, PLLC for submittal to the United States Environmental Protection Agency, Region 2 (USEPA). Pursuant to the March 2014 Administrative Order (AO), Lehigh Valley Railroad Company (LVRR), as the voluntary Respondent for the Lehigh Valley Railroad Derailment Superfund Site, is responsible for Operable Unit 1 (OU-1) remedial action implementation. UMC is the principal consultant to the Respondent and has been designated authority to implement the subject AO Statement of Work (SOW). Benchmark Environmental Engineering & Science, PLLC in association with TurnKey Environmental Restoration, LLC (hereafter referred to collectively as "Benchmark") is the Supervising Contractor for the implementation of Operable Unit # 1 Remedial Action (RA) specific to overburden soil.

This CQAPP was completed in accordance with the Uniform Federal Policy for Implementing Quality Systems ("UFP-QS"), EPA-505-F-03-001, March 2005; Uniform Federal Policy for Quality Assurance Project Plans ("UFP-QAPP"), Parts 1, 2, and 3, EPA-505-B-04-900A, B, and C, March 2005, and various other documents referenced in the aforementioned guidance documents. In addition, this document incorporates the following requirements specified in the AO SOW:

> "The CQAPP shall include a methodology for its implementation which shall include:
>
> i. Procedures to assure that field personnel used by Respondent are properly trained in the use of field equipment and in chain-of-custody procedures.
> ii. Procedures for performing quality control inspections, including timing of the inspection and a description of the purpose of the inspections;
> iii. Control testing procedures for each specific test. This includes information which authenticates that personnel and laboratories

performing the tests are qualified and the equipment and procedures to be used comply with applicable standards;

iv. Procedures for scheduling and managing submittals, including those of subcontractors, off-Site fabricators, suppliers, and purchasing agents; and

v. Reporting procedures including frequency of reports and report formats."

This document serves as Volume 2 of the Remedial Action Work Plan (RAWP) Compendium and addresses only the construction quality assurance/quality control elements of the (RA). A Quality Assurance/Quality Control Project Plan addressing all other elements of the RA has been included as Volume 3 of the RAWP. Where project specific information is required by the UFP-QS guidance documents, identical sections have been provided in the QAPP and CQAPP for ease of reference.

This CQAPP is submitted to the USEPA Project Manager for review and approval. Procedures described in this CQAPP will be followed unless modifications and/or additions are documented in separate addenda or modification documents.

Users of the information derived under the guidance of the CQAPP will include Benchmark, LVRR, the NYSDEC, and USEPA.

Previous soil investigation work was completed under a QAPP drafted by Unicorn Management Consultants, LLC dated March 26, 2008 and an addendum dated August 28, 2009. A preliminary CQAPP was also submitted as Appendix J of the September 2013 Soil Remedial Design Report. This document supersedes all previous submittals for construction-related quality assurance associated with the RA.

The following table provides cross-references to identify where each required QAPP element is located throughout this document.

Required QAPP Element(s) and Corresponding CQAPP Section(s)	CQAPP Worksheet #	Required Information
Project Management and Objectives		
2.1 Title and Approval Page	1	Title and Approval Page
2.2 Document Format and Table of Contents		
2.2.1 Document Control Format	TOC 2	-Table of Contents -QAPP Identifying Information
2.2.2 Document Control Numbering System		
2.2.3 Table of Contents		
2.2.4 QAPP Identifying Information		
2.3 Distribution List and Project Personnel Sign-Off Sheet		
2.3.1 Distribution List	3	-Distribution List
2.3.2 Project Personnel Sign-Off Sheet	4	-Project Personnel Sign-Off Sheet
2.4 Project Organization		
2.4.1 Project Organizational Chart	5	-Project Organizational Chart
2.4.2 Communication Pathways		-Communication Pathways
2.4.3 Personnel Responsibilities and Qualifications	6 7	-Personnel Responsibilities and Qualifications Table
2.4.4 Special Training Requirements and Certifications	8	-Special Personnel Training Requirements Table
2.5 Project Planning/Problem Definition		
2.5.1 Project Planning (Scoping)	9	-Project Planning Session Documentation
2.5.2 Problem Definition, Site History, and Background		-Project Scoping Session Participants Sheet
	10	-Problem Definition, Site History and Background
2.6 Project Quality Objectives and Measurement Performance Criteria		
2.6.1 Development of Project Quality Objectives	11 12	-Site specific PQOs -Measurement Performance Criteria Table
2.6.2 Measurement Performance Criteria		
2.7 Secondary Data Evaluation	13	-Sources of Secondary Data and Information -Secondary Data Criteria and Limitations Table
2.8 Project Overview and Schedule		
2.8.1 Project Overview	14	-Summary of Project Tasks

Required QAPP Element(s) and Corresponding CQAPP Section(s)	CQAPP Worksheet #	Required Information
2.8.2 Project Schedule	15 16	-Reference Limits and Evaluation Table -Project Schedule/Timeline Table
Measurement/Data Acquisition		
3.1 Sampling Tasks		
3.1.1 Sampling Process Design and Rationale	17 18 19 20 21 22	-Sampling Design and Rationale -Sample Location Map -Sample Locations and Methods/SOP Requirements Table -Field Quality Control Sample Summary Table -Sampling SOPs -Project Sampling SOP References Table -Field Equipment Calibration, Maintenance, Testing, and Inspection Table
3.1.2 Sampling Procedures and Requirements		
3.1.2.1 Sampling Collection Procedures		
3.1.2.2 Sample Containers, Volume, and Preservation		
3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures		
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures		
3.1.2.5 Supply Inspection and Acceptance Procedures		
3.1.2.6 Field Documentation Procedures		
3.2 Analytical Tasks		
3.2.1 Analytical SOPs	23 24 25	-Analytical SOPs -Analytical SOP References Table -Analytical Instrument Calibration Table -Analytical Instrument and Equipment Maintenance, Testing, and Inspection
3.2.2 Analytical Instrument Calibration Procedures		
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures		
3.2.4 Analytical Supply Inspection and Acceptance Procedures		
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures		
3.3.1 Sample Collection Documentation	26 27	-Sample Collection Documentation Handling, Tracking, and Custody SOPs -Sample Container Identification -Sample Handling Flow Diagram -Example Chain-of-Custody Form and Seal
3.3.2 Sample Handling and Tracking System		
3.3.3 Sample Custody		

Required QAPP Element(s) and Corresponding CQAPP Section(s)	CQAPP Worksheet #	Required Information
3.4 Quality Control Samples		
3.4.1 Sampling Quality Control Samples	26 27	-QC Samples Table -Screening/Confirmatory Analysis Decision Tree
3.4.2 Analytical Quality Control Samples		
3.5 Data Management Tasks		
3.5.1 Project Documentation and Records	29 30	-Project Documents and Records Table -Analytical Services Table -Data Management SOPs
3.5.2 Data Package Deliverables		
3.5.3 Data Reporting Formats		
3.5.4 Data Handling and Management		
3.5.5 Data Tracking and Control		
Assessment/Oversight		
4.1 Assessments and Response Actions		
4.1.1 Planned Assessments	31 32	-Assessments and Response Actions -Planned Project Assessments Table -Audit Checklists -Assessment Findings and Corrective Action Responses Table
4.1.2 Assessment Findings and Corrective Action Responses		
4.2 Quality Assurance Management Reports	33	-QA Management Reports
4.3 Final Project Report		
Data Review		
5.1 Overview		
5.2 Data Review Steps		
5.2.1 Step I: Verification	34 35 36 37	-Verification (Step I) Process Table -Validation (Steps IIa and IIb) -Usability Assessment
5.2.2 Step II: Validation		
5.2.2.1 Step IIa: Validation Activities		
5.2.2.2 Step IIb: Validation Activities		
5.3 Streamlining Data Review		
5.3.1 Data Review Steps to be Streamlined		
5.3.2 Criteria for Streamlining Data Review		
5.3.3 Amounts and Types of Data Appropriate for Streamlining		

Worksheet #3
CQAPP Distribution List

Those directly involved in construction quality assurance/quality control and receiving copies of the CQAPP:

CQAPP Distribution List			
Name	**Project Responsibility**	**Affiliation**	**Document Control Number**
Michael Infurna (212) 637-4177	Remedial Project Manager	USEPA 290 Broadway, 20th Floor New York, NY 10007-1866	
Raymond Klimcsak (212) 637-3916	CERCLA Quality Assurance Coordinator	USEPA 290 Broadway, 19th Floor New York, NY 10007-1866	
Christopher Magee (518) 402-9813	Remedial Project Manager	NYSDEC 625 Broadway Albany, New York 12233-7017	
Francisco Trejo (203) 205-9000	Project Coordinator	Unicorn Management 52 Federal Road, Suite 2C Danbury, CT 06810	
Thomas H. Forbes, P.E. (716) 856-0599	Supervising Contractor Project Manager	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	
Bryan C. Hann (716) 856-0599	Supervising Contractor Quality Assurance Officer	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	
John T. Deth (716) 856-0599	Supervising Contractor Secondary Field Team Leader	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	
Richard L. Dubisz (716) 856-0599	Supervising Contractor Health & Safety Officer/ PrimaryField Team Leader	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	

CQAPP Distribution List			
Name	**Project Responsibility**	**Affiliation**	**Document Control Number**
Michael Perry (585) 288-5380	Laboratory Director	ALS Environmental 1565 Jefferson Road Building 300, Suite 360 Rochester, NY 14623	
Lisa Reyes (585) 288-5380	Laboratory QA Director	ALS Environmental 1565 Jefferson Road Building 300, Suite 360 Rochester, NY 14623	
Elizabeth Dickinson (610) 458-0289	Third Party Data Validator	Trillium, Inc. 27 LaFayette Circle Downington, PA 19335	

Worksheet #4, 7 & 8
Personnel Qualifications & Sign-Off Sheet

Signatures below document that all key project personnel performing work have read the applicable sections of the CQAPP and will perform the tasks as described. Personnel responsibilities and qualifications including special training requirements and education/ experience should be noted.

Personnel Qualifications and Sign-off Sheet				
Name	**Project Title/ Role**	**Education/ Experience**	**Specialized Training/ Certification**	**Signature/Date**
Thomas Forbes	Project Manager	B.S Chemical Engineering, 25+ Years of Environmental Work Experience	NYS Licensed Professional Engineer/ HAZWOPER 40 Hour	
Bryan Hann	QA Officer	B.A. Geology, 20+ Years of Environmental Work Experience	HAZWOPER 40 Hour	
John Deth	Secondary Field Team Leader	A.A.S. Civil Engineering Technology, 30+ Years of Environmental Work Experience	HAZWOPER 40 Hour	
Richard Dubisz	Health & Safety Officer, Primary Field Team Leader	B.S. Environmental Science, 25+ Years of Environmental Work Experience	HAZWOPER 40 Hour	

Personnel Qualifications and Sign-off Sheet				
Name	**Project Title/ Role**	**Education/ Experience**	**Specialized Training/ Certification**	**Signature/Date**

The various field and management duties and responsibilities of key project personnel, as well as training requirements (where applicable), are defined below for construction related tasks.

Management Responsibilities

Michael Infurna, USEPA Region 2, Remedial Project Manager

The USEPA Region 2 is the lead regulatory agency responsible for all regulatory oversight and management of the project.

Christopher Magee, New York State Department of Environmental Conservation (NYSDEC), Remedial Project Manager

The NYSDEC works directly with the USEPA in regulatory oversight and management of the project.

Respondents for the Lehigh Valley Railroad Derailment Superfund Site

The respondents are assumed responsible for implementing the remedial actions. The respondents will report directly to the USEPA Region 2 Remedial Project Manager and provide the main point of contact and control for matters concerning the project.

Francisco Trejo, UMC, Project Coordinator

The Project Coordinator has the responsibility for ensuring that the project meets the USEPA's objectives. The Project Coordinator will report directly to the respondents and the EPA Project Manager and is responsible for technical and project oversight. The Project Coordinator will:

- Define/approve project objectives and develop a detailed work plan schedule.
- Establish/approve project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.

- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Review and analyze overall task performance with respect to planned requirements and authorizations.
- Review and approve all deliverables before their submission to USEPA Region 2.
- Represent the project team at meetings and public hearings.

Thomas H. Forbes, P.E., Benchmark, Supervising Contractor Project Manager

The Supervising Contractor has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of contractor personnel, and subcontractors. The Supervising Contractor reports directly to the Project Coordinator. The Supervising Contractor will:

- Orient all field leaders and support staff concerning the project's special considerations.
- Provide review of contract document submittals.
- Monitor and document field progress, including community air monitoring results.
- Interface with local authorities and members of the public, as required.

Quality Assurance (QA) Responsibilities

Bryan C. Hann, Benchmark, Project QA Officer

The QA Officer will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff as necessary, to resolve any QA dispute. He is responsible for auditing the implementation of the QA program in conformance with the demands of UMC and Benchmark policies, and USEPA requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues. Specific function and duties include:

- Performing QA audits on various phases of the field operations.
- Reviewing and approving QA plans and procedures.
- Providing QA technical assistance to project staff.

- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Supervising Contractor for technical operations.
- Responsible for the data validation of all sample results from the analytical laboratory.

Raymond Klimcsak, USEPA CERCLA Quality Assurance Coordinator (CQAC)

The USEPA CQAC has the responsibility to review and approve all QAPPs.

Field Responsibilities

Thomas H. Forbes, P.E., Benchmark, Supervising Contractor Project Manager

The supervising contractor will manage all field activities associated with the RA. Specific responsibilities during implementation of these tasks include:

- Coordination and oversight of field team leader(s).
- Overseeing training and qualifications.
- Manage contractors and subcontractors.
- Communicate corrective actions, budgetary, quality assurance/quality control, and health and safety issues with associated project team as required.

Richard L. Dubisz, Benchmark, Primary Field Team Leader

John T. Deth, Benchmark, Secondary Field Team Leader

The field team leader will work with the project manager to implement all field tasks associated with the project. Specific responsibilities include:

- Coordination and oversight of field staff and activities.
- Review of project specifications, provide implementation directives to field staff and certify quality assurance/quality control for field activities.
- Support QA and Health and Safety Officers in the maintenance of project compliance with approved documents.
- Communicate status and progress updates to Project Manager daily.

Richard L. Dubisz, Benchmark, Health and Safety Officer

The health and safety officer is certified in health and safety and will oversee all health and safety aspects of field activities associated with the RA. Specific responsibilities include:

- Overseeing health and safety training and maintaining qualification records for all field staff.
- Overseeing all field activities for compliance with specific project health and safety requirements.
- Initiate work stoppage(s) due to health and safety concerns, if required.

(TBD), Field Staff

Field staff may include both Benchmark site personnel and drilling subcontractor personnel. The Supervising Contractor will use the staff to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work. Qualifications for all staff will be established prior to work implementation by Benchmark and provided upon request.

Laboratory Responsibilities

The laboratory assigned with responsibility for chemical analyses of environmental samples is ALS Environmental located at 1565 Jefferson Road, Building 300, Suite 360 in Rochester, New York. ALS Environmental is a New York State ELAP and NELAC certified laboratory.

Karen Bunker, ALS Environmental Project Manager

As a final review prior to the release of the report, the laboratory Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/narratives are present, flags are appropriate, and project specific requirements are met. The laboratory Project Manager signs the final report

and will report directly to the RA Leader. The client services manager provides a complete interface with clients from initial project specification to final deliverables.

Michael Perry, ALS Environmental Laboratory Director

The Laboratory Director is a technical advisor and is responsible for summarizing and reporting overall unit performance. Responsibilities of the ALS Environmental Laboratory Director include:

- Provide technical, operational, and administrative leadership.
- Allocation and management of personnel and equipment resources.
- Quality performance of the facility.

Lisa Reyes, ALS Environmental Quality Assurance (QA) Program Manager

The laboratory QA Manager has the overall responsibility for data after it leaves the laboratory. The laboratory QA Manager will be independent of the laboratory but will communicate data issues through the ALS Environmental Laboratory Director. In addition, the laboratory QA Director will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Define appropriate laboratory QA procedures.
- Prepare laboratory SOPs.
- Perform internal auditing of procedures and electronic auditing of data
- Certification and accreditation activities

Gregg LaForce, ALS Environmental Sample Management Office

The laboratory Sample Management Office will report to the Laboratory Director. The data review process at the laboratory starts at the Sample Control level. Sample control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The sample control supervisor reviews the transaction of the chain-of-

custody forms and the inputted information. Responsibilities of the Sample Control Supervisor will include:

- Receiving and inspecting the incoming sample containers.
- Recording the condition of the incoming sample containers.
- Signing appropriate documents.
- Verifying chain-of-custody.
- Notifying Project Manager of sample receipt and inspection.
- Entering the samples into the LIMS and labeling the samples with the LIMS assigned unique identification number and customer number.
- Distributing samples to the appropriate storage locations.

ALS Environmental Technical Staff

The next level of data review occurs with the Analysts. As results are generated, Analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the Laboratory Information Management System (LIMS). To ensure data compliance, a different analyst or supervisor performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Qualifiers are added as needed. All sample data requiring manual calculations, all GC/MS spectra and all manual integrations are reviewed. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results

- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

Unacceptable analytical results may require reanalysis of the samples and may require the involvement of the Technical Manager, Project Manager, or QA Manager. Corrective action is initiated whenever necessary. Any unresolved problems are documented and the Project Manager narrates the issues in the final report.

Elizabeth Dickinson, Trillium, Inc. Third Party Data Validator Responsibilities

Elizabeth Dickinson will be retained as a third party data validator by the Supervising Contractor to perform an independent data usability evaluation of all samples documented with NYSDEC ASP Category B/EPA Level IV deliverables. The data usability evaluation will involve review of pertinent internal and external QC data as reported by the laboratory. QC parameters that will be evaluated in reference to compliance with the analytical methods, protocols, and deliverables requirements will include those items necessary to satisfy the requirements for preparation of a Data Usability Summary Report (DUSR). The data validator has the responsibility for evaluating the data usability by examining the following:

- Completeness of the data package as defined under the requirements of NYSDEC ASP Category B/EPA Level IV.
- Compliance with required holding times.
- Sample chain-of-custody forms
- QC analysis data, including blanks, instrument tunings, calibrations, spikes, surrogate recoveries, duplicates, laboratory controls and sample data.
- Agreement between laboratory raw data and data summary sheets, with verification that correct data qualifiers were used where appropriate.

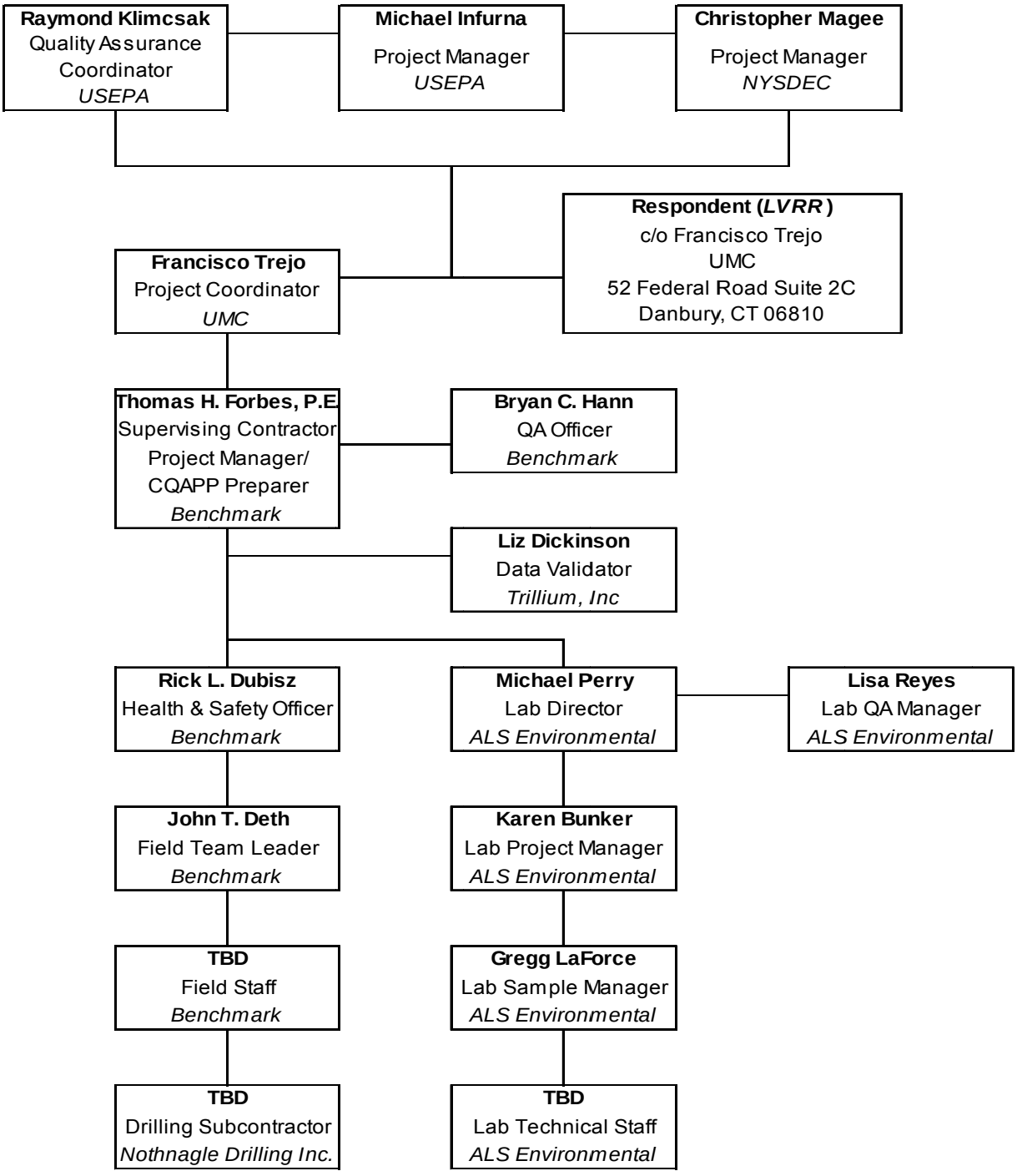
The DUSR will present the review findings with a discussion of any data deficiencies, analytical protocol deviations, and QC problems encountered. Data deficiencies, analytical method protocol deviations, and quality control problems will be described and their effect on the data presented. Recommendations for resampling/ reanalysis will be made where deemed necessary. Data qualifications will be documented for each parameter as required. Additional data validation details are presented in Worksheet #37.

Special Personnel Training Requirements

No non-routine field sampling, analysis or data validations activities are specified requiring special training or requirements for construction RA.

All field staff will require appropriate Hazardous Waste Operations and Emergency Response training and documentation as required by the Occupational Safety and Health Administration standards. The training and certifications of all staff will be documented in the front end of this Worksheet and maintained by the Supervising Contractor Health and Safety Officer.

Worksheet #5
Project Organization



Worksheet #6
Communication Pathways

Communication Driver	Organization	Title	Contact Information	Procedure
Regulatory agency	USEPA	Remedial Project Manager	Michael Infurna (212) 637-4177	• Approval of remedial actions and associated documents including this CQAPP • Approval must be sought for deviation from pre-approved remedial actions & documented in writing.
Regulatory agency Interface, CQAPP modifications	UMC	Project Coordinator	Francisco Trejo (203) 205-9000	• UMC project manager serves as primary regulatory point of contact • All modifications of the CQAPP must be discussed and approved by the Project Coordinator • Modifications to the CQAPP must be completed in writing, approved by all parties and re-submitted to the distribution list • The Project Coordinator will discuss all changes with applicable parties prior to execution of modifications • All regulatory communication will be conducted by the Project Coordinator
Field progress reports	Benchmark	Supervising Contractor Project Manager	Thomas H. Forbes, P.E. (716) 856-0599	• Verbal and/or written field progress reports must be generated by the Supervising Contractor on a daily basis. • Approval must be sought for deviations from pre-approved scope of work

Communication Driver	Organization	Title	Contact Information	Procedure
Stop work due to safety issues	Benchmark	Supervising Contractor Health & Safety Officer	Richard L. Dubisz (716) 856-0599	• Immediate verbal communication of safety issues and pre-approval of non-eminent field corrective actions is required.
QA corrective actions	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• The QA Officer has the authority to stop field work and/or implement corrective actions as necessary to address QA issues.
Field corrective actions	Benchmark	Supervising Contractor Field Team Leader	Richard Dubisz John T. Deth (716) 856-0599	• All field corrective actions must be pre-approved by the Supervising Contractor Project Manager and will be implemented by the Field Team Leader.
Sample receipt variances	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• Immediate verbal communication of sample receipt variances is required. • The QA Officer will communicate with the Supervising Contractor Project Manager and advise corrective actions. • All sample receipt variances will be documented in writing in the sample chain of custody.
Laboratory quality control variances/ analytical corrective actions	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• Immediate verbal communication of laboratory quality control variances is required. • All communication regarding analytical corrective actions will be documented in the laboratory report.

Communication Driver	Organization	Title	Contact Information	Procedure
Data verification issues/data review corrective actions	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• Immediate verbal communication of data verification issues is required. • All communication regarding data review corrective actions will be documented in the data verification report. • All quality assurance issues identified by the third party validator will be addressed by the QA officer.

Worksheet #9
Project Scoping Session Participants Sheet

Date of Session One: June 11, 2013

Scoping Session Purpose: Review the purpose and expected results of the project; the environmental decisions that need to be made; the project quality objectives necessary to achieve expected results and support environmental decisions; the sampling, analytical, and data review activities that will be performed; and the final products and deliverables for the project.

Name	Organization	Title/Role	Email/Phone
Michael O'Connor	Unicorn	Manager of Environmental Projects	moconnor@unicornmgt.com (203) 205-9000
Francisco Trejo	Unicorn	Project Coordinator	ftrejo@unicornmgt.com (203) 205-9000
Thomas H. Forbes, P.E.	Benchmark	Principal Engineer	tforbes@benchmarkees.com (716) 856-0599
Nathan T. Munley	Benchmark	Sr. Project Scientist	nmunley@benchmarkees.com (716) 856-0599
Holly A. Akers	Benchmark	Project Engineer	hakers@benchmarkees.com (716) 856-0599

The results of the project scoping session one was expanded in session two (see below) are presented throughout this CQAPP

Date of Session Two: April 10, 2014

Scoping Session Purpose: Review scope of Remedial Action Work Plan and project implementation including the project schedule, deliverable delegation, any changes in project details, and newly assigned personnel.

Name	Organization	Title/Role	Email/Phone
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The results of the project scoping sessions are presented throughout this CQAPP.

Worksheet #10
Conceptual Site Model

A conceptual site model is provided as Section 1.3 (page 3) in the Soil Remedial Design Report dated September 2013.

The problem to be addressed by the project: Elevated concentrations of chlorinated volatile organic compounds have been detected throughout the Spill Area overburden soil.

Worksheet #11
Construction Quality Objectives

This CQAPP addresses the construction related quality objectives. Project-specific quality objectives are reviewed in the QAPP provided as Volume 3 of the RAWP.

Systematic Planning Process:

1. State the problem: Elevated concentrations of chlorinated volatile organic compounds have been detected throughout the Spill Area overburden soil.
2. Identify the goals of the construction: the ultimate goal of the soil remedial construction is to achieve the Remedial Action Objectives (RAOs) in overburden soil across the Spill Area. Construction specific goals include the completion of construction related activities within the specified schedule and budget, in compliance with health and safety goals, and resulting in high quality product(s) as specified in the design documents.
3. Identify information inputs: see Worksheet #17 Sampling Design and Rationale.
4. Define the boundaries of the study: see Worksheet #14 Project Tasks.
5. Develop the analytic approach: see Worksheet #17 Sampling Design and Rationale.
6. Specify performance or acceptance criteria: see Worksheet #12 Measurement Performance Criteria and Worksheet #14 Project Tasks.
7. Develop the detailed plan for obtaining data: see analytical data needs below and Worksheet #17: Sampling Design and Rationale.

Worksheet #12
Construction Measurement Performance Criteria

The measurement performance criteria will vary depending on the phase of construction work in terms of precision, bias, and sensitivity for construction measurements, as appropriate. The project-specific (non-construction) measurement performance criteria are presented in the QAPP provided as Volume 3 of the RAWP. The construction work is generally defined as the site preparation/grading, trenching, and installation of the SVE system components as shown and specified in the Soil Remedial Design Report.

Time Performance

The construction time performance evaluation will be based on a comparison of the proposed schedule for specific tasks and the actual time to complete those tasks.

Cost Performance

The construction cost performance evaluation will be completed for both supplies and services provided and will be based on a comparison of the proposed cost for specific tasks and the actual cost to complete those tasks.

Quality Performance

The quality performance evaluation will be completed for both supplies and services provided and will be based on a comparison of the design specifications and the documented product of construction services rendered.

Health and Safety Performance

Health and Safety performance will be evaluated based on both the compliance with project health and safety plans and with actual Site and community impacts documented during construction activities.

Construction-Related Analytical Measurement Performance Criteria

Community air monitoring will be completed during all intrusive subsurface Site construction work including real time monitoring and documentation air sampling. The

analytical methods to be employed during air sampling are based on sensitivities that allow for the comparison of the results to the Project Action Levels. The QA samples, analytical laboratory sensitivity, and project criteria for construction-related analytical subject to Category B/Level IV deliverables (confirmation air samples collected during intrusive activities) are listed below.

Matrix: Air			
Analytical Group: TO-15 TCL VOCs			
Concentration Level: Low			
Data Quality Indicator	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**	**QC Sample Assesses Error for Sampling, Analytical or Both**
Precision – Overall	Field Duplicates	RPD ≤ 20%	Both
Precision - Lab	Laboratory Duplicates	RPD ≤ 25%	Analytical
Accuracy/Bias	Internal Standards	60% - 140%	Analytical
Accuracy/Bias	Surrogate Spikes	Limits 70% - 130%	Analytical
Accuracy/Bias Combination	Method Blank	No target compounds ≥ QL	Both

Details relating to the samples to be collected for soil import and the water treatment system are included as applicable throughout this CQAPP, however, only samples subject to Category B/Level IV deliverables are outlined above. Non-construction related project analytical is detailed in the QAPP included as Volume 3 of the RAWP.

Worksheet #13
Secondary Data Evaluation

The current Site conceptual model has been developed based on secondary data. A secondary data evaluation has been performed as follows:

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Historical site information and soil descriptors. Based on the availability of more recent site characterization data, the analytical data provided in the report was not relied upon.	Spill Site Soil Investigation Report, October 1996	NYSDEC/ Rust Environmental and Infrastructure	Provided for historical context	Based on the limited scope and context of data use, no limitations were identified.
Although evaluated for information pertaining to the design and application of ex situ SVE, no reliable data was established.	Lehigh Valley SVE Pilot Test, April 1999	NYSDEC/ International Technology Corporation	Provided for historical context	Data from this source was not relied upon.
Evaluate whether a wetland mitigation plan will be required for remedial activities.	Wetland Delineation Report, October 2010	URS Corporation	No indicators of wetland hydrology or areas dominated by hydrophytic vegetation were observed within the Spill Area.	No known limitations.
Soil characterization & contamination delineation	Soil Data Summary Report Pre-Remedial Design Activities, December 2010	UMC	The extents and characteristics of soil contamination will be relied on in the design and scope of the remedial actions	Data collected and validated under EPA-approved methods. No known limitations.

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Compliance with the National Historic Preservation Act, 16 U.S.C. § 470.	Phase I Cultural Resource Survey, June 2011	Pratt & Pratt Archaeological Consultants	No evidence of significant cultural resources was identified within the Spill Area.	No known limitations.
Remedial Design	Soil Remedial Design Report, September 2013	Benchmark/UMC	Design specifications will be used for implementation	No known limitations

Worksheet #14
Construction Project Tasks

Initially, an SVE pilot test will be installed and operated. Data collected during the pilot testing will be used to verify the full-scale SVE system designs. Based on the revised designs, the North and South Systems will be installed and operated for a period of approximately two years.

The specific activities planned for each phase of construction are as follows:

Pilot System Installation

The scope of work for the pilot test consists of the following tasks, further detailed in the RD Report:

- Implementation of the Erosion Control Plan within the pilot test area
- Clearing, grubbing, and grading within the pilot test footprint
- Trenching and piping installation
- Cleaning of bedrock surface where encountered in trenches via drum vacuuming
- Installation of pilot test vapor monitoring points
- Vapor barrier installation

Anticipated start date: August 2014
Deliverables (see Worksheet #29): Daily Construction Quality Reports, Monthly Progress Reports, Data Usability Summary Report, Pilot Test Summary Report, Revised Soil Remedial Design Report (if necessary)

Full Scale SVE System Installations

The full-scale system installations will include site work as detailed in the Soil RD Report incorporating modifications as necessary from the pilot testing results. The full scale construction activities will include:

- Implementation of the Erosion Control Plan and Stormwater Pollution Prevention Plan within the remainder of the Spill Area

- Extension of the bedrock monitoring well access points within the Spill Area
- Clearing, grubbing, and preliminary grading within the remainder of the Spill Area
- Installation of an access roads and fenced equipment storage area on the northern portion of the Site
- Trenching and piping installation
- Cleaning of bedrock surface where encountered in trenches via drum vacuuming
- Final grading with trenching spoils and imported top soil
- Vapor barrier placement
- Temporary electrical service installation
- Installation of temporary site fencing (i.e., five-foot plastic high visibility fencing)

Anticipated start date: March 2015

Deliverables (see Worksheet #29): Daily Construction Quality Reports, Construction Complete Report, Monthly Progress Reports, Data Usability Summary Report, Remedial Action Report

Worksheet #15

Project Action Limits and Laboratory Specific Detection/Quantitation Limits

The following table outlines the construction-specific analytical methods and requirements for community air monitoring documentation sampling subject to Category B/Level IV laboratory deliverables.

Matrix: Air				
Analytical Group: TO-15 TCL VOCs				
Concentration Level: Low				
Analyte	**Lab Method Detection Limit ($\mu g/m^3$)**	**Lab Method Reporting Limit ($\mu g/m^3$)**	**Lab Replicate Precision Difference (%)**	**Accuracy Limit (%)**
1,1,1-trichloroethane	0.017	0.600	25	70-130
1,1,2,2-tetrachloroethane	0.010	0.150	25	70-130
1,1,2-trichloroethane	0.019	0.600	25	70-130
1,1,-dichloroethene	0.007	0.440	25	70-130
1,1-dichloroethane	0.010	0.450	25	70-130
1,2,4-trichlorobenzene	0.010	1.080	25	70-130
1,2-dibromoethane	0.010	0.170	25	70-130
1,2-dichlorobenzene	0.013	1.30	25	70-130
1,2-dichloroethane	0.017	0.450	25	70-130
1,2-dichloropropane	0.011	0.510	25	70-130
1,3-dichlorobenzene	0.018	1.30	25	70-130
1,4-dichlorobenzene	0.009	1.30	25	70-130
1,4-dioxane	0.173	5.0	25	70-130
2-butanone	0.021	0.650	25	70-130
2-hexanone	0.010	0.450	25	70-130
4-methyl-2-pentanone	0.009	0.900	25	70-130
acetone	0.059	5.0	25	70-130
benzene	0.006	0.350	25	70-130
bromodichloromethane	0.021	0.150	25	70-130
bromoform	0.032	1.1	25	70-130
bromomethane	0.015	0.430	25	70-130
carbon disulfide	0.066	0.340	25	70-130
carbon tetrachloride	0.013	0.070	25	70-130

Matrix: Air				
Analytical Group: TO-15 TCL VOCs				
Concentration Level: Low				
Analyte	**Lab Method Detection Limit ($\mu g/m^3$)**	**Lab Method Reporting Limit ($\mu g/m^3$)**	**Lab Replicate Precision Difference (%)**	**Accuracy Limit (%)**
chlorobenzene	0.011	0.510	25	70-130
chlorodibromomethane	0.026	0.190	25	70-130
chloroethane	0.580	0.580	25	70-130
chloroform	0.009	0.540	25	70-130
chloromethane	0.016	0.450	25	70-130
cis-1,3-dichloropropene	0.014	1.00	25	70-130
cyclohexane	0.011	0.760	25	70-130
dichlorodifluoromethane	0.016	1.09	25	70-130
ethyl benzene	0.010	0.950	25	70-130
freon 113	0.018	0.170	25	70-130
methyl tert butyl ether	0.012	0.790	25	70-130
methylene chloride	0.020	0.380	25	70-130
o xylene	0.011	0.950	25	70-130
p/m xylene	0.012	1.90	25	70-130
styrene	0.008	0.940	25	70-130
tetrachloroethene	0.026	0.080	25	70-130
toluene	0.009	0.410	25	70-130
cis-1,2-dichloroethene	0.016	0.440	25	70-130
trans-1,2-dichloroethene	0.005	0.440	25	70-130
trans-1,3-dichloropropene	0.011	0.500	25	70-130
trichloroethene	0.022	0.060	25	70-130
trichlorofluoromethane	0.016	0.620	25	70-130
vinyl chloride	0.012	0.060	25	70-130

Project Action Limits for the downwind ambient perimeter air sample have been established at 14,000 $\mu g/m^3$ for TCE and 188,000 $\mu g/m^3$ for cis-1,2-DCE.

*Isopropylbenzene, methyl acetate, methyl cyclohexane, 1,2,3-trichlorobenzene, 1,2-dibromo-3-chloropropane, and tert-butylbenzene are outside of the calibration for TO-15 and have been excluded from laboratory provided data.

**Bromochloromethane is used as an Internal Standard and has also been excluded from the laboratory provided data.

Worksheet #16
Project Schedule

Individual schedules for the RAWP, Pilot Test, SVE System Construction, and Post-Remedial Project are included as Figures 11a through 11d, respectively.

Worksheet #17

Sampling Design and Rationale

The sampling design and rationale associated with construction related tasks are detailed in the following table:

Task	Data Need		Data Uses		Number or Frequency of Samples	Compliance Reference Concentration	Points of Compliance/ Sample Locations
	Target Analyte	Matrix/ Laboratory Deliverable Category (A or B)	Remedy Methods of Interest	Criteria			
Air Monitoring during Intrusive Activities	Method TO-15 TCL VOCs	Air *Category B*	Community Air Monitoring During Intrusive Activities	Air quality	One 8- to 10-hour composite sample will be collected each day that intrusive site construction work is performed	TCE: 14,000 µg/m^3 1,2-DCE: 188,000 µg/m^3	Downwind perimeter of the exclusion zone
Imported soil characterization	VOCs	Soil *Category A*	Remedial Construction	Imported soil quality	Assuming 1,150 cubic yards of import soil, 9 discrete samples (Table 5.4(e)10 DER-10)	DER-10 Appendix 5	One discrete sample will be collected from within the import soil for each of the 7 samples

Task	Data Need		Data Uses		Number or Frequency of Samples	Compliance Reference Concentration	Points of Compliance/Sample Locations
	Target Analyte	Matrix/ Laboratory Deliverable Category (A or B)	Remedy Methods of Interest	Criteria to be Considered			
Imported soil characterization	SVOCs, Inorganics & PCBs/ Pesticides	Soil *Category A*	Remedial Construction	Imported soil quality	Assuming 1,150 cubic yards of import soil, 3 composite samples (Table 5.4(e)10 DER-10)	DER-10 Appendix 5	Discrete samples from 3 to 5 random locations within the import soil will be mixed for each of the two composite samples.
Water Treatment System	Method 8260 TCL VOCs	Water *Category A*	Remedial Construction	Discharge water quality	One effluent sample prior to discharge	NYSDEC TOGS 1.1.1	Water treatment system effluent

The analytical SOPs and sampling procedures are presented in Worksheet #23 and #21, respectively.

Worksheet #18
Sampling Locations and Methods

Sampling locations and methods associated with construction activities are described below. Additional details are provided in the Field Operating Procedures (FOPs) included in Attachment A.

Ambient Air Sampling – Construction

In accordance with the Site Health and Safety Contingency Plan (HSCP) and Community Air Monitoring Plan (CAMP), ambient perimeter air sampling will be conducted during site work at the downwind perimeter of the exclusion zone. The samples will be collected using laboratory provided vacuum-sealed Summa canisters equipped with time-compositing flow controllers for representative time-average VOC concentrations. One 8- to 10-hour composite sample will be collected for each day of intrusive site construction work. The sample collection methods are described in FOP #090.0. The following information will be recorded for each sample:

- Sample identification/location
- Date and time of sample collection
- Identity of sampler
- Canister vacuum before and after sample collection
- Canister identification
- Chain-of-custody form number

Sampling canisters will be packaged in laboratory-supplied boxes and delivered to ALS Environmental under COC protocol. Samples will be analyzed by ALS Environmental for Target Compound List (TCL) VOCs by EPA Method TO-15.

Water Treatment System – Construction

A mobile water treatment system will be on-site during intrusive construction activities for water generated during decontamination activities and groundwater or storm water collected during site work. A treatment system effluent sample will be collected to verify the discharge water quality. The sample will be collected by directly filling volatile organic analysis (VOA) vials to be placed in a cooler on ice and delivered to ALS Environmental under COC protocol. A laboratory-supplied trip blank will accompany the VOA vials from and to the laboratory. The trip blank and samples will be analyzed by ALS Environmental for TCL VOCs via EPA Method 8260.

Imported Soil Characterization – Construction

Approximately 1,150 cubic yards of imported soil may be required for site grading activities during construction. Imported soil will be characterized as recommended in NYSDEC DER-10, *Technical Guidance for Site Investigation and Remediation*, Table 5.4(e)10 including grab and composite samples. The required samples will be collected in laboratory supplied containers, placed in a cooler on ice and delivered to ALS Environmental under COC protocol. A laboratory-supplied trip blank will accompany the VOA vials from and to the laboratory. The trip blank will be analyzed by ALS Environmental for TCL VOCs via EPA Method 8260. The samples will be analyzed for TCL VOCs, SVOCs, inorganics, PCBs and pesticides.

Worksheet #19 and 30

Analytical Containers, Preservation, and Hold Times

Sample Matrix	Parameter (Analytical Method) *Laboratory Deliverable Category*	Number of Samples (Including Field QC Samples)	Sampling SOP	Sample Containers (number per sample, size and type)	Sample Preservation (temperature, light, chemical)	Maximum Holding Time
Air (8- to 10-hour composites)	TCL VOCs (Compendium TO-15) *Category B*	10	090.0	6L Summa canister	None	30 days
Soil[2,3] (Import)	TCL VOCs (SW846 Methods 5035/8260C) *Category A*	Assuming up to 1,150 cubic yards of import soil, 9 discrete samples (Table 5.4(e)10 DER-10)	057.0	3-5g EnCore®	Cool to 0-6ºC	48 hours from collection to preservation, 14 days
Soil[2] (Import)	TCL SVOCs (SW846 Method 8270) *Category A*	Assuming up to 1,150 cubic yards of import soil, 3 composite samples (Table 5.4(e)10 DER-10)	013.0	8 oz clear, wide-mouth bottle with Teflon-lined cap	Cool to 0-6ºC	14 days to extract, 40 days to analyze

Sample Matrix	Parameter (Analytical Method) *Laboratory Deliverable Category*	Number of Samples (Including Field QC Samples)	Sampling SOP	Sample Containers (number per sample, size and type)	Sample Preservation (temperature, light, chemical)	Maximum Holding Time
Soil[2] (Import)	TAL Metals & Cyanide (SW846 Methods 6010/7000) *Category A*	Assuming 800-1,000 cubic yards of import soil, two composite samples (See Table 5.4(e)10 DER-10)	013.0	8oz clear, wide-mouth bottle with Teflon-lined cap	Cool to 0-6ºC	180 days, Hg 28 days, CN 14 days
Soil[2] (Import)	TCL PCBs/Pesticides (SW846 Methods 8082/8081) *Category A*	Assuming 800-1,000 cubic yards of import soil, two composite samples (See Table 5.4(e)10 DER-10)	013.0	8oz clear, wide-mouth bottle with Teflon-lined cap	Cool to 0-6ºC	14 days to extract, 40 days to analyze
Water (Water Treatment System)	TCL VOCs (SW846 Method 8260C) *Category A*	1	086.0	3-40 mL Glass Vials	HCl (1:1) to pH < 2, Cool to 0-6ºC	14 days

[1]Please see Appendix B of the RAWP for Analytical Method SOPs.
[2]A minimum of one field duplicate per 20 samples will be collected per analytical group per matrix per sampling procedure per sampling event.
[3]One trip blank sample will be provided per cooler containing VOA samples.

Worksheet #20
Field Quality Control Summary

Field Sample Quality Control

QC Sample	Frequency	Acceptance Criteria	Corrective Action(s)
Trip Blank	One per cooler containing soil and/or water samples	No detections at concentrations greater than ½ the reporting limit	Review storage and handling procedures. Alter procedures as necessary. Qualify associated sample results per Region 2 guidance.
Field Duplicate	One duplicate per 20 samples collected.	RPD≤50% for analytes present in both samples at concentrations greater than 2 times the reporting limit.	Review analysis procedures and similarity of samples.

RPD = relative percent difference

$$RPD = 100\frac{|X_1 - X_2|}{\overline{X}}$$

Where X_1 and X_2 are values for sample 1 and 2, respectively and $\overline{X}$ is a sample mean.

Construction Quality Control

A quality control program will be in place during the completion of construction activities at the Spill Area including site work and the installation of the SVE systems. The quality control program for construction work products and services, including subcontractors and suppliers, will be conducted through implementation of approved operating procedures; appropriate use and control of equipment; and the control and management of materials and technical services. The inspection procedures for construction work are detailed below.

Workmanship

Workmanship will be performed in accordance with the prepared plans and specifications. The quality of work activities will be assessed through inspection of submittals, surveillance

of activities, and review of plans/procedures for compliance with project requirements. All construction work will be assessed initially and periodically using the three-phase inspection procedure outlined below.

Preparatory Phase Inspection

The Supervising Contractor will perform a preparatory phase inspection prior to each definable feature of work. These inspections are performed to review the applicable specifications and to verify that the necessary resources, conditions, and controls are in place and compliant before the start of work activities. The following tasks will be completed in the preparatory phase inspection by the Supervising Contractor:

- Review work plans and operating procedures to ensure that they describe pre-qualifying requirements or conditions, equipment and materials, appropriate sequence, methodology and quality control provisions.
- Verify that the required plans, specifications, and procedures have been prepared, approved, and are available to the field staff.
- Verify availability, functionality, appropriateness, and calibration of all field equipment
- Verify that staff responsibilities have been assigned and communicated.
- Verify that staff have the necessary knowledge, expertise, and information to perform work tasks.
- Verify that prerequisite site work has been completed and that lessons learned during previous similar work have been incorporated as appropriate into the project procedures to prevent recurrence of past problems.

The results of the preparatory phase inspection should be documented on the preparatory phase inspection checklist and summarized in the daily quality control report. Attachment B includes examples of these forms.

Initial Phase Inspection

An initial phase inspection is required the first time a new work task is performed following the successful completion of the preparatory phase inspection. During the initial phase inspection, the Supervising Contractor will perform the following tasks:

- Check preliminary work for compliance with procedures and specifications.
- Establish the acceptable level of workmanship.
- Check for omissions.
- Resolve differences of interpretation.

The initial phase inspection results should be documented on the initial phase inspection checklist (see Attachment B) and summarized in the daily quality control report.

Follow-Up Phase Inspection

The follow-up phase inspection will be completed during the completion of work tasks to provide continuous compliance and level of workmanship. The follow-up phase inspection will include the following tasks:

- Complete on-site monitoring of the practices and operations taking place.
- Verify continued compliance with the specifications and requirements of the contract and approved project plans and procedures.
- Verify that a daily health and safety inspection is performed and documented (see Attachment B).
- Resolve discrepancies between site practices and approved plans/procedures.
- Perform corrective actions for unsatisfactory and nonconforming conditions or practices.

The follow-up phase inspection results are to be summarized in the daily quality control report.

Management & Oversight of Quality Assurance

The quality of the construction services and products will be verified initially and periodically thereafter using the three-phase inspection. The quality, activities, and deliverables will be verified through inspection of submittals, monitoring of activities, and review of their plans/procedures for compliance with project requirements. The Supervising Contractor is responsible for both on-site and off-site subcontractor quality control and monitoring of work activities. Discrepancies associated with subcontractor work are to be communicated

to the subcontractor for resolution. The Supervising Contractor and staff have the authority to act directly with subcontractor representatives on routine quality control activities. If a discrepancy is dependent upon subsequent operation, a resolution is to be made by the Supervising Contractor prior to performance of the subsequent operation.

Equipment

Equipment used for construction activities will be controlled as follows:

- Benchmark's equipment will be inventoried and controlled.
- Measurement and test equipment will be calibrated as required and regularly maintained to assure optimum performance. Measurement and test equipment that do not meet specified performance criteria will be tagged or segregated to exclude their use.

Analytical & Material Requirements

Details pertaining to ambient air and water treatment sampling associated with construction work are included in Worksheets #17 and #18. Quality control requirements for construction materials are included in Worksheet #22.

Worksheet #21
Construction Field Standard Operating Procedures

Project Field Operating Procedures (FOPs):	
No.	**Sampling FOP Name**
011.1	Calibration and Maintenance of Portable Photoionization Detector
013.0	Composite Sample Collection Procedure for Non-Volatile Organic Analysis
018.0	Drilling & Excavation Equipment Decontamination
026.1	Hollow Stem Auger (HSA) Drilling Procedures
046.0	Sample Labeling, Storage, and Shipment Procedures
057.0	Soil Sample Collection for VOC Analysis – EnCore Sampling
073.2	Real-Time Air Monitoring During Intrusive Activities
076.0	"Before Going Into the Field" Procedure
084.0	Calibration and Maintenance of Portable Particulate Meter
085.0	Field Quality Control Procedures
086.0	Treatment System Sampling Procedures
090.0	Outdoor Ambient Air VOC Sample Collection Procedure

Worksheet #22

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment Calibration and Corrective Action

Instrument	Calibration Activity	Frequency	Acceptance Criteria	Corrective Action	SOP or FOP Reference
MiniRAE 2000 PID or similar with 10.6 eV lamp	Calibration with a 10 ppmv trichloroethylene standard	Prior to arrival on site, at the start of each day, when temperature fluctuate more than 10 degrees	Response should be within 0.5 ppm of calibration gas standard	Replace any filters, clean lamp, return to manufacturer or supplier for repairs	011.0
Portable Particulate Meter	Unit is factory calibrated.	As necessary	Accuracy shall be within ± 2% of reading precision over the temperature range of -4 to 158 degrees Fahrenheit and 10 to 95% humidity.	Return to manufacturer or supplier for servicing.	084.0

Inspection/Acceptance Requirements Construction Materials

The quality of construction materials will be verified throughout project work as follows:

Receiving and Storage

The Supervising Contractor is to inspect construction materials upon receipt and prior to use. Visual inspection criteria include identification, signs of damage or distortion, completeness, evidence of compliance with specifications, and associated documentation. Materials observed in poor condition or outside of the project specifications will not be accepted.

Material Documentation

Documentation of all construction materials are to be provided to the Supervising Contractor for record-keeping purposes.

Imported Soil

Characterization requirements for soil import to the Spill Area are detailed in Worksheets #17 and #18. The soil quality compliance documentation will be provided to the Supervising Contractor for verification. Bills of lading documenting the source of the material and quantity by weight must be provided and accepted by the Supervising Contractor.

Inspection/Acceptance Requirements for Supplies and Consumables

Supplies	Inspection Frequency	Type of Inspection	Responsible Party	Corrective Action
Calibration gas for PID	During mobilization preparation	Verify positive pressure in canister	Sampler	Replace or fill canister
Chains of custody for samples	During mobilization preparation	Verify that appropriate type and number of forms will accompany samples	Sampler	Obtain additional copies as necessary before sampling
Soil and water sampling glassware	Upon receipt	Verify containers are not damaged and contain preservative	Sampler	Request new containers
Summa Canisters	Upon receipt	Verify canisters are not damaged and appropriate cleaning certifications are	Sampler	Do not use rejected canisters. Obtain additional canisters from

Worksheet #23

Analytical Standard Operating Procedures

Analytical Method Reference: **Includes document title, method name/number, revision number and date**	
No.	**Analytical Method Name**
1a	USEPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS) Method TO-15, Second Edition, January 1999
2a	USEPA Solid & Hazardous Waste Method SW-846, Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, Method 5035, Update IVB, January 3, 2008
3a	USEPA Solid & Hazardous Waste Methods SW-846, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8260B, Update IVB, January 3, 2008
4a	USEPA Solid & Hazardous Waste Methods SW-846, Semi-volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8270D, Update IVB, January 3, 2008
5a	USEPA Solid & Hazardous Waste Methods SW-846, Organochlorine Pesticides by Gas Chromatography, Method 8081B, Update IVB, January 3, 2008
6a	USEPA Solid & Hazardous Waste Methods SW-846, Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Method 8082A, January 3, 2008.
7a	USEPA Solid & Hazardous Waste Methods SW-846, Inductively Coupled Plasma-Atomic Emission Spectrometry, Method 6010C, Update IVB, January 3, 2008
8a	USEPA Solid & Hazardous Waste Methods SW-846, Flame Atomic Absorption Spectrophotometry, Method 7000B, Update IVB, January 3, 2008

Project Analytical Standard Operating Procedures (SOPs):
Standard Operating Procedure ID VOC-8260, Volatile Organic Compounds by GC/MS, Reference Method 8260C, Rev. 12, Effective 8/20/2012
Standard Operating Procedure ID VOC-TO-15, Volatile Organic Compounds in Air Samples Collected in Specially Prepared Canisters and Gas Collection Bags by Gas Chromatography/Mass Specrometry (GC/MS), Reference Method TO-15, Rev. 3, Effective 10/2/2012

Copies of the laboratory analytical SOPs are included in Appendix C of the RAWP.

Worksheet #24
Analytical Instrument Calibration Table

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
GC/MS (TO-15)	Tuning criteria	Every day of analysis, including initial calibration	Bromofluorobenzene (BFB) spectrum must meet criteria in Table 1 of the TO-15 SOP.	Re-evaluate BFB spectrum before analyzing samples, reanalyze BFB. Retune Instrument if new spectrum fails.	VOC-TO-15
GC/MS (TO-15)	Initial calibration	Before sample analysis	Relative standard deviation (RSD) of the response factors ≤30%. If a target analyte cannot meet the % RSD criteria for relative response factor calibration, then linear regression may be used with at least 5 calibration points and a correlation coefficient of 0.99 or greater.	Recalibrate and repeat initial calibration. If linear regression fails, prepare a new set of calibration standards and repeat.	VOC-TO-15
GC/MS (TO-15)	ICV sample	After every sample	Average response factor must be within 30% of initial calibration.	Repeat ICV. If second ICV is not within criteria, investigate possible causes of failure or recalibrate instrument.	VOC-TO-15
GC/MS (TO-15)	Continuing calibration verification (CCV/LCS)	Before sample analysis	Percent difference of the continuing calibration response factor from the initial calibration response factor must be ≤30%.	If the CCV/LCS analysis fails a second time, recalibrate instrument.	VOC-TO-15

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

The analytical instrument and equipment maintenance, testing and inspection information is presented in Sections 13.0 and 14.0 of the ALS Environmental Quality Assurance Manual included as Appendix B of the RAWP.

Worksheet #26
Sample Handling System

Sampling Organization: Benchmark
Laboratory: ALS Environmental
Method of Sample Delivery: TBD
Number of Days From Reporting to Sample Disposal: At least 60 days

Activity	**Organization and title or position of person responsible for the activity**	**SOP Reference**
Sample Labeling	Sampler - TBD	046.0
Chain-of-Custody Completion	Sampler – TBD	046.0
Packaging	Sampler – TBD	046.0
Shipping Coordination	Sampler – TBD	046.0
Sample receipt, inspection, and log-in	ALS Environmental – TBD	SMO-GEN
Sample custody and storage	ALS Environmental – TBD	SMO-ICOC
Sample disposal	ALS Environmental – TBD	SMO-SPLDIS

Worksheet #27
Sample Custody Requirements

The procedures that will be used to maintain sample custody and integrity for the project include the use of COC forms, sample identification, custody seals, laboratory sample receipt forms, and laboratory sample transfer forms. The following describes the sample custody procedure that will be implemented during the remedial work:

Sample Identification Procedures: All samples collected for the project will be identified using the format specified in FOP #046.0; Sample Labeling, Storage, and Shipment Procedures..

Sample ID example: **GW051402047**

- **GW** Sample matrix: GW = groundwater; SW = surface water; SUB subsurface soil; SS = surface soil; SED = sediment; L = leachate; A = air
- **05** Month of sample collection
- **14** Day of sample collection
- **02** Year of sample collection
- **047** Consecutive sample number

Field Sample Custody/Tracking Procedures: The field sample custody/tracking procedures are detailed in FOP #046.0; Sample Labeling, Storage, and Shipment Procedures.

Laboratory Sample Custody/Tracking Procedures: Following receipt of the samples, the laboratory will accept, log, and maintain COC in accordance with the custody procedures described in the laboratory manual (see Appendix B of the RAWP).

Chain-of-Custody Procedures: A sample COC form and applicable procedures are detailed in FOP #046.0; Sample Labeling, Storage, and Shipment Procedures.

Field Screening Samples

All field screening-level analyses will be completed on-Site by field personnel.

Worksheet #28
Analytical Quality Control and Corrective Action

QC Item	Frequency	Methodology	Acceptance Criteria	Corrective Action
Laboratory method blank (TO-15)	1 per batch of up to 20 samples.	A canister is pressurized with nitrogen or zero air, humidified, and analyzed.	Free of target analyte contamination at or above the reporting limit.	Evaluate system to eliminate sources of contamination and reanalyze blank. If sample carryover has occurred, reanalyze samples with positive results for the contaminant <5X blank concentration.
Internal Standard (IS) (TO-15)	Each Sample	Measured amounts of certain compounds added after preparation of a sample.	Internal standard area counts for the CCV must be within 60-140% of the midpoint of the initial calibration, and for samples and QC samples, must be within 60-140% of the CCV area counts. Retention times of the internal standards must be within ±20 seconds of the most recent calibration (CCV or midpoint ICAL).	Correct any instrument malfuntions, dilute sample if matrix related, reanalyze as needed. Flag if problem cannot be resolved.

QC Item	Frequency	Methodology	Acceptance Criteria	Corrective Action
Laboratory duplicate (TO-15)	Each day of analysis	Two aliquots of the sample same are prepared and analyzed in the same manner.	RPD<25% for analytes detected in original and duplicate.	Repeat analysis.
Canister leak check (TO-15)	Before analysis	Measure the vacuum of the canister over a period of 24 hours.	Vacuum must not increase more than 2 “Hg.	Determine and repair source of leak.
Canister cleaning certification (TO-15)	One per batch of 20 or fewer canisters or each if individual certification required.	Analyze canister using the appropriate analytical method SOP.	Target analytes must not be present above Reporting Limits.	Re-clean and re-certify entire batch of canisters.

Worksheet #29
Project Documents and Records

Construction related documentation including the daily construction quality reports, preparatory phase inspection checklists, initial inspection checklists, deviation forms, daily health and safety forms, bills of lading, and purchase orders will be maintained by Benchmark and included in reports listed below.

A field book will be used to compile information collected during the field work portion of the project, including sampling conditions, observations, and deviations from SOPs or this CQAPP. When available, sampling forms will be used to document sampling activities.

At the analytical laboratory, samples are to be recorded in a permanently bound sample log-in notebook and a laboratory notebook, specific for each instrument. The laboratory will provide a full data package including: sample data; COC forms; QA/QC narratives; internal standard area summaries; calibration summaries; surrogate recovery summaries; all applicable CLP or equivalent forms and raw data; and data pertaining to blanks, matrix spikes, laboratory control, and duplicate samples. Full data packages will be provided for all samples analyzed. If demonstration of system cleanliness by analysis of an instrument blank is required, these records must be included in the data package. Records of the most recent quarterly verifications of the method limit of detection and limit of quantitation studies must be submitted with or prior to the data package.

Data will be provided by the laboratory in a digital format and appended to project reports as appropriate. The data usability summary report will be provided by the data validator and also appended to reports as appropriate. The construction-related deliverables associated with the project are detailed in the Soil RD Report and include the following:

- Daily Construction Quality Reports
- Construction Complete Report
- Monthly Progress Reports
- Remedial Action Report

- Data Usability Summary Report

Data will be stored in electronic format on UMC's office secure local area network located at 52 Federal Road, Suite 2C, Danbury, Connecticut.

Worksheet #31, 32, and 33
Assessments and Corrective Action

Field Tasks

During field activities, the field team is responsible for completing tasks in accordance with specified methods and SOPs. The Supervising Contractor will be responsible for understanding the field program objectives and checking the completion of tasks. If a task is performed in a way that deviates from specified methods or SOPs, the field team will complete a Deviation Form describing the method or SOP deviation, the rationale for the deviation, and any corrective actions that may be required. An example deviation form is provided in Attachment B. Deviations will be reported as soon as possible to the QA Officer for review. If the deviation results in serious consequences for data integrity, the Project Coordinator may require corrective actions, such as collecting and analyzing additional samples.

If any unexpected circumstances are encountered in the field, the Project Coordinator will be contacted before the field activity proceeds. Field tasks will be documented by field staff and overseen in the field by the Supervising Contractor. The Supervising Contractor will be responsible for carrying out corrective actions as directed by the Project Coordinator. The Project Coordinator may consult with the Respondent, USEPA, NYSDEC, or other stakeholders before providing direction regarding corrective actions or changes to the scope of work.

Construction Tasks

The primary goals of the QC program detailed in Worksheet #22 are to prevent nonconformance and facilitate continual process improvement. To the extent that the first of these goals is not achieved, identified deficiencies or nonconformances are to be corrected in a timely and cost-effective manner, with the intent of preventing their recurrence. This CQAPP includes provisions for preventing quality problems and facilitating process improvements as well as for identifying, documenting, and tracking deficiencies until corrective action has been verified.

Preventive Measures

Certain elements of the QC program are designed to be proactive. The primary tools for problem prevention include personnel qualifications, training, and preparatory and initial inspections. Should these preventive measures fail, tracking and communicating deficiencies provide a mechanism for preventing their recurrence.

Continual Improvement

Project personnel at all levels are encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed in a more efficient or cost-effective manner. However, deviations from established protocols are not to be implemented without prior approval.

Nonconformance Tracking and Status

Each identified nonconformance will be documented in the daily quality control report (see Attachment B). The Supervising Contractor is responsible for maintaining the documentation and confirming that appropriate corrective actions were implemented and verified.

Laboratory Tasks

The analytical laboratory is responsible for ensuring that all laboratory tasks are completed in accordance with specified methods and SOPs. The laboratory must maintain its NELAC certification throughout the course of the project.

Modifications to CQAPP

Major modifications to this CQAPP must have prior approval by the USEPA Project Manager.

Worksheet #34
Data Verification and Validation Inputs

Description	Verification (Completeness)	Validation (Conformance to Specifications)
Planning Documents/Records		
RAWP	X	
Soil Remedial Design Report	X	
Field SOPs	X	
Laboratory SOPs	X	
Field Records		
Field Logbooks	X	X
Equipment Calibration Records	X	X
Chain of Custody Forms	X	X
Sampling diagrams/surveys	X	X
Drilling logs	X	X
Relevant correspondence	X	
Change orders/deviations	X	X
Field audit reports	X	X
Field corrective action reports	X	X
Analytical Data Package		
Cover sheet	X	X
Case narrative	X	X
Internal laboratory chain of custody	X	X
Sample receipt records	X	X
Sample chronology	X	X
Communication records	X	X
Copies of lab notes	X	X
Corrective action reports	X	X
Definition of laboratory qualifiers	X	X
Documentation of QC results	X	X
Documentation of method deviations	X	X
Instrument calibration reports	X	X
QC sample raw data	X	X
QC summary report	X	X
Raw data	X	X
Electronic data deliverable	X	X

Worksheet #35
Data Verification Procedures

Field notes, sampling forms, and deviation forms will be reviewed for errors and omissions by the sampler, Supervising Contractor, and QA Officer. Field notes will be compared to COC documents and laboratory reports to verify that all samples intended for laboratory analysis were sent to the laboratory and analyzed.

Field analytical data will be used solely for screening; therefore, no comparison with laboratory analytical results will be performed. Field analytical data will be evaluated by the Field Leader and the QA Officer based on the observed performance of the screening equipment and any required deviations from the applicable SOP.

The laboratory data verification process will include both the review by the QA Officer as discussed above and during the usability assessment discussed in Worksheet #37.

Worksheet #36
Data Validation Procedures

The QA Officer will evaluate the field records for consistency and review pertinent QC information on these records. Deviation reports will be reviewed for consistency with field records to determine if appropriate corrective actions have been completed and if these deviations impact project goals. A field data validation report will be included as an appendix to appropriate reports. All original field forms will be electronically filed by UMC.

Analytical data generated by the laboratory will be reviewed for data completeness by Trillium, Inc., a subcontracted data validator. In accordance with the SOW, the data subject to Category B/Level IV deliverables will be validated according to the procedures stated in the USEPA Region 2 Volatile Organic Analysis of Ambient Air in Canister by Method TO-15 (SOP #HW-31). Where required, other EPA-approved equivalent procedures may be used. Data validation will verify compliance with sample hold time requirements, proper COC documentation, acceptable detection limits, internal standard recoveries, and laboratory control sample recoveries.

Data validation is a process by which laboratory-reported data are subjected to a comprehensive, technically oriented evaluation by personnel experienced in the analysis and review of sample data from environmental matrices. Non-compliance with the method specifications may be noted where relevant.

During the validation process, laboratory data are verified against all available supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data validator. Raw data is examined in detail to check calculations, compound identification, and/or transcription errors. Validated results are either qualified or unqualified; if results are unqualified, this means that the reported values may be used without reservation. Final validated results are annotated with the qualification codes.

The data validator will evaluate the data precision, accuracy, and completeness as described below.

- Accuracy: The amount of agreement between the true value of a parameter and the measured value. Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. To assess the accuracy of the laboratory measurements, the trueness of instrumental calibrations will be evaluated by assessment of linearity and differences of daily calibrations to the linearity measurement; the percent recovery will be calculated for all spiked analytes, including internal standards, surrogates, and target analytes; and the accuracy of the analytical system near the detection limits will be taken into account. The control limits for percent recovery of spike compounds and surrogates are listed in the laboratory SOP corresponding to the specific analytical method used for analysis.
- Precision: The measurement of the agreement between samples from the same population. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Precision can be expressed as the relative standard deviation (RSD) between independent samples or as the relative percent difference (RPD) between duplicate samples.
- Completeness: The measure of the amount of validated data obtained compared to that which was expected to be obtained. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of a data set. For completeness requirements, valid results are all results not qualified with an "R" flag. An "R" flag placed on the data by the data validator indicates that the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria. Results with an "R" flag that are replaced by other analyses, as in the case of diluted analyses, are not included in the assessment of completeness. A target completeness goal of at least 90% is anticipated.

The results of each component of the data review will be summarized in the final report. A table summarizing the QC results will be included, as well as any revisions or qualifiers deemed necessary.

Where appropriate and/or where advised by the analytical laboratory, data may be accepted as is, accepted but qualified, or rejected ("R") if it is determined not to be of sufficient quality for this project. Data validation, acceptance, and qualification decisions will be made by the QA Officer.

Worksheet #37
Usability Assessment

The results of the data validation will be used to prepare a data usability assessment, which will be included in the final project reports. The data usability assessment will summarize the findings of the data validation.

Deviations or specific data qualifications identified by Trillium, Inc. will be discussed in terms of their effect on the pilot test decision-making process. Data usability will be determined based on the data verification and data validation processes described in Worksheets #34-36. If deviations are identified that may cause data to be unusable, additional samples may be collected and screened/analyzed to provide useable data. If no significant deviations are identified, the data will be used to complete the applicable reports as specified on Worksheet #29.

All associated QA/QC efforts will be summarized in the appropriate reports detailed in Worksheet #29 including assessments of field and analytical data quality and usability.

ATTACHMENT A

CONSTRUCTION FIELD OPERATING PROCEDURES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FOP Number	Description
011.1	Calibration and Maintenance of Portable Photoionization Detector
013.0	Composite Sample Collection Procedure for Non-Volatile Organic Analysis
018.0	Drilling and Excavation Equipment Decontamination Procedures
026.1	Hollow Stem Auger (HSA) Drilling Procedures
046.0	Sample Labeling, Storage and Shipment Procedures
057.0	Soil Sample Collection for VOC Analysis - EnCore Sampling
073.2	Real-Time Air Monitoring During Intrusive Activities
076.0	"Before Going Into the Field" Procedure
084.0	Calibration and Maintenance of Portable Particulate Meter
085.0	Field Quality Control Procedures
086.0	Treatment System Sample Procedure
090.0	Outdoor Ambient Air VOC Sample Collection Procedure

Notes:

1. FOPs are identified by the sequential FOP number and revision number. For example, FOP number 097.3 indicates FOP

BENCHMARK
ENVIRONMENTAL
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SCIENCE, PLLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Photoionization Detector (PID)

FOP 011.1

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

PURPOSE

This procedure describes a general method for the calibration and maintenance of a portable photoionization detector (PID). The PID detects and initially quantifies a reading of the volatile organic compound (VOC) concentration in air. The PID is used as a field-screening tool for initial evaluation of soil samples and for ambient air monitoring of compounds with ionization potentials (IP) less than the PID lamp electron voltage (eV) rating. The IP is the amount of energy required to move an electron to an infinite distance from the nucleus thus creating a positive ion plus an electron. It should be noted that all of the major components of air (i.e., carbon dioxide, methane, nitrogen, oxygen etc.) have IP's above 12 eV. As a result, they will not be ionized by the 9.8, 10.6, or 11.7 eV lamps typically utilized in field PIDs. The response of the PID will then be the sum of the organic and inorganic compounds in air that are ionized by the appropriate lamp (i.e., 9.8, 10.6 or 11.7 eV). Attached to this FOP is a table summarizing common organic compounds and their respective IPs.

Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Compound-specific calibration methods should be selected on a project-by-project basis to increase the accuracy of the instrument. The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the MiniRAE 2000 Portable VOC Monitor equipped with a 10.6 eV lamp. The actual equipment to be used in the field will be equivalent or similar. The following information is provided for general reference; the equipment-specific manufacturer's manual should be followed with precedence over this FOP.

Note: The PID indicates total VOC concentration readings that are normalized to a calibration standard, so actual quantification of individual compounds is not provided. In addition, the PID response to compounds is highly variable, dependent on ionization potential of the compound, and the presence or absence of other compounds.

ACCURACY

The MiniRAE 2000 is accurate to ± 2 ppm or 10% of the reading for concentrations ranging from 0-2,000 ppm and ± 20% of the reading at concentrations greater than 2,000 ppm. Response time is less than two seconds to 90 percent of full-scale. The operating temperature range is 0 to 45° C and the operating humidity range is 0 to 95 % relative humidity (non-condensing).

CALIBRATION PROCEDURE

The calibration method and correction factor, if applicable, will be selected on a project-by-project basis and confirmed with the Project Manager prior to the start of field work.

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the PID according to the manufacture's specifications.

2. Calibrate the PID using a compressed gas cylinder or equivalent containing the calibration standard, a flow regulator, and a tubing assembly. In addition, a compressed gas cylinder containing zero air ("clean" air) may be required if ambient air conditions do not permit calibration to "clean air".

3. Fill two Tedlar® bags equipped with a one-way valve with zero-air (if applicable) and the calibration standard gas.

4. Assemble the calibration equipment and actuate the PID in its calibration mode.

5. Select the appropriate calibration method. Calibration may be completed with two methods: 1) where the calibration standard gas is the same as the measurement gas (no correction factor is applied) or 2) where the calibration standard gas is not the same as the measurement gas and a correction factor will be applied. An isobutylene standard gas must be used as the calibration standard gas for the use of correction factors with the MiniRAE 2000. See below for additional instructions for calibration specific to use with or without correction factors.

Calibrating Without a Correction Factor

Navigate within the menu to select the "cal memory" for the specific calibration standard gas prior to calibration. The default gas selections for the MiniRAE 2000 are as follows:

Cal Memory #0	Isobutylene
Cal Memory #1	Hexane
Cal Memory #2	Xylene
Cal Memory #3	Benzene
Cal Memory #4	Styrene
Cal Memory #5	Toluene
Cal Memory #6	Vinyl Chloride
Cal Memory #7	Custom

The calibration standard gas for Cal Memory #1-7 may be toggled for selection of any of the approximately 100 preprogrammed calibration standard gases for use without an applied correction factor (i.e., the calibration gas must be the same as the measurement gas).

Calibrating With a Correction Factor

Navigate within the menu to select the "Cal Memory".

Select "Cal Memory #0" and toggle for selection of any of the approximately 100 preprogrammed chemicals. During calibration, the unit requests isobutylene gas and displays the isobutylene concentration immediately following calibration, but when the unit is returned to the normal reading mode, it displays the selected chemical and applies the correction factor.

If the pre-programmed list does not include the desired chemical or a user-defined measurement gas and correction factor is desired, toggle Cal Memory #0 to "user defined custom gas". A list of approximately 300 correction factors is attached in Technical Note 106 generated by MiniRAE.

6. Once the PID settings have been verified, connect the PID probe to the zero air calibration bag (or calibrate to ambient air if conditions permit) and wait for a stable indication.

7. Connect the PID probe to the calibration standard bag. Measure an initial reading of the standard and wait for a stable indication.

8. Keep the PID probe connected to the calibration standard bag, calibrate to applicable concentration (typically 100 ppm with isobutylene) with the standard and wait for a stable indication.

9. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish

maintenance schedules and component replacement. Information will include, at a minimum:

- Time, date and initials of the field team member performing the calibration
- The unique identifier for the meter, including manufacturer, model, and serial number
- The calibration standard and concentration
- Correction factors used, if any
- The brand and expiration date of the calibration standard gas
- The instrument readings: before and after calibration
- The instrument settings (if applicable)
- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

MAINTENANCE

- The probe and dust filter of the PID should be checked before and after every use for cleanliness. Should instrument response become unstable, recalibration should be performed. If this does not resolve the problem, access the photoionization bulb and clean with the manufacturer-supplied abrasive compound, then recalibrate.

- The PID battery must be recharged after each use. Store the PID in its carrying case when not in use. Additional maintenance details related to individual components of the PID are provided in the equipment manufacturer's instruction manual. If calibration or instrument performance is not in accordance with specifications, send the instrument to the equipment manufacturer for repair.

- Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

ATTACHMENTS

Table 1; Summary of Ionization Potentials
Equipment Calibration Log (sample)
Technical Note TN-106

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
A		
2-Amino pyridine	8	
Acetaldehyde	10.21	
Acetamide	9.77	
Acetic acid	10.69	X
Acetic anhydride	10	
Acetone	9.69	
Acetonitrile	12.2	X
Acetophenone	9.27	
Acetyl bromide	10.55	
Acetyl chloride	11.02	X
Acetylene	11.41	X
Acrolein	10.1	
Acrylamide	9.5	
Acrylonitrile	10.91	X
Allyl alcohol	9.67	
Allyl chloride	9.9	
Ammonia	10.2	
Aniline	7.7	
Anisidine	7.44	
Anisole	8.22	
Arsine	9.89	
B		
1,3-Butadiene (butadiene)	9.07	
1-Bromo-2-chloroethane	10.63	X
1-Bromo-2-methylpropane	10.09	
1-Bromo-4-fluorobenzene	8.99	
1-Bromobutane	10.13	
1-Bromopentane	10.1	
1-Bromopropane	10.18	
1-Bromopropene	9.3	
1-Butanethiol	9.14	
1-Butene	9.58	
1-Butyne	10.18	
2,3-Butadione	9.23	
2-Bromo-2-methylpropane	9.89	
2-Bromobutane	9.98	
2-Bromopropane	10.08	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Bromothiophene	8.63	
2-Butanone (MEK)	9.54	
3-Bromopropene	9.7	
3-Butene nitrile	10.39	
Benzaldehyde	9.53	
Benzene	9.25	
Benzenethiol	8.33	
Benzonitrile	9.71	
Benzotrifluoride	9.68	
Biphenyl	8.27	
Boron oxide	13.5	X
Boron trifluoride	15.56	X
Bromine	10.54	
Bromobenzene	8.98	
Bromochloromethane	10.77	X
Bromoform	10.48	
Butane	10.63	X
Butyl mercaptan	9.15	
cis-2-Butene	9.13	
m-Bromotoluene	8.81	
n-Butyl acetate	10.01	
n-Butyl alcohol	10.04	
n-Butyl amine	8.71	
n-Butyl benzene	8.69	
n-Butyl formate	10.5	
n-Butyraldehyde	9.86	
n-Butyric acid	10.16	
n-Butyronitrile	11.67	X
o-Bromotoluene	8.79	
p-Bromotoluene	8.67	
p-tert-Butyltoluene	8.28	
s-Butyl amine	8.7	
s-Butyl benzene	8.68	
sec-Butyl acetate	9.91	
t-Butyl amine	8.64	
t-Butyl benzene	8.68	
trans-2-Butene	9.13	
C		

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
1-Chloro-2-methylpropane	10.66	X
1-Chloro-3-fluorobenzene	9.21	
1-Chlorobutane	10.67	X
1-Chloropropane	10.82	X
2-Chloro-2-methylpropane	10.61	X
2-Chlorobutane	10.65	X
2-Chloropropane	10.78	X
2-Chlorothiophene	8.68	
3-Chloropropene	10.04	
Camphor	8.76	
Carbon dioxide	13.79	X
Carbon disulfide	10.07	
Carbon monoxide	14.01	X
Carbon tetrachloride	11.47	X
Chlorine	11.48	X
Chlorine dioxide	10.36	
Chlorine trifluoride	12.65	X
Chloroacetaldehyde	10.61	X
α -Chloroacetophenone	9.44	
Chlorobenzene	9.07	
Chlorobromomethane	10.77	X
Chlorofluoromethane (Freon 22)	12.45	X
Chloroform	11.37	X
Chlorotrifluoromethane (Freon 13)	12.91	X
Chrysene	7.59	
Cresol	8.14	
Crotonaldehyde	9.73	
Cumene (isopropyl benzene)	8.75	
Cyanogen	13.8	X
Cyclohexane	9.8	
Cyclohexanol	9.75	
Cyclohexanone	9.14	
Cyclohexene	8.95	
Cyclo-octatetraene	7.99	
Cyclopentadiene	8.56	
Cyclopentane	10.53	
Cyclopentanone	9.26	
Cyclopentene	9.01	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Cyclopropane	10.06	
m-Chlorotoluene	8.83	
o-Chlorotoluene	8.83	
p-Chlorotoluene	8.7	
D		
1,1-Dibromoethane	10.19	
1,1-Dichloroethane	11.12	X
1,1-Dimethoxyethane	9.65	
1,1-Dimethylhydrazine	7.28	
1,2-Dibromoethene	9.45	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12.2	X
1,2-Dichloroethane	11.12	X
1,2-Dichloropropane	10.87	X
1,3-Dibromopropane	10.07	
1,3-Dichloropropane	10.85	X
2,2-Dimethyl butane	10.06	
2,2-Dimethyl propane	10.35	
2,3-Dichloropropene	9.82	
2,3-Dimethyl butane	10.02	
3,3-Dimethyl butanone	9.17	
cis-Dichloroethene	9.65	
Decaborane	9.88	
Diazomethane	9	
Diborane	12	X
Dibromochloromethane	10.59	
Dibromodifluoromethane	11.07	X
Dibromomethane	10.49	
Dibutylamine	7.69	
Dichlorodifluoromethane (Freon 12)	12.31	X
Dichlorofluoromethane	12.39	X
Dichloromethane	11.35	X
Diethoxymethane	9.7	
Diethyl amine	8.01	
Diethyl ether	9.53	
Diethyl ketone	9.32	
Diethyl sulfide	8.43	
Diethyl sulfite	9.68	
Difluorodibromomethane	11.07	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Dihydropyran	8.34	
Diiodomethane	9.34	
Diisopropylamine	7.73	
Dimethoxymethane (methylal)	10	
Dimethyl amine	8.24	
Dimethyl ether	10	
Dimethyl sulfide	8.69	
Dimethylaniline	7.13	
Dimethylformamide	9.18	
Dimethylphthalate	9.64	
Dinitrobenzene	10.71	X
Dioxane	9.19	
Diphenyl	7.95	
Dipropyl amine	7.84	
Dipropyl sulfide	8.3	
Durene	8.03	
m-Dichlorobenzene	9.12	
N,N-Diethyl acetamide	8.6	
N,N-Diethyl formamide	8.89	
N,N-Dimethyl acetamide	8.81	
N,N-Dimethyl formamide	9.12	
o-Dichlorobenzene	9.06	
p-Dichlorobenzene	8.95	
p-Dioxane	9.13	
trans-Dichloroethene	9.66	
E		
Epichlorohydrin	10.2	
Ethane	11.65	X
Ethanethiol (ethyl mercaptan)	9.29	
Ethanolamine	8.96	
Ethene	10.52	
Ethyl acetate	10.11	
Ethyl alcohol	10.48	
Ethyl amine	8.86	
Ethyl benzene	8.76	
Ethyl bromide	10.29	
Ethyl chloride (chloroethane)	10.98	X
Ethyl disulfide	8.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Ethyl ether	9.51	
Ethyl formate	10.61	X
Ethyl iodide	9.33	
Ethyl isothiocyanate	9.14	
Ethyl mercaptan	9.29	
Ethyl methyl sulfide	8.55	
Ethyl nitrate	11.22	X
Ethyl propionate	10	
Ethyl thiocyanate	9.89	
Ethylene chlorohydrin	10.52	
Ethylene diamine	8.6	
Ethylene dibromide	10.37	
Ethylene dichloride	11.05	X
Ethylene oxide	10.57	
Ethylenelmine	9.2	
Ethynylbenzene	8.82	
F		
2-Furaldehyde	9.21	
Fluorine	15.7	X
Fluorobenzene	9.2	
Formaldehyde	10.87	X
Formamide	10.25	
Formic acid	11.05	X
Freon 11 (trichlorofluoromethane)	11.77	X
Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane)	11.3	X
Freon 113 (1,1,2-trichloro-1,2,2-trifluororethane)	11.78	X
Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)	12.2	X
Freon 12 (dichlorodifluoromethane)	12.31	X
Freon 13 (chlorotrifluoromethane)	12.91	X
Freon 22 (chlorofluoromethane)	12.45	X
Furan	8.89	
Furfural	9.21	
m-Fluorotoluene	8.92	
o-Fluorophenol	8.66	
o-Fluorotoluene	8.92	
p-Fluorotoluene	8.79	
H		
1-Hexene	9.46	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Heptanone	9.33	
2-Hexanone	9.35	
Heptane	10.08	
Hexachloroethane	11.1	X
Hexane	10.18	
Hydrazine	8.1	
Hydrogen	15.43	X
Hydrogen bromide	11.62	X
Hydrogen chloride	12.74	X
Hydrogen cyanide	13.91	X
Hydrogen fluoride	15.77	X
Hydrogen iodide	10.38	
Hydrogen selenide	9.88	
Hydrogen sulfide	10.46	
Hydrogen telluride	9.14	
Hydroquinone	7.95	
I		
1-Iodo-2-methylpropane	9.18	
1-Iodobutane	9.21	
1-Iodopentane	9.19	
1-Iodopropane	9.26	
2-Iodobutane	9.09	
2-Iodopropane	9.17	
Iodine	9.28	
Iodobenzene	8.73	
Isobutane	10.57	
Isobutyl acetate	9.97	
Isobutyl alcohol	10.12	
Isobutyl amine	8.7	
Isobutyl formate	10.46	
Isobutyraldehyde	9.74	
Isobutyric acid	10.02	
Isopentane	10.32	
Isophorone	9.07	
Isoprene	8.85	
Isopropyl acetate	9.99	
Isopropyl alcohol	10.16	
Isopropyl amine	8.72	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Isopropyl benzene	8.69	
Isopropyl ether	9.2	
Isovaleraldehyde	9.71	
m-Iodotoluene	8.61	
o-Iodotoluene	8.62	
p-Iodotoluene	8.5	
K		
Ketene	9.61	
L		
2,3-Lutidine	8.85	
2,4-Lutidine	8.85	
2,6-Lutidine	8.85	
M		
2-Methyl furan	8.39	
2-Methyl napthalene	7.96	
1-Methyl napthalene	7.96	
2-Methyl propene	9.23	
2-Methyl-1-butene	9.12	
2-Methylpentane	10.12	
3-Methyl-1-butene	9.51	
3-Methyl-2-butene	8.67	
3-Methylpentane	10.08	
4-Methylcyclohexene	8.91	
Maleic anhydride	10.8	X
Mesityl oxide	9.08	
Mesitylene	8.4	
Methane	12.98	X
Methanethiol (methyl mercaptan)	9.44	
Methyl acetate	10.27	
Methyl acetylene	10.37	
Methyl acrylate	9.9	
Methyl alcohol	10.85	X
Methyl amine	8.97	
Methyl bromide	10.54	
Methyl butyl ketone	9.34	
Methyl butyrate	10.07	
Methyl cellosolve	9.6	
Methyl chloride	11.28	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Methyl chloroform (1,1,1-trichloroethane)	11	X
Methyl disulfide	8.46	
Methyl ethyl ketone	9.53	
Methyl formate	10.82	X
Methyl iodide	9.54	
Methyl isobutyl ketone	9.3	
Methyl isobutyrate	9.98	
Methyl isocyanate	10.67	X
Methyl isopropyl ketone	9.32	
Methyl isothiocyanate	9.25	
Methyl mercaptan	9.44	
Methyl methacrylate	9.7	
Methyl propionate	10.15	
Methyl propyl ketone	9.39	
α -Methyl styrene	8.35	
Methyl thiocyanate	10.07	
Methylal (dimethoxymethane)	10	
Methylcyclohexane	9.85	
Methylene chloride	11.32	X
Methyl-n-amyl ketone	9.3	
Monomethyl aniline	7.32	
Monomethyl hydrazine	7.67	
Morpholine	8.2	
n-Methyl acetamide	8.9	
N		
1-Nitropropane	10.88	X
2-Nitropropane	10.71	X
Naphthalene	8.12	
Nickel carbonyl	8.27	
Nitric oxide, (NO)	9.25	
Nitrobenzene	9.92	
Nitroethane	10.88	X
Nitrogen	15.58	X
Nitrogen dioxide	9.78	
Nitrogen trifluoride	12.97	X
Nitromethane	11.08	X
Nitrotoluene	9.45	
p-Nitrochloro benzene	9.96	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
O		
Octane	9.82	
Oxygen	12.08	X
Ozone	12.08	X
P		
1-Pentene	9.5	
1-Propanethiol	9.2	
2,4-Pentanedione	8.87	
2-Pentanone	9.38	
2-Picoline	9.02	
3-Picoline	9.02	
4-Picoline	9.04	
n-Propyl nitrate	11.07	X
Pentaborane	10.4	
Pentane	10.35	
Perchloroethylene	9.32	
Pheneloic	8.18	
Phenol	8.5	
Phenyl ether (diphenyl oxide)	8.82	
Phenyl hydrazine	7.64	
Phenyl isocyanate	8.77	
Phenyl isothiocyanate	8.52	
Phenylene diamine	6.89	
Phosgene	11.77	X
Phosphine	9.87	
Phosphorus trichloride	9.91	
Phthalic anhydride	10	
Propane	11.07	X
Propargyl alcohol	10.51	
Propiolactone	9.7	
Propionaldehyde	9.98	
Propionic acid	10.24	
Propionitrile	11.84	X
Propyl acetate	10.04	
Propyl alcohol	10.2	
Propyl amine	8.78	
Propyl benzene	8.72	
Propyl ether	9.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Propyl formate	10.54	
Propylene	9.73	
Propylene dichloride	10.87	X
Propylene imine	9	
Propylene oxide	10.22	
Propyne	10.36	
Pyridine	9.32	
Pyrrole	8.2	
Q		
Quinone	10.04	
S		
Stibine	9.51	
Styrene	8.47	
Sulfur dioxide	12.3	X
Sulfur hexafluoride	15.33	X
Sulfur monochloride	9.66	
Sulfuryl fluoride	13	X
T		
o-Terphenyls	7.78	
1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112)	11.3	X
1,1,1-Trichloroethane	11	X
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	11.78	X
2,2,4-Trimethyl pentane	9.86	
o-Toluidine	7.44	
Tetrachloroethane	11.62	X
Tetrachloroethene	9.32	
Tetrachloromethane	11.47	X
Tetrahydrofuran	9.54	
Tetrahydropyran	9.25	
Thiolacetic acid	10	
Thiophene	8.86	
Toluene	8.82	
Tribromoethene	9.27	
Tribromofluoromethane	10.67	X
Tribromomethane	10.51	
Trichloroethene	9.45	
Trichloroethylene	9.47	
Trichlorofluoromethane (Freon 11)	11.77	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Trichloromethane	11.42	X
Triethylamine	7.5	
Trifluoromonobromo-methane	11.4	X
Trimethyl amine	7.82	
Tripropyl amine	7.23	
V		
o-Vinyl toluene	8.2	
Valeraldehyde	9.82	
Valeric acid	10.12	
Vinyl acetate	9.19	
Vinyl bromide	9.8	
Vinyl chloride	10	
Vinyl methyl ether	8.93	
W		
Water	12.59	X
X		
2,4-Xylidine	7.65	
m-Xylene	8.56	
o-Xylene	8.56	
p-Xylene	8.45	

FOP 011.0

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name: _____ Date: _____

Project No.: _____

Client: _____ Instrument Source: ☐ BM ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	POST CAL. READING	SETTINGS
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00 7.00 10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	9706000145[illegible]		< 0.4 [illegible] [illegible]00 800		
☐ Sp. Cond. meter	uS mS		Myron L Company Ultra Meter 6P	[illegible]		_____ mS @ 25 °C		
☐ PID	ppm		MinRAE 20[illegible]			open air zero _____ ppm Iso. Gas		MIBK response factor = 1.0
☐ Dissolved Oxygen	ppm		YSI Model 5[illegible]					
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

SAMPLE

ADDITIONAL REMARKS: _____

PREPARED BY: _____ **DATE:** _____

Correction Factors, Ionization Energies*, And Calibration Characteristics

Correction Factors and Ionization Energies

RAE Systems PIDs can be used for the detection of a wide variety of gases that exhibit different responses. In general, any compound with ionization energy (IE) lower than that of the lamp photons can be measured.* The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. In our PIDs, correction factors can be used in one of three ways:

1) Calibrate the monitor with isobutylene in the usual fashion to read in isobutylene equivalents. Manually multiply the reading by the correction factor (CF) to obtain the concentration of the gas being measured.

2) Calibrate the unit with isobutylene in the usual fashion to read in isobutylene equivalents. Call up the correction factor from the instrument memory or download it from a personal computer and then call it up. The monitor will then read directly in units of the gas of interest.

3) Calibrate the unit with isobutylene, but input an equivalent, "corrected" span gas concentration when prompted for this value. The unit will then read directly in units of the gas of interest.

* *The term "ionization energy" is more scientifically correct and replaces the old term "ionization potential." High-boiling ("heavy") compounds may not vaporize enough to give a response even when their ionization energies are below the lamp photon energy. Some inorganic compounds like H_2O_2 and NO_2 give weak response even when their ionization energies are well below the lamp photon energy.*

Example 1:
With the unit calibrated to read isobutylene equivalents, the reading is 10 ppm with a 10.6 eV lamp. The gas being measured is butyl acetate, which has a correction factor of 2.6. Multiplying 10 by 2.6 gives an adjusted butyl acetate value of 26 ppm. Similarly, if the gas being measured were trichloroethylene (CF = 0.54), the adjusted value with a 10 ppm reading would be 5.4 ppm.

Example 2:
With the unit calibrated to read isobutylene equivalents, the reading is 100 ppm with a 10.6 eV lamp. The gas measured is m-xylene (CF = 0.43). After downloading this factor, the unit should read about 43 ppm when exposed to the same gas, and thus read directly in m-xylene values.

Example 3:
The desired gas to measure is ethylene dichloride (EDC). The CF is 0.6 with an 11.7 eV lamp. During calibration with 100 ppm isobutylene, insert 0.6 times 100, or 60 at the prompt for the calibration gas concentration. The unit then reads directly in EDC values.

Conversion to mg/m^3

To convert from ppm to mg/m^3, use the following formula:

$$\text{Conc. (mg/m}^3\text{)} = \frac{[\text{Conc.(ppmv) x mol. wt. (g/mole)}]}{\text{molar gas volume (L)}}$$

For air at 25 °C (77 °F), the molar gas volume is 24.4 L/mole and the formula reduces to:

$$\text{Conc.(mg/m}^3\text{)} = \text{Conc.(ppmv) x mol. wt. (g/mole) x } 0.041$$

For example, if the instrument is calibrated with a gas standard in ppmv, such as 100 ppm isobutylene, and the user wants the display to read in mg/m^3 of hexane, whose m.w. is 86 and CF is 4.3, the overall correction factor would be 4.3 x 86 x 0.041 equals 15.2.

Correction Factors for Mixtures

The correction factor for a mixture is calculated from the sum of the mole fractions Xi of each component divided by their respective correction factors CFi:

$$CFmix = 1 / (X_1/CF_1 + X_2/CF_2 + X_3/CF_3 + \ldots Xi/CFi)$$

Thus, for example, a vapor phase mixture of 5% benzene and 95% n-hexane would have a CFmix of CFmix = 1 / (0.05/0.53 + 0.95/4.3) = 3.2. A reading of 100 would then correspond to 320 ppm of the total mixture, comprised of 16 ppm benzene and 304 ppm hexane.

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For a spreadsheet to compute the correction factor and TLV of a mixture see the appendix at the end of the CF table.

TLVs and Alarm Limits for Mixtures

The correction factor for mixtures can be used to set alarm limits for mixtures. To do this one first needs to calculate the exposure limit for the mixture. The Threshold Limit Value (TLV) often defines exposure limits. The TLV for the mixture is calculated in a manner similar to the CF calculation:

$$TLV\ mix = 1 / (X_1/TLV_1 + X_2/TLV_2 + X_3/TLV_3 + \ldots X_i/TLV_i)$$

In the above example, the 8-h TLV for benzene is 0.5 ppm and for n-hexane 50 ppm. Therefore the TLV of the mixture is TLVmix = 1 / (0.05/0.5 + 0.95/50) = 8.4 ppm, corresponding to 8.0 ppm hexane and 0.4 ppm benzene. For an instrument calibrated on isobutylene, the reading corrsponding to the TLV is:

$$Alarm\ Reading = TLVmix / CFmix = 8.4 / 3.2 = 2.6\ ppm$$

A common practice is to set the lower alarm limit to half the TLV, and the higher limit to the TLV. Thus, one would set the alarms to 1.3 and 2.6 ppm, respectively.

Calibration Characteristics

a) Flow Configuration. PID response is essentially independent of gas flow rate as long as it is sufficient to satisfy the pump demand. Four main flow configurations are used for calibrating a PID:

1) **Pressurized gas cylinder (Fixed-flow regulator):** The flow rate of the regulator should match the flow demand of the instrument pump or be slightly higher.
2) **Pressurized gas cylinder (Demand-flow regulator):** A demand-flow regulator better matches pump speed differences, but results in a slight vacuum during calibration and thus slightly high readings.
3) **Collapsible gas bag:** The instrument will draw the calibration gas from the bag at its normal flow rate, as long as the bag valve is large enough. The bag should be filled with enough gas to allow at least one minute of flow (~ 0.6 L for a MiniRAE, ~0.3 L for MultiRAE).
4) **T (or open tube) method:** The T method uses a T-junction with gas flow higher than the pump draw. The gas supply is connected to one end of the T, the instrument inlet is connected to a second end of the T, and excess gas flow escapes through the third, open end of the T. To prevent ambient air mixing, a long tube should be connected to the open end, or a high excess rate should be used. Alternatively, the instrument probe can be inserted into an open tube slightly wider than the probe. Excess gas flows out around the probe.

The first two cylinder methods are the most efficient in terms of gas usage, while the bag and T methods give slightly more accurate results because they match the pump flow better.

b) Pressure. Pressures deviating from atmospheric pressure affect the readings by altering gas concentration and pump characteristics. It is best to calibrate with the instrument and calibration gas at the same pressure as each other and the sample gas. (Note that the cylinder pressure is not relevant because the regulator reduces the pressure to ambient.) If the instrument is calibrated at atmospheric pressure in one of the flow configurations described above, then 1) pressures slightly above ambient are acceptable but high pressures can damage the pump and 2) samples under vacuum may give low readings if air leaks into the sample train.

c) Temperature. Because temperature effects gas density and concentration, the temperature of the calibration gas and instrument should be as close as possible to the ambient temperature where the unit will be used. We recommend that the temperature of the calibration gas be within the instrument's temperature specification (typically 14° to 113° F or -10° to 45° C). Also, during actual measurements, the instrument should be kept at the same or higher temperature than the sample temperature to avoid condensation in the unit.

d) Matrix. The matrix gas of the calibration compound and VOC sample is significant. Some common matrix components, such as methane and water vapor can affect the VOC signal. PIDs are

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most commonly used for monitoring VOCs in air, in which case the preferred calibration gas matrix is air. For a MiniRAE, methane, methanol, and water vapor reduce the response by about 20% when their concentration is 15,000 ppm and by about 40% at 30,000 ppm. Despite earlier reports of oxygen effects, RAE PID responses with 10.6 eV lamps are independent of oxygen concentration, and calibration gases in a pure nitrogen matrix can be used. H_2 and CO_2 up to 5 volume % also have no effect.

e) Concentration. Although RAE Systems PIDs have electronically linearized output, it is best to calibrate in a concentration range close to the actual measurement range. For example, 100 ppm standard gas for anticipated vapors of 0 to 250 ppm, and 500 ppm standard for expected concentrations of 250 to 1000 ppm. The correction factors in this table were typically measured at 50 to 100 ppm and apply from the ppb range up to about 1000 ppm. Above 1000 ppm the CF may vary and it is best to calibrate with the gas of interest near the concentration of interest.

f) Filters. Filters affect flow and pressure conditions and therefore all filters to be used during sampling should also be in place during calibration. Using a water trap (hydrophobic filter) greatly reduces the chances of drawing water aerosols or dirt particles into the instrument. Regular filter replacements are recommended because dirty filters can adsorb VOCs and cause slower response time and shifts in calibration.

g) Instrument Design. High-boiling ("heavy") or very reactive compounds can be lost by reaction or adsorption onto materials in the gas sample train, such as filters, pumps and other sensors. Multi-gas meters, including EntryRAE, MultiRAE and AreaRAE have the pump and other sensors upstream of the PID and are prone to these losses. Compounds possibly affected by such losses are shown in green in the table, and may give slow response, or in extreme cases, no response at all. In many cases the multi-gas meters can still give a rough indication of the relative concentration, without giving an accurate, quantitative reading. The ppbRAE and MiniRAE series instruments have inert sample trains and therefore do not exhibit significant loss; nevertheless, response may be slow for the very heavy compounds and additional sampling time up to a minute or more should be allowed to get a stable reading.

Table Abbreviations:

CF = Correction Factor (multiply by reading to get corrected value for the compound when calibrated to isobutylene)
NR = No Response
IE = Ionization Energy (values in parentheses are not well established)
C = Confirmed Value indicated by "+" in this column; all others are preliminary or estimated values and are subject to change
ne = Not Established ACGIH 8-hr. TWA
C## = Ceiling value, given where 8-hr.TWA is not available

Disclaimer:

Actual readings may vary with age and cleanliness of lamp, relative humidity, and other factors. For accurate work, the instrument should be calibrated regularly under the operating conditions used. The factors in this table were measured in dry air at room temperature, typically at 50-100 ppm. CF values may vary above about 1000 ppm.

Updates:

The values in this table are subject to change as more or better data become available. Watch for updates of this table on the Internet at **http://www.raesystems.com**

IE data are taken from the CRC Handbook of Chemistry and Physics, 73rd Edition, D.R. Lide (Ed.), CRC Press (1993) and NIST Standard Ref. Database 19A, NIST Positive Ion Energetics, Vers. 2.0, Lias, et.al., U.S. Dept. Commerce (1993). Exposure limits (8-h TWA and Ceiling Values) are from the 2005 ACGIH Guide to Occupational Exposure Values, ACGIH, Cincinnati, OH 2005. Equations for exposure limits for mixtures of chemicals were taken from the 1997 TLVs and BEIs handbook published by the ACGIH (1997).

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	1.1	+	1.4	+	9.71	500
Acetone cyanohydrin	2-Hydroxyisobutyronitrile	75-86-5	C_4H_7NO					4	+	11.1	C5
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2.1	+	11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O	4.5	+	2.4	+	1.6	+	9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	H_3N	NR	+	9.7	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5		1.6		10.00	ne
Aniline	Aminobenzene	62-53-3	C_7H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O	0.89	+	0.58	+	0.56	+	8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzenamine, N-methyl-	N-Methylphenylamine	100-61-8	C_7H_9N			0.7				7.53	
Benzene		71-43-2	C_6H_6	0.55	+	0.53	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne
Benzyl chloride	α-Chlorotoluene, Chloromethylbenzene	100-44-7	C_7H_7Cl	0.7	+	0.6	+	0.5	+	9.14	1
Benzyl formate	Formic acid benzyl ester	104-57-4	$C_8H_8O_2$	0.9	+	0.73	+	0.66	+		ne
Boron trifluoride		7637-07-2	BF_3	NR		NR		NR		15.5	C1
Bromine		7726-95-6	Br_2	NR	+	1.30	+	0.74	+	10.51	0.1
Bromobenzene		108-86-1	C_6H_5Br			0.6		0.5		8.98	ne
2-Bromoethyl methyl ether		6482-24-2	C_3H_7OBr			0.84	+			~10	ne
Bromoform	Tribromomethane	75-25-2	$CHBr_3$	NR	+	2.5	+	0.5	+	10.48	0.5
Bromopropane,1-	n-Propyl bromide	106-94-5	C_3H_7Br	150	+	1.5	+	0.6	+	10.18	ne
Butadiene	1,3-Butadiene, Vinyl ethylene	106-99-0	C_4H_6	0.8		0.85	+	1.1		9.07	2
Butadiene diepoxide, 1,3-	1,2,3,4-Diepoxybutane	298-18-0	$C_4H_6O_2$	25	+	3.5	+	1.2		~10	ne
Butanal	1-Butanal	123-72-8	C_4H_8O			1.8				9.84	
Butane		106-97-8	C_4H_{10}			67	+	1.2		10.53	800
Butanol, 1-	Butyl alcohol, n-Butanol	71-36-3	$C_4H_{10}O$	70	+	4.7	+	1.4	+	9.99	20
Butanol, t-	tert-Butanol, t-Butyl alcohol	75-65-0	$C_4H_{10}O$	6.9	+	2.9	+			9.90	100
Butene, 1-	1-Butylene	106-98-9	C_4H_8			0.9				9.58	ne
Butoxyethanol, 2-	Butyl Cellosolve, Ethylene glycol monobutyl ether	111-76-2	$C_6H_{14}O_2$	1.8	+	1.2	+	0.6	+	<10	25
Butoxyethanol acetate	Ethanol, 2-(2-butoxyethoxy)-, acetate	124-17-4	$C_{10}H_{20}O_4$			5.6				≤10.6	
Butoxyethoxyethanol	2-(2-Butoxyethoxy)ethanol	112-34-5	$C_8H_{18}O_3$			4.6				≤10.6	
Butyl acetate, n-		123-86-4	$C_6H_{12}O_2$			2.6	+			10	150
Butyl acrylate, n-	Butyl 2-propenoate, Acrylic acid butyl ester	141-32-2	$C_7H_{12}O_2$			1.6	+	0.6	+		10
Butylamine, n-		109-73-9	$C_4H_{11}N$	1.1	+	1.1	+	0.7	+	8.71	C5
Butyl cellosolve	see 2-Butoxyethanol	111-76-2									
Butyl hydroperoxide, t-		75-91-2	$C_4H_{10}O_2$	2.0	+	1.6	+			<10	1
Butyl mercaptan	1-Butanethiol	109-79-5	$C_4H_{10}S$	0.55	+	0.52	+			9.14	0.5
Carbon disulfide		75-15-0	CS_2	4	+	1.2	+	0.44		10.07	10
Carbon tetrachloride	Tetrachloromethane	56-23-5	CCl_4	NR	+	NR	+	1.7	+	11.47	5
Carbonyl sulfide	Carbon oxysulfide	463-58-1	COS							11.18	

Cellosolve see 2-Ethoxyethanol
CFC-14 see Tetrafluoromethane
CFC-113 see 1,1,2-Trichloro-1,2,2-trifluoroethane

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Chlorine		7782-50-5	Cl_2					1.0	+	11.48	0.5
Chlorine dioxide		10049-04-4	ClO_2	NR	+	NR	+	NR	+	10.57	0.1
Chlorobenzene	Monochlorobenzene	108-90-7	C_6H_5Cl	0.44	+	0.40	+	0.39	+	9.06	10
Chlorobenzotrifluoride, 4-	PCBTF, OXSOL 100 p-Chlorobenzotrifluoride	98-56-6	$C_7H_4ClF_3$	0.74	+	0.63	+	0.55	+	<9.6	25
Chloro-1,3-butadiene, 2-	Chloroprene	126-99-8	C_4H_5Cl			3					10
Chloro-1,1-difluoroethane, 1-	HCFC-142B, R-142B	75-68-3	$C_2H_3ClF_2$	NR		NR		NR		12.0	ne
Chlorodifluoromethane	HCFC-22, R-22	75-45-6	$CHClF_2$	NR		NR		NR		12.2	1000
Chloroethane	Ethyl chloride	75-00-3	C_2H_5Cl	NR	+	NR	+	1.1	+	10.97	100
Chloroethanol	Ethylene chlrohydrin	107-07-3	C_2H_5ClO					2.9		10.52	C1
Chloroethyl ether, 2-	bis(2-chloroethyl) ether	111-44-4	$C_4H_8Cl_2O$	8.6	+	3.0	+				5
Chloroethyl methyl ether, 2-	Methyl 2-chloroethyl ether	627-42-9	C_3H_7ClO			3					ne
Chloroform	Trichloromethane	67-66-3	$CHCl_3$	NR	+	NR	+	3.5	+	11.37	10
Chloro-2-methylpropene, 3-	Methallyl chloride, Isobutenyl chloride	563-47-3	C_4H_7Cl	1.4	+	1.2	+	0.63	+	9.76	ne
Chloropicrin		76-06-2	CCl_3NO_2	NR	+	~400	+	7	+	?	0.1
Chlorotoluene, o-	o-Chloromethylbenzene	95-49-8	C_7H_7Cl			0.5		0.6		8.83	50
Chlorotoluene, p-	p-Chloromethylbenzene	106-43-4	C_7H_7Cl					0.6		8.69	ne
Chlorotrifluoroethene	CTFE, Chlorotrifluoroethylene Genetron 1113	79-38-9	C_2ClF_3	6.7	+	3.9	+	1.2	+	9.76	5
Chlorotrimethylsilane		75-77-4	C_3H_9ClSi	NR		NR		0.82	+	10.83	ne
Cresol, m-	m-Hydroxytoluene	108-39-4	C_7H_8O	0.57	+	0.50	+	0.57	+	8.29	5
Cresol, o-	o-Hydroxytoluene	95-48-7	C_7H_8O			1.0				8.50	
Cresol, p-	p-Hydroxytoluene	106-44-5	C_7H_8O			1.4				8.35	
Crotonaldehyde	*trans*-2-Butenal	123-73-9 4170-30-3	C_4H_6O	1.5	+	1.1	+	1.0	+	9.73	2
Cumene	Isopropylbenzene	98-82-8	C_9H_{12}	0.58	+	0.54	+	0.4	+	8.73	50
Cyanogen bromide		506-68-3	CNBr	NR		NR		NR		11.84	ne
Cyanogen chloride		506-77-4	CNCl	NR		NR		NR		12.34	C0.3
Cyclohexane		110-82-7	C_6H_{12}	3.3	+	1.4	+	0.64	+	9.86	300
Cyclohexanol	Cyclohexyl alcohol	108-93-0	$C_6H_{12}O$	1.5	+	0.9	+	1.1	+	9.75	50
Cyclohexanone		108-94-1	$C_6H_{10}O$	1.0	+	0.9	+	0.7	+	9.14	25
Cyclohexene		110-83-8	C_6H_{10}			0.8	+			8.95	300
Cyclohexylamine		108-91-8	$C_6H_{13}N$			1.2				8.62	10
Cyclopentane 85% 2,2-dimethylbutane 15%		287-92-3	C_5H_{10}	NR	+	15	+	1.1		10.33	600
Cyclopropylamine	Aminocyclpropane	765-30-0	C_3H_7N	1.1	+	0.9	+	0.9	+		ne
Decamethylcyclopentasiloxane		541-02-6	$C_{10}H_{30}O_5Si_5$	0.16	+	0.13	+	0.12	+		ne
Decamethyltetrasiloxane		141-62-8	$C_{10}H_{30}O_3Si_4$	0.17	+	0.13	+	0.12	+	<10.2	ne
Decane		124-18-5	$C_{10}H_{22}$	4.0	+	1.4	+	0.35	+	9.65	ne
Diacetone alcohol	4-Methyl-4-hydroxy-2-pentanone	123-42-2	$C_6H_{12}O_2$			0.7					50
Dibromochloromethane	Chlorodibromomethane	124-48-1	$CHBr_2Cl$	NR	+	5.3	+	0.7	+	10.59	ne
Dibromo-3-chloropropane, 1,2-	DBCP	96-12-8	$C_3H_5Br_2Cl$	NR	+	1.7	+	0.43	+		0.001
Dibromoethane, 1,2-	EDB, Ethylene dibromide, Ethylene bromide	106-93-4	$C_2H_4Br_2$	NR	+	1.7	+	0.6	+	10.37	ne
Dichlorobenzene, o-	1,2-Dichlorobenzene	95-50-1	$C_6H_4Cl_2$	0.54	+	0.47	+	0.38	+	9.08	25
Dichlorodifluoromethane	CFC-12	75-71-8	CCl_2F_2			NR	+	NR	+	11.75	1000
Dichlorodimethylsilane		75-78-5	$C_2H_6Cl_2Si$	NR		NR		1.1	+	>10.7	ne
Dichloroethane, 1,2-	EDC, 1,2-DCA, Ethylene dichloride	107-06-2	$C_2H_4Cl_2$			NR	+	0.6	+	11.04	10
Dichloroethene, 1,1-	1,1-DCE, Vinylidene chloride	75-35-4	$C_2H_2Cl_2$			0.82	+	0.8	+	9.79	5
Dichloroethene, c-1,2-	*c*-1,2-DCE, *cis*-Dichloroethylene	156-59-2	$C_2H_2Cl_2$			0.8				9.66	200
Dichloroethene, t-1,2-	*t*-1,2-DCE, *trans*-Dichloroethylene	156-60-5	$C_2H_2Cl_2$			0.45	+	0.34	+	9.65	200
Dichloro-1-fluoroethane, 1,1-	R-141B	1717-00-6	$C_2H_3Cl_2F$	NR	+	NR	+	2.0	+		ne
Dichloromethane	see Methylene chloride										

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Dichloropentafluoropropane	AK-225, mix of ~45% 3,3-dichloro-1,1,1,2,2-pentafluoro-propane (HCFC-225ca) & ~55% 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	442-56-0 507-55-1	$C_3HCl_2F_5$	NR	+	NR	+	25	+		ne
Dichloropropane, 1,2-		78-87-5	$C_3H_6Cl_2$					0.7		10.87	75
Dichloro-1-propene, 1,3-		542-75-6	$C_3H_4C_{12}$	1.3	+	0.96	+			<10	1
Dichloro-1-propene, 2,3-		78-88-6	$C_3H_4Cl_2$	1.9	+	1.3	+	0.7	+	<10	ne
Dichloro-1,1,1-trifluoroethane, 2,2-	R-123	306-83-2	$C_2HCl_2F_3$	NR	+	NR	+	10.1	+	11.5	ne
Dichloro-2,4,6-trifluoropyridine, 3,5-	DCTFP	1737-93-5	$C_5Cl_2F_3N$	1.1	+	0.9	+	0.8	+		ne
Dichlorvos *	Vapona; O,O-dimethyl O-dichlorovinyl phosphate	62-73-7	$C_4H_7Cl_2O_4P$			0.9	+			<9.4	0.1
Dicyclopentadiene	DCPD, Cyclopentadiene dimer	77-73-6	$C_{10}H_{12}$	0.57	+	0.48	+	0.43	+	8.8	5
Diesel Fuel		68334-30-5	m.w. 226			0.9	+				11
Diesel Fuel #2 (Automotive)		68334-30-5	m.w. 216	1.3		0.7	+	0.4	+		11
Diethylamine		109-89-7	$C_4H_{11}N$			1	+			8.01	5
Diethylaminopropylamine, 3-		104-78-9	$C_7H_{18}N_2$			1.3					ne
Diethylbenzene	See Dowtherm J										
Diethylmaleate		141-05-9	$C_8H_{12}O_4$			4					ne
Diethyl sulfide	see Ethyl sulfide										
Diglyme	See Methoxyethyl ether	111-96-6	$C_6H_{14}O_3$								
Diisobutyl ketone	DIBK, 2,2-dimethyl-4-heptanone	108-83-8	$C_9H_{18}O$	0.71	+	0.61	+	0.35	+	9.04	25
Diisopropylamine		108-18-9	$C_6H_{15}N$	0.84	+	0.74	+	0.5	+	7.73	5
Diketene	Ketene dimer	674-82-8	$C_4H_4O_2$	2.6	+	2.0	+	1.4	+	9.6	0.5
Dimethylacetamide, N,N-	DMA	127-19-5	C_4H_9NO	0.87	+	0.8	+	0.8	+	8.81	10
Dimethylamine		124-40-3	C_2H_7N			1.5				8.23	5
Dimethyl carbonate	Carbonic acid dimethyl ester	616-38-6	$C_3H_6O_3$	NR	+	~70	+	1.7	+	~10.5	ne
Dimethyl disulfide	DMDS	624-92-0	$C_2H_6S_2$	0.2	+	0.20	+	0.21	+	7.4	ne
Dimethyl ether	see Methyl ether										
Dimethylethylamine	DMEA	598-56-1	$C_4H_{11}N$	1.1	+	1.0	+	0.9	+	7.74	~3
Dimethylformamide, N,N-	DMF	68-12-2	C_3H_7NO	0.7	+	0.7	+	0.8	+	9.13	10
Dimethylhydrazine, 1,1-	UDMH	57-14-7	$C_2H_8N_2$			0.8	+	0.8	+	7.28	0.01
Dimethyl methylphosphonate	DMMP, methyl phosphonic acid dimethyl ester	756-79-6	$C_3H_9O_3P$	NR	+	4.3	+	0.74	+	10.0	ne
Dimethyl sulfate		77-78-1	$C_2H_6O_4S$	~23		~20	+	2.3	+		0.1
Dimethyl sulfide	see Methyl sulfide										
Dimethyl sulfoxide	DMSO, Methyl sulfoxide	67-68-5	C_2H_6OS			1.4	+			9.10	ne
Dioxane, 1,4-		123-91-1	$C_4H_8O_2$			1.3				9.19	25
Dioxolane, 1,3-	Ethylene glycol formal	646-06-0	$C_3H_6O_2$	4.0	+	2.3	+	1.6	+	9.9	20
Dowtherm A see Therminol® *											
Dowtherm J (97% Diethylbenzene) *		25340-17-4	$C_{10}H_{14}$			0.5					
DS-108F Wipe Solvent	Ethyl lactate/Isopar H/ Propoxypropanol ~7:2:1	97-64-3 64742-48-9 1569-01-3	m.w. 118	3.3	+	1.6	+	0.7	+		ne
Epichlorohydrin	ECH Chloromethyloxirane, 1-chloro2,3-epoxypropane	106-89-8	C_2H_5ClO	~200	+	8.5	+	1.4	+	10.2	0.5
Ethane		74-84-0	C_2H_6			NR	+	15	+	11.52	ne
Ethanol	Ethyl alcohol	64-17-5	C_2H_6O			10	+	3.1	+	10.47	1000
Ethanolamine *	MEA, Monoethanolamine	141-43-5	C_2H_7NO	5.6	+	1.6	+			8.96	3
Ethene	Ethylene	74-85-1	C_2H_4			9	+	4.5	+	10.51	ne
Ethoxyethanol, 2-	Ethyl cellosolve	110-80-5	$C_4H_{10}O_2$			1.3				9.6	5
Ethyl acetate		141-78-6	$C_4H_8O_2$			4.6	+	3.5		10.01	400
Ethyl acetoacetate		141-97-9	$C_6H_{10}O_3$	1.4	+	1.2	+	1.0	+	<10	ne
Ethyl acrylate		140-88-5	$C_5H_8O_2$			2.4	+	1.0	+	<10.3	5
Ethylamine		75-04-7	C_2H_7N			0.8				8.86	5

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Ethylbenzene		100-41-4	C_8H_{10}	0.52	+	0.52	+	0.51	+	8.77	100
Ethyl caprylate	Ethyl octanoate	106-32-1	$C_{10}H_{20}O_2$		+	0.52	+	0.51	+		
Ethylenediamine	1,2-Ethanediamine; 1,2-Diaminoethane	107-15-3	$C_2H_8N_2$	0.9	+	0.8	+	1.0	+	8.6	10
Ethylene glycol *	1,2-Ethanediol	107-21-1	$C_2H_6O_2$			16	+	6	+	10.16	C100
Ethylene glycol, Acrylate	2-hydroxyethyl Acrylate	818-61-1	$C_5H_8O_3$			8.2				≤10.6	
Ethylene glycol dimethyl ether	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		0.86		0.7		9.2	ne
Ethylene glycol monobutyl ether acetate	2-Butoxyethyl acetate	112-07-2	$C_8H_{16}O_3$			1.3				≤10.6	
Ethylene glycol, monothio	mercapto-2-ethanol	60-24-2	C_2H_6OS			1.5				9.65	
Ethylene oxide	Oxirane, Epoxyethane	75-21-8	C_2H_4O			13	+	3.5	+	10.57	1
Ethyl ether	Diethyl ether	60-29-7	$C_4H_{10}O$			1.1	+	1.7		9.51	400
Ethyl 3-ethoxypropionate	EEP	763-69-9	$C_7H_{14}O_3$	1.2	+	0.75	+				ne
Ethyl formate		109-94-4	$C_3H_6O_2$					1.9		10.61	100
Ethylhexyl acrylate, 2-	Acrylic acid 2-ethylhexyl ester	103-11-7	$C_{11}H_{20}O_2$			1.1	+	0.5	+		ne
Ethylhexanol	2-Ethyl-1-hexanol	104-76-7	C8H18O			1.9				≤10.6	
Ethylidenenorbornene	5-Ethylidene bicyclo(2,2,1)hept-2-ene	16219-75-3	C_9H_{12}	0.4	+	0.39	+	0.34	+	≤8.8	ne
Ethyl (S)-(-)-lactate see also DS-108F	Ethyl lactate, Ethyl (S)-(-)-hydroxypropionate	687-47-8 97-64-3	$C_5H_{10}O_3$	13	+	3.2	+	1.6	+	~10	ne
Ethyl mercaptan	Ethanethiol	75-08-1	C_2H_6S	0.60	+	0.56	+			9.29	0.5
Ethyl sulfide	Diethyl sulfide	352-93-2	$C_4H_{10}S$			0.5	+			8.43	ne
Formaldehyde	Formalin	50-00-0	CH_2O	NR	+	NR	+	1.6	+	10.87	C0.3
Formamide		75-12-7	CH_3NO			6.9	+	4		10.16	10
Formic acid		64-18-6	CH_2O_2	NR	+	NR	+	9	+	11.33	5
Furfural	2-Furaldehyde	98-01-1	$C_5H_4O_2$			0.92	+	0.8	+	9.21	2
Furfuryl alcohol		98-00-0	$C_5H_6O_2$			0.80	+			<9.5	10
Gasoline #1		8006-61-9	m.w. 72			0.9	+				300
Gasoline #2, 92 octane		8006-61-9	m.w. 93	1.3	+	1.0	+	0.5	+		300
Glutaraldehyde	1,5-Pentanedial, Glutaric dialdehyde	111-30-8	$C_5H_8O_2$	1.1	+	0.8	+	0.6	+		C0.05
Glycidyl methacrylate	2,3-Epoxypropyl methacrylate	106-91-2	$C_7H_{10}O_3$	2.6	+	1.2	+	0.9	+		0.5
Halothane	2-Bromo-2-chloro-1,1,1-trifluoroethane	151-67-7	$C_2HBrClF_3$					0.6		11.0	50
HCFC-22 see Chlorodifluoromethane											
HCFC-123 see 2,2-Dichloro-1,1,1-trifluoroethane											
HCFC-141B see 1,1-Dichloro-1-fluoroethane											
HCFC-142B see 1-Chloro-1,1-difluoroethane											
HCFC-134A see 1,1,1,2-Tetrafluoroethane											
HCFC-225 see Dichloropentafluoropropane											
Heptane, n-		142-82-5	C_7H_{16}	45	+	2.8	+	0.60	+	9.92	400
Heptanol, 4-	Dipropylcarbinol	589-55-9	$C_7H_{16}O$	1.8	+	1.3	+	0.5	+	9.61	ne
Hexamethyldisilazane, 1,1,1,3,3,3- *	HMDS	999-97-3	$C_6H_{19}NSi_2$			0.2	+	0.2	+	~8.6	ne
Hexamethyldisiloxane	HMDSx	107-46-0	$C_6H_{18}OSi_2$	0.33	+	0.27	+	0.25	+	9.64	ne
Hexane, n-		110-54-3	C_6H_{14}	350	+	4.3	+	0.54	+	10.13	50
Hexanol, 1-	Hexyl alcohol	111-27-3	$C_6H_{14}O$	9	+	2.5	+	0.55	+	9.89	ne
Hexene, 1-		592-41-6	C_6H_{12}			0.8				9.44	30
HFE-7100 see Methyl nonafluorobutyl ether											
Histoclear (Histo-Clear)	Limonene/corn oil reagent		m.w. ~136	0.5	+	0.4	+	0.3	+		ne
Hydrazine *		302-01-2	H_4N_2	>8	+	2.6	+	2.1	+	8.1	0.01
Hydrazoic acid	Hydrogen azide		HN_3							10.7	
Hydrogen	Synthesis gas	1333-74-0	H_2	NR	+	NR	+	NR	+	15.43	ne
Hydrogen cyanide	Hydrocyanic acid	74-90-8	HCN	NR	+	NR	+	NR	+	13.6	C4.7
Hydrogen iodide *	Hydriodic acid	10034-85-2	HI			~0.6*				10.39	
Hydrogen peroxide		7722-84-1	H_2O_2	NR	+	NR	+	NR	+	10.54	1
Hydrogen sulfide		7783-06-4	H_2S	NR	+	3.3	+	1.5	+	10.45	10
Hydroxypropyl methacrylate		27813-02-1 923-26-2	$C_7H_{12}O_3$	9.9	+	2.3	+	1.1	+		ne
Iodine *		7553-56-2	I_2	0.1	+	0.1	+	0.1	+	9.40	C0.1

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Iodomethane	Methyl iodide	74-88-4	CH_3I	0.21	+	0.22	+	0.26	+	9.54	2
Isoamyl acetate	Isopentyl acetate	123-92-2	$C_7H_{14}O_2$	10.1		2.1		1.0		<10	100
Isobutane	2-Methylpropane	75-28-5	C_4H_{10}			100	+	1.2	+	10.57	ne
Isobutanol	2-Methyl-1-propanol	78-83-1	$C_4H_{10}O$	19	+	3.8	+	1.5		10.02	50
Isobutene	Isobutylene, Methyl butene	115-11-7	C_4H_8	1.00	+	1.00	+	1.00	+	9.24	Ne
Isobutyl acrylate	Isobutyl 2-propenoate	106-63-8	$C_7H_{12}O_2$			1.5	+	0.60	+		Ne
Isoflurane	1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether, forane	26675-46-7	$C_3H_2ClF_5O$	NR	+	NR	+	48	+	~11.7	Ne
Isooctane	2,2,4-Trimethylpentane	540-84-1	C8H18			1.2				9.86	ne
Isopar E Solvent	Isoparaffinic hydrocarbons	64741-66-8	m.w. 121	1.7	+	0.8	+				Ne
Isopar G Solvent	Photocopier diluent	64742-48-9	m.w. 148			0.8	+				Ne
Isopar K Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 156	0.9	+	0.5	+	0.27	+		Ne
Isopar L Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 163	0.9	+	0.5	+	0.28	+		Ne
Isopar M Solvent	Isoparaffinic hydrocarbons	64742-47-8	m.w. 191			0.7	+	0.4	+		Ne
Isopentane	2-Methylbutane	78-78-4	C_5H_{12}			8.2					Ne
Isophorone		78-59-1	$C_9H_{14}O$					3		9.07	C5
Isoprene	2-Methyl-1,3-butadiene	78-79-5	C_5H_8	0.69	+	0.63	+	0.60	+	8.85	Ne
Isopropanol	Isopropyl alcohol, 2-propanol, IPA	67-63-0	C_3H_8O	500	+	6.0	+	2.7		10.12	200
Isopropyl acetate		108-21-4	$C_5H_{10}O_2$			2.6				9.99	100
Isopropyl ether	Diisopropyl ether	108-20-3	$C_6H_{14}O$			0.8				9.20	250
Jet fuel JP-4	Jet B, Turbo B, F-40 Wide cut type aviation fuel	8008-20-6 + 64741-42-0	m.w. 115			1.0	+	0.4	+		Ne
Jet fuel JP-5	Jet 5, F-44, Kerosene type aviation fuel	8008-20-6 + 64747-77-1	m.w. 167			0.6	+	0.5	+		29
Jet fuel JP-8	Jet A-1, F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 165			0.6	+	0.3	+		30
Jet fuel A-1 (JP-8)	F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 145			0.67					34
Jet Fuel TS	Thermally Stable Jet Fuel, Hydrotreated kerosene fuel	8008-20-6 + 64742-47-8	m.w. 165	0.9	+	0.6	+	0.3	+		30
Limonene, D-	(R)-(+)-Limonene	5989-27-5	$C_{10}H_{16}$			0.33	+			~8.2	Ne
Kerosene C10-C16 petro.distillate – see Jet Fuels		8008-20-6									
MDI – see 4,4'-Methylenebis(phenylisocyanate)											
Maleic anhydride	2,5-Furandione	108-31-6	$C_4H_2O_3$							~10.8	0.1
Mesitylene	1,3,5-Trimethylbenzene	108-67-8	C_9H_{12}	0.36	+	0.35	+	0.3	+	8.41	25
Methallyl chloride – see 3-Chloro-2-methylpropene											
Methane	Natural gas	74-82-8	CH_4	NR	+	NR	+	NR	+	12.61	Ne
Methanol	Methyl alcohol, carbinol	67-56-1	CH_4O	NR	+	NR	+	2.5	+	10.85	200
Methoxyethanol, 2-	Methyl cellosolve, Ethylene glycol monomethyl ether	109-86-4	$C_3H_8O_2$	4.8	+	2.4	+	1.4	+	10.1	5
Methoxyethoxyethanol, 2-	2-(2-Methoxyethoxy)ethanol Diethylene glycol monomethyl ether	111-77-3	$C_7H_{16}O$	2.3	+	1.2	+	0.9	+	<10	Ne
Methoxyethyl ether, 2-	bis(2-Methoxyethyl) ether, Diethylene glycol dimethyl ether, Diglyme	111-96-6	$C_6H_{14}O_3$	0.64	+	0.54	+	0.44	+	<9.8	Ne
Methyl acetate		79-20-9	$C_3H_6O_2$	NR	+	6.6	+	1.4	+	10.27	200
Methyl acrylate	Methyl 2-propenoate, Acrylic acid methyl ester	96-33-3	$C_4H_6O_2$			3.7	+	1.2	+	(9.9)	2
Methylamine	Aminomethane	74-89-5	CH_5N			1.2				8.97	5
Methyl amyl ketone	MAK, 2-Heptanone, Methyl pentyl ketone	110-43-0	$C_7H_{14}O$	0.9	+	0.85	+	0.5	+	9.30	50
Methyl bromide	Bromomethane	74-83-9	CH_3Br	110	+	1.7	+	1.3	+	10.54	1
Methyl t-butyl ether	MTBE, *tert*-Butyl methyl ether	1634-04-4	$C_5H_{12}O$			0.9	+			9.24	40
Methyl cellosolve	see 2-Methoxyethanol										
Methyl chloride	Chloromethane	74-87-3	CH_3Cl	NR	+	NR	+	0.74	+	11.22	50
Methylcyclohexane		107-87-2	C_7H_{14}	1.6	+	0.97	+	0.53	+	9.64	400
Methylene bis(phenyl-isocyanate), 4,4'- *	MDI, Mondur M		$C_{15}H_{10}N_2O_2$	Very slow ppb level response							0.005

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Methylene chloride	Dichloromethane	75-09-2	CH_2Cl_2	NR	+	NR	+	0.89	+	11.32	25
Methyl ether	Dimethyl ether	115-10-6	C_2H_6O	4.8	+	3.1	+	2.5	+	10.03	Ne
Methyl ethyl ketone	MEK, 2-Butanone	78-93-3	C_4H_8O	0.86	+	0.9	+	1.1	+	9.51	200
Methylhydrazine	Monomethylhydrazine, Hydrazomethane	60-34-4	$C_2H_6N_2$	1.4	+	1.2	+	1.3	+	7.7	0.01
Methyl isoamyl ketone	MIAK, 5-Methyl-2-hexanone	110-12-3	$C_7H_{14}O$	0.8	+	0.76	+	0.5	+	9.28	50
Methyl isobutyl ketone	MIBK, 4-Methyl-2-pentanone	108-10-1	$C_6H_{12}O$	0.9	+	0.8	+	0.6	+	9.30	50
Methyl isocyanate	CH3NCO	624-83-9	C_2H_3NO	NR	+	4.6	+	1.5		10.67	0.02
Methyl isothiocyanate	CH3NCS	551-61-6	C_2H_3NS	0.5	+	0.45	+	0.4	+	9.25	ne
Methyl mercaptan	Methanethiol	74-93-1	CH_4S	0.65		0.54		0.66		9.44	0.5
Methyl methacrylate		80-62-6	$C_5H_8O_2$	2.7	+	1.5	+	1.2	+	9.7	100
Methyl nonafluorobutyl ether	HFE-7100DL	163702-08-7, 163702-07-6	$C_5H_3F_9O$			NR	+	~35	+		ne
Methyl-1,5-pentanediamine, 2- (coats lamp) *	Dytek-A amine, 2-Methyl pentamethylenediamine	15520-10-2	C6H16N2			~0.6	+			<9.0	ne
Methyl propyl ketone	MPK, 2-Pentanone	107-87-9	$C_5H_{12}O$			0.93	+	0.79	+	9.38	200
Methyl-2-pyrrolidinone, N-	NMP, N-Methylpyrrolidone, 1-Methyl-2-pyrrolidinone, 1-Methyl-2-pyrrolidone	872-50-4	C_5H_9NO	1.0	+	0.8	+	0.9	+	*9.17*	ne
Methyl salicylate	Methyl 2-hydroxybenzoate	119-36-8	C_8H_8O3	1.3	+	0.9	+	0.9	+	~9	ne
Methylstyrene, α-	2-Propenylbenzene	98-83-9	C_9H_{10}			0.5				8.18	50
Methyl sulfide	DMS, Dimethyl sulfide	75-18-3	C_2H_6S	0.49	+	0.44	+	0.46	+	8.69	ne
Mineral spirits	Stoddard Solvent, Varsol 1, White Spirits	8020-83-5 8052-41-3 68551-17-7	m.w. 144	1.0		0.69	+	0.38	+		100
Mineral Spirits - Viscor 120B Calibration Fluid, b.p. 156-207°C		8052-41-3	m.w. 142	1.0	+	0.7	+	0.3	+		100
Monoethanolamine - see Ethanolamine											
Mustard *	HD, Bis(2-chloroethyl) sulfide	505-60-2 39472-40-7 68157-62-0	$C_4H_8Cl_2S$			0.6					0.0005
Naphtha - see VM & P Naptha											
Naphthalene	Mothballs	91-20-3	$C_{10}H_8$	0.45	+	0.42	+	0.40	+	8.13	10
Nickel carbonyl (in CO)	Nickel tetracarbonyl	13463-39-3	C_4NiO_4			0.18				<8.8	0.001
Nicotine		54-11-5	$C_{10}H_{14}N_2$			2.0				≤10.6	
Nitric oxide		10102-43-9	NO	~6		5.2	+	2.8	+	9.26	25
Nitrobenzene		98-95-3	$C_6H_5NO_2$	2.6	+	1.9	+	1.6	+	9.81	1
Nitroethane		79-24-3	$C_2H_5NO_2$					3		10.88	100
Nitrogen dioxide		10102-44-0	NO_2	23	+	16	+	6	+	9.75	3
Nitrogen trifluoride		7783-54-2	NF_3	NR		NR		NR		13.0	10
Nitromethane		75-52-5	CH_3NO_2					4		11.02	20
Nitropropane, 2-		79-46-9	$C_3H_7NO_2$					2.6		10.71	10
Nonane		111-84-2	C_9H_{20}			1.4				9.72	200
Norpar 12	n-Paraffins, mostly C_{10}-C_{13}	64771-72-8	m.w. 161	3.2	+	1.1	+	0.28	+		ne
Norpar 13	n-Paraffins, mostly C_{13}-C_{14}	64771-72-8	m.w. 189	2.7	+	1.0	+	0.3	+		ne
Octamethylcyclotetrasiloxane		556-67-2	$C_8H_{24}O_4Si_4$	0.21	+	0.17	+	0.14	+		ne
Octamethyltrisiloxane		107-51-7	$C_8H_{24}O_2Si_3$	0.23	+	0.18	+	0.17	+	<10.0	ne
Octane, n-		111-65-9	C_8H_{18}	13	+	1.8	+			9.82	300
Octene, 1-		111-66-0	C_8H_{16}	0.9	+	0.75	+	0.4	+	9.43	75
Pentane		109-66-0	C_5H_{12}	80	+	8.4	+	0.7	+	10.35	600
Peracetic acid *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$	NR	+	NR	+	2.3	+		ne
Peracetic/Acetic acid mix *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$			50	+	2.5	+		ne
Perchloroethene	PCE, Perchloroethylene, Tetrachloroethylene	127-18-4	C_2Cl_4	0.69	+	0.57	+	0.31	+	9.32	25
PGME	Propylene glycol methyl ether, 1-Methoxy-2-propanol	107-98-2	$C_6H_{12}O_3$	2.4	+	1.5	+	1.1	+		100

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PGMEA	Propylene glycol methyl ether acetate, 1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate	108-65-6	$C_6H_{12}O_3$	1.65	+	1.0	+	0.8	+		ne
Phenol	Hydroxybenzene	108-95-2	C_6H_6O	1.0	+	1.0	+	0.9	+	8.51	5
Phosgene	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	8.5	+	11.2	0.1
Phosgene in Nitrogen	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	6.8	+	11.2	0.1
Phosphine (coats lamp)		7803-51-2	PH_3	28		3.9	+	1.1	+	9.87	0.3
Photocopier Toner	Isoparaffin mix					0.5	+	0.3	+		ne
Picoline, 3-	3-Methylpyridine	108-99-6	C_6H_7N			0.9				9.04	ne
Pinene, α-		2437-95-8	$C_{10}H_{16}$			0.31	+	0.47		8.07	ne
Pinene, β-		18172-67-3	$C_{10}H_{16}$	0.38	+	0.37	+	0.37	+	~8	100
Piperylene, isomer mix	1,3-Pentadiene	504-60-9	C_5H_8	0.76	+	0.69	+	0.64	+	8.6	100
Propane		74-98-6	C_3H_8			NR	+	1.8	+	10.95	2500
Propanol, n-	Propyl alcohol	71-23-8	C_3H_8O			5		1.7		10.22	200
Propene	Propylene	115-07-1	C_3H_6	1.5	+	1.4	+	1.6	+	9.73	ne
Propionaldehyde	Propanal	123-38-6	C_3H_6O			1.9				9.95	ne
Propyl acetate, n-		109-60-4	$C_5H_{10}O_2$			3.5		2.3		10.04	200
Propylamine, n-	1-Propylamine, 1-Aminopropane	107-10-8	C_3H_9N	1.1	+	1.1	+	0.9	+	8.78	ne
Propylene carbonate *		108-32-7	$C_4H_6O_3$			62	+	1	+	10.5	ne
Propylene glycol	1,2-Propanediol	57-55-6	$C_3H_8O_2$	18		5.5	+	1.6	+	<10.2	ne
Propylene glycol propyl ether	1-Propoxy-2-propanol	1569-01-3	$C_6H_{14}O_2$	1.3	+	1.0	+	1.6	+		ne
Propylene oxide	Methyloxirane	75-56-9 16088-62-3 15448-47-2	C_3H_6O	~240		6.6	+	2.9	+	10.22	20
Propyleneimine	2-Methylaziridine	75-55-8	C_3H_7N	1.5	+	1.3	+	1.0	+	9.0	2
Propyl mercaptan, 2-	2-Propanethiol, Isopropyl mercaptan	75-33-2	C_3H_8S	0.64	+	0.66	+			9.15	ne
Pyridine		110-86-1	C_5H_5N	0.78	+	0.7	+	0.7	+	9.25	5
Pyrrolidine (coats lamp)	Azacyclohexane	123-75-1	C_4H_9N	2.1	+	1.3	+	1.6	+	~8.0	ne
RR7300 (PGME/PGMEA)	70:30 PGME:PGMEA (1-Methoxy-2-propanol:1-Methoxy-2-acetoxypropane)	107-98-2	$C_4H_{10}O_2$ / $C_6H_{12}O_3$			1.4	+	1.0	+		ne
Sarin	GB, Isopropyl methylphosphonofluoridate	107-44-8 50642-23-4	$C_4H_{10}FO_2P$			~3					
Stoddard Solvent - see Mineral Spirits		8020-83-5									
Styrene		100-42-5	C_8H_8	0.45	+	0.40	+	0.4	+	8.43	20
Sulfur dioxide		7446-09-5	SO_2	NR		NR	+	NR	+	12.32	2
Sulfur hexafluoride		2551-62-4	SF_6	NR		NR		NR		15.3	1000
Sulfuryl fluoride	Vikane	2699-79-8	SO_2F_2	NR		NR		NR		13.0	5
Tabun *	Ethyl N, N-dimethylphosphoramidocyanidate	77-81-6	$C_5H_{11}N_2O_2P$			0.8					15ppt
Tetrachloroethane, 1,1,1,2-		630-20-6	$C_2H_2Cl_4$					1.3		~11.1	ne
Tetrachloroethane, 1,1,2,2-		79-34-5	$C_2H_2Cl_4$	NR	+	NR	+	0.60	+	~11.1	1
Tetrachlorosilane		10023-04-7	$SiCl_4$	NR		NR		15	+	11.79	ne
Tetraethyl lead	TEL	78-00-2	$C_8H_{20}Pb$	0.4		0.3		0.2		~11.1	0.008
Tetraethyl orthosilicate	Ethyl silicate, TEOS	78-10-4	$C_8H_{20}O_4Si$			0.7	+	0.2	+	~9.8	10
Tetrafluoroethane, 1,1,1,2-	HFC-134A	811-97-2	$C_2H_2F_4$			NR		NR			ne
Tetrafluoroethene	TFE, Tetrafluoroethylene, Perfluoroethylene	116-14-3	C_2F_4			~15				10.12	ne
Tetrafluoromethane	CFC-14, Carbon tetrafluoride	75-73-0	CF_4			NR	+	NR	+	>15.3	ne
Tetrahydrofuran	THF	109-99-9	C_4H_8O	1.9	+	1.7	+	1.0	+	9.41	200
Tetramethyl orthosilicate	Methyl silicate, TMOS	681-84-5	$C_4H_{12}O_4Si$	10	+	1.9	+			~10	1
Therminol® D-12 *	Hydrotreated heavy naphtha	64742-48-9	m.w. 160	0.8	+	0.51	+	0.33	+		ne
Therminol® VP-1 *	Dowtherm A, 3:1 Diphenyl oxide: Biphenyl	101-84-8 92-52-4	$C_{12}H_{10}O$ $C_{12}H_{10}$			0.4	+				1
Toluene	Methylbenzene	108-88-3	C_7H_8	0.54	+	0.50	+	0.51	+	8.82	50

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Tolylene-2,4-diisocyanate	TDI, 4-Methyl-1,3-phenylene-2,4-diisocyanate	584-84-9	$C_9H_6N_2O_2$	1.4	+	1.4	+	2.0	+		0.002
Trichlorobenzene, 1,2,4-	1,2,4-TCB	120-82-1	$C_6H_3Cl_3$	0.7	+	0.46	+			9.04	C5
Trichloroethane, 1,1,1-	1,1,1-TCA, Methyl chloroform	71-55-6	$C_2H_3Cl_3$			NR	+	1	+	11	350
Trichloroethane, 1,1,2-	1,1,2-TCA	79-00-5	$C_2H_3Cl_3$	NR	+	NR	+	0.9	+	11.0	10
Trichloroethene	TCE, Trichoroethylene	79-01-6	C_2HCl_3	0.62	+	0.54	+	0.43	+	9.47	50
Trichloromethylsilane	Methyltrichlorosilane	75-79-6	CH_3Cl_3Si	NR		NR		1.8	+	11.36	ne
Trichlorotrifluoroethane, 1,1,2-	CFC-113	76-13-1	$C_2Cl_3F_3$			NR		NR		11.99	1000
Triethylamine	TEA	121-44-8	$C_6H_{15}N$	0.95	+	0.9	+	0.65	+	7.3	1
Triethyl borate	TEB; Boric acid triethyl ester	150-46-9	$C_6H_{15}O_3B$			2.2	+	1.1	+	~10	ne
Triethyl phosphate	Ethyl phosphate	78-40-0	$C_6H_{15}O_4P$	~50	+	3.1	+	0.60	+	9.79	ne
Trifluoroethane, 1,1,2-		430-66-0	$C_2H_3F_3$					34		*12.9*	ne
Trimethylamine		75-50-3	C_3H_9N			0.9				7.82	5
Trimethylbenzene, 1,3,5- - see Mesitylene		108-67-8									25
Trimethyl borate	TMB; Boric acid trimethyl ester, Boron methoxide	121-43-7	$C_3H_9O_3B$			5.1	+	1.2	+	10.1	ne
Trimethyl phosphate	Methyl phosphate	512-56-1	$C_3H_9O_4P$			8.0	+	1.3	+	9.99	ne
Trimethyl phosphite	Methyl phosphite	121-45-9	$C_3H_9O_3P$			1.1	+		+	*8.5*	2
Turpentine	Pinenes (85%) + other diisoprenes	8006-64-2	$C_{10}H_{16}$	0.37	+	0.30	+	0.29	+	~8	20
Undecane		1120-21-4	$C_{11}H_{24}$			2				9.56	ne
Varsol – see Mineral Spirits											
Vinyl actetate		108-05-4	$C_4H_6O_2$	1.5	+	1.2	+	1.0	+	9.19	10
Vinyl bromide	Bromoethylene	593-60-2	C_2H_3Br			0.4				9.80	5
Vinyl chloride	Chloroethylene, VCM	75-01-4	C_2H_3Cl			2.0	+	0.6	+	9.99	5
Vinyl-1-cyclohexene, 4-	Butadiene dimer, 4-Ethenylcyclohexene	100-40-3	C_8H_{12}	0.6	+	0.56	+			9.83	0.1
Vinylidene chloride - see 1,1-Dichloroethene											
Vinyl-2-pyrrolidinone, 1-	NVP, N-vinylpyrrolidone, 1-ethenyl-2-pyrrolidinone	88-12-0	C_6H_9NO	1.0	+	0.8	+	0.9	+		ne
Viscor 120B - see Mineral Spirits - Viscor 120B Calibration Fluid											
V. M. & P. Naphtha	Ligroin; Solvent naphtha; Varnish maker's & painter's naptha	64742-89-8	m.w. 111 (C_8-C_9)	1.7	+	0.97	+				300
Xylene, m-	1,3-Dimethylbenzene	108-38-3	C_8H_{10}	0.50	+	0.44	+	0.40	+	8.56	100
Xylene, o-	1,2-Dimethylbenzene	95-47-6	C_8H_{10}	0.56	+	0.46	+	0.43		8.56	100
Xylene, p-	1,4-Dimethylbenzene	106-42-3	C_8H_{10}	0.48	+	0.39	+	0.38	+	8.44	100
None				1		1		1			
Undetectable				1E+6		1E+6		1E+6			

* Compounds indicated in green can be detected using a MiniRAE 2000 or ppbRAE/+ with slow response, but may be lost by adsorption on a MultiRAE or EntryRAE. Response on multi-gas meters can give an indication of relative concentrations, but may not be quantitative and for some chemicals no response is observed.

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Appendix I:
Example of Automatic Calculation of Correction Factors, TLVs and Alarm Limits for Mixtures
(Calculations performed using Excel version of this database, available on request)

Compound	CF 9.8 eV	CF 10.6 eV	CF 11.7eV	Mol. Frac	Conc ppm	TLV ppm	STEL Ppm
Benzene	0.55	0.53	0.6	0.01	1	0.5	2.5
Toluene	0.54	0.5	0.51	0.06	10	50	150
Hexane, n-	300	4.3	0.54	0.06	10	50	150
Heptane, n-	45	2.8	0.6	0.28	50	400	500
Styrene	0.45	0.4	0.42	0.06	10	20	40
Acetone	1.2	1.1	1.4	0.28	50	750	1000
Isopropanol	500	6	2.7	0.28	50	400	500
None	1	1	1	0.00	0	1	
Mixture Value:	2.1	1.5	0.89	1.00	181	56	172
TLV Alarm Setpoint when Calibrated to Isobutylene:	26 ppm	37 ppm	62 ppm		ppm	ppm	ppm
STEL Alarm Setpoint, same Calibration	86 ppm	115 ppm	193 ppm				

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FIELD OPERATING PROCEDURES

Composite Sample Collection Procedure for Non-VOC Analysis

FOP 013.0

COMPOSITE SAMPLE COLLECTION PROCEDURE FOR NON-VOLATILE ORGANIC ANALYSIS

PURPOSE

This guideline addresses the procedure to be used when soil samples are to be composited in the field.

PROCEDURE

1. Transfer equal weighted aliquots of soil from individual split-spoon samples, excavator bucket, hand auger or surface soil sample location to a large precleaned stainless steel (or Pyrex glass) mixing bowl.

2. Thoroughly mix (homogenize) and break up the soil using a stainless steel scoop or trowel.

3. Spread the composite sample evenly on a stainless steel tray and quarter the sample.

4. Discard alternate (i.e., diagonal) quarters and, using a small stainless steel scoop or spatula, collect equal portions of subsample from the remaining two quarters until the amount required for the composite sample is acquired. Transfer these subsamples to a precleaned stainless steel (or Pyrex glass) mixing bowl and re-mix.

5. Transfer the composite sample to the laboratory provided, precleaned sample jars. Store any excess sample from the stainless steel tray in a separate, precleaned, wide-mouth sample jar and refrigerate for future use, if applicable.

6. Decontaminate all stainless steel (or Pyrex glass) equipment in accordance with Benchmark's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures.

7. Prepare samples in accordance with Benchmark's Sample Labeling, Storage and Shipment FOP.

8. Record all sampling details in the Project Field Book and on the Soil/Sediment Sample Collection Summary Log (sample attached).

ATTACHMENTS

Soil/Sediment Sample Collection Summary Log (sample)

REFERENCES

Benchmark FOPs:

040 *Non-disposable and Non-dedicated Sampling Equipment Decontamination*

046 *Sample Labeling, Storage and Shipment*

FOP 013.0

COMPOSITE SAMPLE COLLECTION PROCEDURE FOR NON-VOLATILE ORGANIC ANALYSIS

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

SOIL/SEDIME

SAMPLE COLLECTION SUMMARY L

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to varian location changes, depth changes, import matrix observations or description, grav thickness, etc.)
			from	to						

SAMPLE

Equipment Rinsate Blanks *- Pour clean deionized wate... ...uipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples coll the same day. HSL Metals can be substituted by only the Metals a... ...exa... ...romium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionzied water lot # or distilay. manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matri... ...or all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' sectio*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
5. BD - Blind Duplicate - indicate location of duplicate.

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FIELD OPERATING PROCEDURES

Drilling and Excavation Equipment Decontamination Procedures

FOP 018.0

DRILLING AND EXCAVATION EQUIPMENT DECONTAMINATION PROCEDURES

PURPOSE

This procedure is to be used for the decontamination of drilling and excavation equipment (i.e., drill rigs, backhoes, augers, drill bits, drill rods, buckets, and associated equipment) used during a subsurface investigation. The purpose of this procedure is to remove chemical constituents associated with a particular drilling or excavation location from this equipment. This prevents these constituents from being transferred between drilling or excavation locations, or being transported out of controlled areas.

PROCEDURE

The following procedure will be utilized prior to the use of drilling or excavation equipment at each location, and prior to the demobilization of such equipment from the site:

1. Remove all loose soil and other particulate materials from the equipment at the survey site.

2. Wrap augers, tools, plywood, and other reusable items with a plastic cover prior to transport from the site of use to the decontamination facility.

3. Transport equipment to the decontamination facility. All equipment must be decontaminated at an established decontamination facility. This facility will be placed within a controlled area, and will be equipped with necessary features to contain and collect wash water and entrained materials.

4. Wash equipment thoroughly with pressurized low-volume water or steam, supplied by a pressure washer or steam cleaner.

5. If necessary, use a brush or scraper to remove visible soils adhering to the equipment, and a non-phosphate detergent to remove any oils, grease, and/or hydraulic fluids adhering to the equipment. Continue pressure washing until all visible contaminants are removed.

6. Allow equipment to air dry.

7. Store equipment in a clean area or wrap the equipment in new plastic sheeting as necessary to ensure cleanliness until ready for use.

8. Manage all wash waters and entrained solids as described in the Benchmark Field Operating Procedure for Management of Investigation-Derived Waste.

ATTACHMENTS

none

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FIELD OPERATING PROCEDURES

Hollow Stem Auger Drilling Procedures

FOP 026.1

HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES

PURPOSE

This guideline presents a method for drilling a borehole through unconsolidated materials, including soils or overburden, and consolidated materials, including bedrock.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using hollow-stem auger methods and equipment.

1. Follow Benchmark's Field Operating Procedure for Drill Site Selection Procedure prior to implementing any drilling activity.

2. Perform drill rig safety checks with the driller by completing the Drilling Safety Checklist form (sample attached).

3. Conduct tailgate health and safety meeting with project team and drillers by completing the Tailgate Safety Meeting Form.

4. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures (i.e., PID, FID, combustible gas meter) or manufacturer's recommendations for calibration of field meters (i.e., DataRAM 4 Particulate Meter).

5. Ensure all drilling equipment (i.e., augers, rods, split-spoons) appear clean and free of soil prior to initiating any subsurface intrusion. Decontamination of drilling equipment should be in accordance with Benchmark's FOP: Drilling and Excavation Equipment Decontamination Procedures.

6. Mobilize the auger rig to the site and position over the borehole.

7. Level and stabilize the rig using the rig jacks, and recheck the rig location against the planned drilling location. If necessary, raise the jacks and adjust the rig position.

8. Place a metal or plywood auger pan over the borehole location to collect the auger cuttings. This auger pan will be equipped with a 12-inch nominal diameter hole for auger passage. As an alternative, a piece of polyethylene tarp may be used as a substitute.

9. Advance augers into the subsurface. For sampling or pilot-hole drilling, nominal 8-inch outside diameter (OD) augers should be used. The boring diameter will be approved by the Benchmark field supervisor.

10. Collect soil samples via split spoon sampler in accordance with Benchmark's Field Operating Procedure for Split Spoon Sampling.

11. Check augers periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.

12. Continue drilling until reaching the assigned total depth, or until auger refusal occurs. Auger refusal is when the drilling penetration drops below 0.1 feet per 10 minutes, with the full weight of the rig on the auger bit, and a center bit (not center plug) in place.

13. Plug and abandon boreholes not used for well installation in accordance with Benchmark's Field Operating Procedure for Abandonment of Borehole.

OTHER PROCEDURAL ISSUES

- Slip rings may be used for lifting a sampling or bit string. The string will not be permitted to extend more than 15 feet above the mast crown.

- Borings will not be over drilled (rat holed) without the express permission of the Benchmark field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.

- Potable water may be placed in the auger stem if critically necessary for borehole control or to accomplish sampling objectives and must be approved by the Benchmark Project Manager and/or NYSDEC Project Manager. Upon approval,

the potable water source and quantity used will be documented in the Project Field Book and subsequent report submittal.

ATTACHMENTS

Drilling Safety Checklist (sample)
Tailgate Safety Meeting Form (sample)

REFERENCES

Benchmark FOPs:

001 *Abandonment of Borehole Procedures*
010 *Calibration and Maintenance of Portable Flame Ionization Detector*
011 *Calibration and Maintenance of Portable Photoionization Detector*
017 *Drill Site Selection Procedure*
018 *Drilling and Excavation Equipment Decontamination Procedures*
058 *Split Spoon Sampling Procedures*

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DRILLING SAFETY CHECKLIST

Project: **Supplemental Phase II RFI/ICMs**	Date:
Project No.: **0041-009-500**	Drilling Company:
Client: **RealCo., Inc.**	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
"Kill switches" installed by the manufacturer are in operable condition and all workers at the drill site are familiar with their location and how to activate them?		
"Kill switches" are accessible to workers on both sides of the rotating stem? NOTE: Optional based on location and number of switches provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wires, "bird cages" and worn or missing sections?		
Cables are terminated at the working end with a proper eye splice, either swaged Coupling or using cable clamps?		
Cable clamps are installed with the saddle on the live or load side? Clamps should not be alternated and should be of the correct size and number for the cable size to which it is installed. Clamps are complete with no missing parts?		
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation?		
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load?		
Drive shafts, belts, chain drives and universal joints shall be guarded to prevent accidental insertion of hands and fingers or tools?		
Outriggers shall be extended prior to and whenever the boom is raised off its cradle. Hydraulic outriggers must maintain pressure to continuously support and stabilize the drill rig even while unattended.		
Outriggers shall be properly supported on the ground surface to prevent settling into the soil.		
Controls are properly labeled and have freedom of movement. Controls should not be blocked or locked in an action position.		
Safeties on any device shall not be bypassed or neutralized.		
Controls shall be operated smoothly and cables and lifting devices shall not be jerked or operated erratically to overcome resistance.		
Slings, chokers and lifting devices are inspected before using and are in proper working order? Damaged units are removed from service and are properly tagged?		
Shackles and clevises are in proper working order and pins and screws are fully inserted before placing under a load?		
High-pressure hoses have a safety (chain, cable or strap) at each end of the hose section to prevent whipping in the event of a failure?		
Rotating parts of the drill string shall be free of sharp projections or hooks, which could entrap clothing or foreign objects?		
Wire ropes should not be allowed to bend around sharp edges without cushion material.		
The exclusion zone is centered over the borehole and the radius is equal or greater than the boom height?		

SAMPLE

ITEMS TO CHECK	OK	ACTION NEEDED

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DRILLING SAFETY CHECKLIST

Project: **Supplemental Phase II RFI/ICMs**	Date:
Project No.: **0041-009-500**	Drilling Company:
Client: **RealCo., Inc.**	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
The work area around the borehole shall be kept clear of trip hazards and walking surfaces should be free of slippery material.		
Workers shall not proceed higher than the drilling deck without a fall restraining device and must attach the device in a manner to restrict fall to less than 6 feet.		
A fire extinguisher of appropriate size shall be immediately available to the drill crew. The drill crew shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to, under, by, or near power lines only in accordance with the following: .333 © (3) (ii) 50 kV or less -minimum clearance is 10 ft. For 50 kV or over - 10ft. Plus ½ in. For each additional kV **Benchmark Policy: Maintain 20 feet clearance**		
29 CFR 1910.333 © (3) (iii) While the rig is in transit with the boom in the down position, clearance from energized power lines will be maintained as follows: Less than 50 kV - 4 feet 50 to 365 kV - 10 feet 365 to 720 kV - 16 feet		

SAMPLE

Name: _____ (printed)

Signed: _____ Date: _____

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

SAMPLE

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

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FIELD OPERATING PROCEDURES

Sample Labeling, Storage, and Shipment Procedures

FOP 046.0

SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

PURPOSE

The collection and analysis of samples of environmental media, including soils, groundwater, surface water, and sediment, are the central activities of the field investigation. These samples must be properly labeled to preserve its identity, and properly stored and shipped in a manner that preserves its integrity and chain of custody. This procedure presents methods for these activities.

SAMPLE LABELING PROCEDURE

1. Assign each sample retained for analysis a unique 9-digit alphanumeric identification code or as indicated in the Project Work Plan. Typically, this code will be formatted as follows:

Sample I.D. Example: GW051402047	
GW	**Sample matrix** GW = groundwater; SW = surface water; SUB = subsurface soil; SS = surface soil; SED = sediment; L = leachate; A = air
05	Month of sample collection
14	Day of sample collection
02	Year of sample collection
047	Consecutive sample number

2. Consecutive sample numbers will indicate the individual sample's sequence in the total set of samples collected during the investigation/sampling event. The sample number above, for example, would indicate the 47th sample retained for analysis during the field investigation, collected on May 14, 2002.

3. Affix a non-removable (when wet) label to each sample container. The following information will be written on the label with black or blue ink that will not smudge when wet:

   - Project number
   - Sample ID (see Step 1 above)
   - Date of sample collection
   - Time of sample collection (military time only)
   - Specify "grab" or "composite" sample with an "X"
   - Sampler initials
   - Preservative(s) (if applicable)
   - Analytes for analysis (if practicable)

4. Record all sample label information in the Project Field Book and on a Sample Summary Collection Log (see attached samples), keyed to the sample identification number. In addition, add information regarding the matrix, sample location, depth, etc. to provide a complete description of the sample.

SAMPLE STORAGE PROCEDURE

1. Immediately after collection, placement in the proper container, and labeling, place samples to be retained for chemical analysis into resealable plastic bags.

2. Place bagged samples into an ice chest filled approximately half-full of double bagged ice. Blue ice is not an acceptable substitute for ice.

3. Maintain samples in an ice chest or in an alternative location (e.g. sample refrigerator) as approved by the Benchmark Field Team Leader until time of shipment. Periodically drain melt-water off coolers and replenish ice as necessary.

4. Ship samples on a daily basis, unless otherwise directed by the Benchmark Field Team Leader.

5. Maintain appropriate custody procedures on coolers and other sample storage containers at all times. These procedures are discussed in detail in the Project Quality Assurance Project Plan, Monitoring Plan or Work Plan.

6. Samples shall be kept in a secure location locked and controlled (i.e., locked building or fenced area) so that only the Project Field Team Leader has access to the location or under the constant visual surveillance of the same.

SAMPLE SHIPPING PROCEDURE

1. Fill out the chain-of-custody form completely (see attached sample) with all relevant information. The white original goes with the samples and should be placed in a resealable plastic bag and taped inside the sample cooler lid; the sampler should retain the copy.

2. Place a layer of inert cushioning material such as bubble pack in the bottom of cooler.

3. Place each bottle in a bubble wrap sleeve or other protective wrap. To the extent practicable, then place each bottle in a resealable plastic bag.

4. Open a garbage bag (or similar) into a cooler and place sample bottles into the garbage bag (or similar) with volatile organic analysis (VOA) vials near the center of the cooler.

5. Pack bottles with ice in plastic bags. At packing completion, cooler should be at least 50 percent ice, by volume. Coolers should be completely filled, so that samples do not move excessively during shipping.

6. Duct tape (or similar) cooler drain closed and wrap cooler completely in two or more locations to secure lid, specifically covering the hinges of the cooler.

7. Place laboratory label address identifying cooler number (i.e., 1 of 4, 2 of 4 etc.) and overnight delivery waybill sleeves on cooler lid or handle sleeve (Federal Express).

8. Sign the custody seal tape with an indelible soft-tip marker and place over the duct tape across the front and back seam between the lid and cooler body.

9. Cover the signed custody seal tape with an additional wrap of transparent strapping tape.

10. Place "Fragile" and "This Side Up" labels on all four sides of the cooler. "This Side Up" labels are yellow labels with a black arrow with the arrowhead pointing toward the cooler lid.

11. For coolers shipped by overnight delivery, retain a copy of the shipping waybill, and attach to the chain-of-custody documentation.

ATTACHMENTS

Soil/Sediment Sample Summary Collection Log (sample)
Groundwater/Surface Water Sample Summary Collection Log (sample)
Wipe Sample Summary Collection Log (sample)
Air Sample Summary Collection Log (sample)
Chain-Of-Custody Form (sample)

REFERENCES

None

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

AIR SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. SC - Summa Canister.
3. TB - Tedlar Bag (quantity).
4. No Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blanks, Field Duplicates, Field Blanks or Rinsates collected for air samples.

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

CHAIN OF CUSTODY RECORD

Project No.	Project Name					Number of Containers	VOCs	SVOCs	Metals						REMARKS
Samplers (Signature)															
No.	Date	Time	comp	grab	Sample Identification										

Possible Hazard Identification:
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal:
☐ Return to Client ☐ Disposal by Lab ☐ Archive _____(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐

QC Level:
I. ☐ II. ☐ III. ☐ Project Specific (specify):_____

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

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

WIPE SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. FD - Field Duplicate.
4. FB - Field Blank.
5. RS - Rinsate.
6. No Matrix Spike, Matrix Spike Duplicate or Matrix Spike Blanks for wipe samples.
7. Rinsates should be taken at a rate of 1 per day during wipe sampling. Only take when reusable equipment is used.
8. Wipe sample FB collected by wiping unused glove (and any other sampling equipment coming into contact with sampled surface) with prepared gauze pad and place in sample jar. Take at a rate of 1 FB per 20 samples.
9. Wipe sample FDs taken adjacent to original sample at a rate of 1 FD per 20 samples.
10. **EH :** Extract and Hold

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

AIR SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. SC - Summa Canister.
3. TB - Tedlar Bag (quantity).
4. No Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blanks, Field Duplicates, Field Blanks or Rinsates collected for air samples.

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

CHAIN OF CUSTODY RECORD

Project No.	Project Name					Number of Containers	VOCs	SVOCs	Metals						REMARKS
Samplers (Signature)															
No.	Date	Time	comp	grab	Sample Identification										

Possible Hazard Identification:
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal:
☐ Return to Client ☐ Disposal by Lab ☐ Archive _____(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐

QC Level:
I. ☐ II. ☐ III. ☐ Project Specific (specify):_____

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

SAMPLE

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FIELD OPERATING PROCEDURES

Soil Sample Collection for VOC Analysis (EnCore Sampling)

FOP 057.0

SOIL SAMPLE COLLECTION FOR VOC ANALYSIS – ENCORE SAMPLING

BACKGROUND AND PURPOSE

This procedure describes the methods for collecting soil samples for VOC analysis to ensure that the sample adequately represents the VOC concentrations in the soil in accordance with SW-846 Method 5035A (effective July 1, 2002). These compounds tend to volatilize from the soil after disturbance or introduction to the atmosphere. Therefore, care must be exercised to ensure that the sample collected is not altered during the collection and storage procedures. A variety of sampling options are allowed and Appendix A of Method 5035A provides details regarding the many options available for sample collection. The collection and preservation procedures are intended to prevent loss of VOCs during sample transport, handling and analysis.

Method 5035A is a method designed for volatile sample collection and analysis of soils and solid wastes for volatile organic compounds. This method is described in Update III to the Third Edition of SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, and is required for all analytical methods using purge and trap techniques (8021, 8015B, and 8260B). Alternative protocols may be used in some states (including New York), however this method is strongly recommended.

The volatile analysis is performed over two ranges:

	GC/MS (µg/kg)	GC (µg/kg)
Low Level	5 – 300	Not Available
High Level	>250	>20

The different levels require different sampling techniques. The low level method can only handle samples within a specific concentration range (these samples CANNOT be diluted), therefore a high level sample MUST be collected to ensure that all the target analytes can be quantified.

Naturally occurring carbonates in some soils may cause effervescence (foaming) on contact with the sodium bisulfate (NaHSO4) solution used as preservative for the low-level preparation. This interference makes it necessary for the laboratory to use the high-level prep or an alternative technique for low level. Check with the NYSDEC to discuss acceptable options.

Typically, analytical laboratories will support the following options for the two levels:

Option	No. of Containers	Sample Size (g)	Holding Time (days)
A – Low Level EnCore™ Samplers	3*	5	14**
B – High Level EnCore™ Sampler	1*	5	14**
C – High Level Methanol vial w/syringe	1	10	14

* Additional EnCore™ Samplers are required for MS/MSD.

** The sample MUST be extracted and preserved in sodium bisulfate or methanol within 48 hours of collection.

NOTE: The EnCore™ Sampler is disposable – it can only be used ONCE. It CANNOT be cleaned and/or reused. The samplers MUST be used in conjunction with an EnCore™ T-handle.

PROCEDURE

The preferred method for collecting and storing a soil sample for VOC analysis is using the EnCore™ method. This field procedure is described in this FOP.

1. The sampling team should reference the manufacturers' directions prior to sample collection (attached).

   a. Ensure that the EnCore™ Sampler is present at the sampling location before collecting the sample from the borehole or surface sample location. The necessary parts of the EnCore™ Sampler will consist of three disposable coring bodies, three disposable caps, and a reusable stainless steel T-handle.

   b. Retrieve the sampling tool from the borehole or sample location.

   c. Expose a surface of the soil sample. For Shelby tube samples, this would require the extrusion of the sample. For split spoon samples, this would require the spoon be disassembled and opened. If liners are being used in conjunction with a split spoon or solid barrel sampler, this would require the removal of the liners from the sampler, so that the soil at the liner's end is exposed.

   d. Following the manufacturer's directions for the use of the EnCore™ Sampler (attached), collect three aliquots of soil from the exposed soil surface, using the three coring bodies. After the collection of each aliquot, cap and label each aliquot. The manufacturer's direction for use of the EnCore™ Sampler are attached

2. If the use of the EnCore™ Sampler is not possible due to soil texture (e.g. gravels) the sample must be field preserved with acid and methanol in accordance with SW-846 Method 5035A.

3. If the soil material is too coarse for sampling with the EnCore™ Sampler and contains excessive calcium carbonate material that reacts with the acid preservative, the sample will be retained in the brass or stainless steel liner of the split-spoon sampler or similar device. The ends of these liners will be covered with Teflon™ rounds, capped and sealed with tape.

4. Record all information associated with sample collection in the Project Field Book.

5. The samples will be labeled, stored and shipped in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures. The samples are shipped overnight for delivery and preservation at the laboratory.

ATTACHMENTS

EnCore™ Sampling Procedure (manufacturers instructions)

REFERENCES

Benchmark FOPs:
046 Sample Labeling, Storage and Shipment Procedures

ATTACHMENT

EnCore™ Sampling Procedure (manufacturers instructions)

Disposable
En Core® Sampler

Sampling Procedures

Using The
En Core® T-Handle

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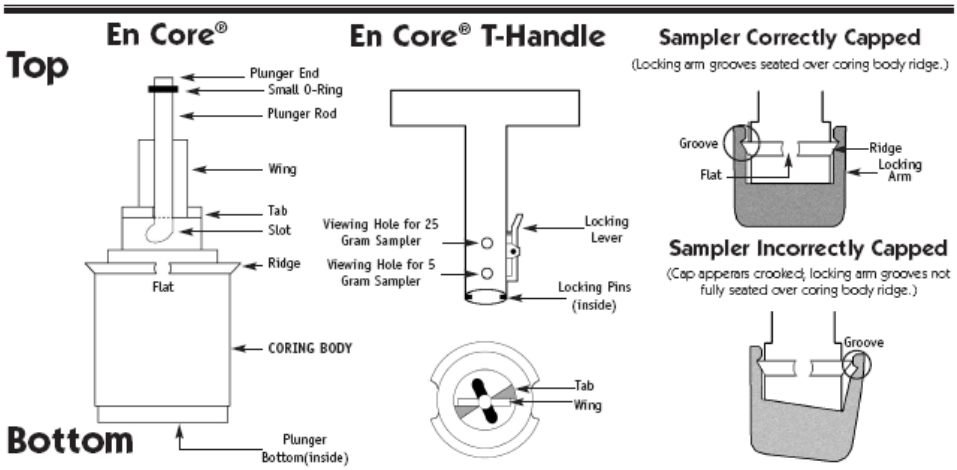
NOTE:

1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.

2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!

3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)



BEFORE TAKING SAMPLE:

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

2. Depress **locking lever** on En Core T-Handle. Place coring body, **plunger end first**, into open end of T-Handle, *aligning the (2) **slots** on the coring body with the (2) **locking pins** in the T-Handle*. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.

TAKING SAMPLE:

3. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle **viewing hole**. Remove Sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while it is still on T-handle. *Push* cap over **flat** area of **ridge** *and twist* to lock **cap** in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram).**

PREPARING SAMPLER FOR SHIPMENT:

5. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.

Disposable En Core® Sampler

EXTRUSION PROCEDURES

USING THE En Core® EXTRUSION TOOL

CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.

1. Use a pliers to break locking arms on cap of En Core Sampler. Do not remove cap at this time. **(CAUTION: Broken edges will be sharp.)**

2. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.

3. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)

4. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. To release soil core, remove cap from Sampler and push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE® SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

PRINCIPLE OF USE. The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

QUALITY CONTROL. The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

WARRANTY. En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b)Samplers that have been opened, taken apart or mishandled; (c)Samplers not used in accordance with the directions; and (d)Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

LIMITATION OF LIABILITY. IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE, DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.

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The En Core™ Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending.

* Viton® is a registered trademark of DuPont Dow Elastomers.

BENCHMARK
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FIELD OPERATING PROCEDURES

Real-Time Air Monitoring During Intrusive Activities

FOP 073.2

REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

PURPOSE

This guideline presents requirements for real-time community air monitoring and required responses during all project required intrusive activities, such as drilling, test pitting, earthwork construction etc. This procedure is consistent with the requirements for community air monitoring for all intrusive projects, including projects conducted at remediation sites, as established by the New York State Department of Health (NYSDOH) and the New York State Department of Environmental Conservation (NYSDEC). Accordingly, it follows procedures and practices outlined under NYSDEC's DER-10 (May 2010) Appendix 1A (NYSDOH's Generic Community Air Monitoring Plan) and Appendix 1B (Fugitive Dust and Particulate Monitoring).

This FOP requires real-time monitoring for constituents of concern (COC) (i.e., volatile organic compounds (VOCs), lower explosive limit (% LEL), particulates (i.e., dust) etc.) at the upwind and downwind perimeter as well as the exclusion zone of a project site during all intrusive activities. This FOP is not intended for use in establishing action levels for worker respiratory protection (see Project Health and Safety Plan (HASP) for worker protection action levels). Rather, its intent is to provide a measure of protection for the surrounding community from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The community, as referenced in this document, includes any off-site residences, public buildings/grounds and commercial or industrial establishments adjacent to the project site. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, this FOP helps to confirm that work activities did not spread contamination off-site through via air transport mechanisms. Community air monitoring shall be integrated with the construction

worker personal exposure-monitoring program contained in the project and site-specific HASP.

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

MONITORING & MITIGATION PROCEDURE

Real-time air monitoring perimeter locations for monitoring stations will be established based on the location of the exclusion zone (i.e., immediate work area) and wind direction. Where wind direction is shifting or winds are calm, the downwind monitoring location will default to the perimeter location nearest the most sensitive receptor (i.e., residential property). All downwind receptors being equal, the downwind monitoring location will default to the perimeter location downwind of the prevailing winds at the site. Although additional site specific COCs may be monitored during real-time air monitoring activities, the most common COCs are discussed in this FOP, including organic vapors (i.e., VOCs), airborne particulates (i.e., fugitive dust) and combustible gases (i.e., methane) and oxygen.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil samples. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence

ORGANIC VAPORS

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be

capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

- All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

o **Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures**

  - When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and

particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure (s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen SUlfide, carbon monoxide) may also need to be monitored Response levels and actions should be pre-determined, as necessary, for each site.

Additionally, if following the cessation of work and efforts to abate the emission source are unsuccessful, and if sustained organic vapor levels exceed 25 ppm above background within the 20-foot zone for more than 30 minutes, then the **Major Vapor Emission Response Plan** (see below) will automatically be placed into effect.

Major Vapor Emission Response Plan

Upon activation of Major Vapor Emission Response Plan, the following activities will be undertaken:

1. All Emergency Response Contacts as listed below and in the Site-Specific Health and Safety Plan will be contacted.

2. The local police authorities will immediately be contacted by the Site Safety and Health Officer and advised of the situation.

3. The Site Safety and Health Officer will determine if site workers can safely undertake source abatement measures. Abatement measures may include covering the source area with clean fill or plastic sheeting, or consolidating contaminated materials to minimize surface area. The Site Safety and Health Officer will adjust worker personal protective equipment as necessary to protect workers from over-exposure to organic vapors.

The following personnel are to be notified by the Site Safety and Health Officer in the listed sequence if the Major Vapor Emission Response Plan is activated:

Contact	Phone
Police (Genesee County Sheriff Dispatch)	911/(585) 343-5000
Fire Department	911/(585) 768-2527
New York State DOH	(518) 402-7860

New York State DEC Region 8	(585) 226-2466, switchboard
New York State DEC Region 9	(716) 851-7220
State Emergency Response Hotline	(800) 457-7362

In addition, the Site Safety and Health Officer will provide these authorities with a description of the apparent source of the contamination and abatement measures being taken by the contractor, if any.

AIRBORNE PARTICULATES

Fugitive dust suppression and airborne particulate monitoring shall be performed during any intrusive activities involving disturbance or handling of site soil/fill materials. Fugitive dust suppression techniques will include the following minimum measures:

- Spraying potable water on all excessively dry work areas and roads.
- All fill materials leaving the site will be hauled in properly covered containers or haul trailers.
- Additional dust suppression efforts may be required as discussed below.

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance

of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (μg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 μg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 μg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 μg/m^3 of the upwind level and in preventing visible dust migration.

- All readings must be recorded and be available for State (DEC and DOH) personnel to review.

Visual Assessment

In conjunction with the real-time monitoring program, Benchmark personnel and any subcontractors thereof will be responsible for visually assessing fugitive dust migration from the site. If airborne dust is observed leaving the site, the work will be stopped until supplemental dust suppression techniques are employed in those areas.

Supplemental Dust Suppression

Supplemental dust suppression techniques may include but are not necessarily limited to the

following measures:

- Reducing the excavation size, number of excavations or volume of material handled.
- Restricting vehicle speeds.
- Applying water on buckets during excavation and dumping.
- Wetting equipment and excavation faces.
- Wetting haul roads.
- Restricting work during extreme wind conditions.
- Use of a street sweeper on paved haul roads, where feasible.

Work can resume using supplemental dust suppression techniques provided that the measures are successful in reducing the sustained downwind particulate concentration to below 150 ug/m^3 of the upwind level, and in preventing visible dust migration off-site.

COMBUSTIBLE GASES & OXYGEN

Ambient combustible gas and oxygen concentrations should be measured prior to commencing intrusive activities each workday and a minimum of every 30-minutes thereafter. Air monitoring activities should be performed using equipment appropriate to measure combustible gases in percent lower explosive limit (LEL) and percent oxygen and calibrated daily. All combustible gas and oxygen readings must be recorded in the Project Field Book and/or Real-Time Air Monitoring Logs (sample attached) and, if applicable, be made available for State (DEC and DOH) personnel to review.

Mitigation upon the detection of various action levels of organic vapors are presented below:

Combustible Gas:

- If the sustained ambient air concentration of combustible gas at the downwind perimeter of the site exceeds a reading of 10 to 25% LEL, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 10% LEL, work activities can resume with continued monitoring.

- If sustained combustible gas levels at the downwind perimeter of the site persist at levels in excess of 25% LEL, work activities must be halted, the source of explosion hazards identified, corrective actions taken to abate emissions and monitoring continued. Following combustible gas mitigation, work activities can resume provided that the sustained total organic vapor level 200 feet downwind of the exclusions zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less, (but in no case less than 20 feet) is below a sustained value of 10% LEL.

Oxygen:

- If the sustained ambient oxygen concentration at the downwind perimeter of the site measures a reading between 19.5% - 21% oxygen, work activities can continue with extreme caution, however attempts to determine the potential source of oxygen displacement must be conducted.

- If the sustained oxygen level readily decreases below 19.5% LEL, work activities should be discontinued and all personnel must leave the area immediately.

- If the sustained oxygen level at the downwind perimeter of the site persists at levels between 21-25%, work activities can resume with caution.

- If the sustained oxygen level at the downwind perimeter of the site persists at levels exceeding 25% (fire hazard potential), work activities should be discontinued and all personnel must leave the area immediately.

ATTACHMENTS

Real-Time Air Monitoring Log (sample)

REFERENCES

Benchmark FOPs:

006 *Calibration and Maintenance of Combustible Gas/Oxygen Meter*
010 *Calibration and Maintenance of Flame Ionization Detector*
011 *Calibration and Maintenance of Portable Photoionization Detector*
084 *Calibration and Maintenance of Portable Particulate Meter*

REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

REAL TIME AIR MONITORING LOG

Date:
Project Name:
Project Number:
Project Location:
Client:
Purpose of Air Monitoring:

WEATHER CONDITIONS:

Time of Day:	A.M.	P.M.
Ambient Air Temp.:		
Wind Direction:		
Wind Speed:		
Precipitation:		

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Location/Activity/Comments
			PID (ppm)	LEL (%)	H_2S (ppm)	O_2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

SAMPLE

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By: Date:

BENCHMARK
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FIELD OPERATING PROCEDURES

"Before Going Into The Field" Procedure

FOP 076.0

"BEFORE & AFTER" PROJECT PROCEDURES FOR FIELD PERSONNEL

PURPOSE

This procedure describes the required field and office activities to be preformed "before and after" project assignments by field personnel. Field activities may include, but are not limited to, drilling oversight, excavation contractor oversight, matrix sample collection (e.g., soil, sediment, groundwater, surface water, wipe, and/or air), third party oversight, and site reconnaissance to name a few. Office activities may include, but are not limited to, photocopying field book entries, completing all field forms, tabulating collected field and laboratory data, and preparation of report text.

The primary goal of this procedure is to eliminate delays and unnecessary budgetary "strain" due to a lack of preparedness and knowledge of the site by the field team members. This procedure also seeks to streamline the preparation and transfer of field information/data from field personnel to the Project Manager upon field work completion.

PROJECT ASSIGNMENT

During the initial meeting with the Project Manager, several questions should be raised by the field team member and answered by the Project Manager. A pad of paper and pen should be in hand to record all pertinent job information. At a minimum, the following questions should be answered:

1. *What is the job number?*
2. *Who is the client and the on-site representative (if applicable)?*
3. *What is the name of the project?*
4. *What are the job responsibilities and how should they be accomplished?*
5. *How much time do I have to complete the assigned tasks?*
6. *Are there any project required documents? What are they?*

Any deviation from the above questions should be approved by the Project Manager prior to contravention, not at the end of the day or following the project completion.

"BEFORE" CHECKLISTS

Checklists should be developed and used so that all of the required steps prior to going into the field are undertaken. A good checklist will include:

- Adequate review of the documents listed in this FOP
- Any documents, equipment, and supplies presented in this FOP
- Providing adequate notification to the laboratory (so that holding times are not exceeded) and to the owner of the site and the primary regulatory agency (usually in writing) that a round of sampling is to commence in order to facilitate sampling and allow for a sampling audit or split sampling.
- Specifying and documenting the equipment maintenance and calibration undertaken prior to going into the field relative to the sampling event.
- Checking and calibrating the equipment.
- Listing the documents, equipment, and supplies required to collect samples at the site as presented in this FOP.

Prior to going into the field, sampling personnel should reacquaint themselves with the sampling plan. The review is undertaken so that the required specific protocol such as sampling from the least to the most contaminated wells, knowing where quality control samples are to be taken, knowing the disposition of purge water, etc., is understood and followed.

The amount of equipment maintenance and calibration required prior to going into the field should be clearly specified in the presampling equipment maintenance and calibration checklists, which are based on the manufacturer's recommendations, sampling objectives, and prior experience. Maintenance and calibration performed before sampling must be

documented to provide evidence that the equipment was adequately maintained and calibrated and to keep a permanent record of equipment servicing and performance.

A list of all the documents, equipment, and supplies required for the sampling event should be prepared and used. It can be frustrating and time consuming to forget equipment and supplies, so some up-front preparation is warranted. The following sections provide a list of the documentation, equipment, and supplies, which should assist in preparing a site-specific equipment and supply checklist. Once prepared, the checklist and project requirements should be reviewed with the Project Manager.

"BEFORE" DOCUMENTATION SUMMARY

Prior to going into the field, the field team should review and understand all of the project documents including, but not limited to:

- The Health and Safety Plan (HASP)
- The Site Analytical Plan (SAP), Sampling Plan, or similar document
- The Quality Assurance Project Plan (QAPP)
- The Work Plan
- Project specific Field Operating Procedures and field forms
- Site Maps
- Equipment operation manuals
- Chain-of-Custody forms
- Shipping labels and custody seals
- Any reference materials (i.e., conversion tables, volume calculation, etc.). The Pocket Ref, Third Edition by Thomas Glover is a great source for the field.

If at any time, the field team does not understand the project required protocol, procedures, sample locations, etc.; the Project Manager should be consulted for clarification.

"BEFORE" EQUIPMENT SUMMARY

Prior to going into the field, the field team should review the following equipment checklist, noting that project specific equipment may not be included in this list:

- Water level indicator
- Pumps, sample tubing, flow controllers, power cord(s), batteries, compressors, generators, etc.
- Bailers (disposable, PVC, stainless steel, glass), rope
- Flow-through cell
- Field meters with adequate calibration solutions (pH/Eh meter, conductivity meter, dissolved oxygen meter, turbidity meter, batteries, etc.)
- Garden hose
- Explosive gas meter and/or photoionization detector (PID) with calibration supplies
- Complete set of hand tools including a sharp knife, screw drivers, pliers, hacksaw, flashlight, large pipe wrench, hammer, bolt cutters, and replacement locks
- Fish hook with weight and string
- Field filtering equipment and supplies
- Decontamination supplies, such as scrub brushes, Alconox®, distilled water, potable water, 5-gallon bucket, paper towels, aluminum foil
- 5-gallon bucket(s)
- Measuring cup
- Sample bottles/containers (with extras) and preservatives
- Stainless steel spoons, trowels, shovels
- Shipping containers (i.e., coolers)
- Clipboard
- Calculator
- Water resistant clock or watch with second hand
- First aid kit

"BEFORE" SUPPLIES SUMMARY

Prior to going into the field, the field team should review the following supplies checklist, noting that project specific supplies may not be included in this list:

- Laboratory grade non-phosphate detergent (Alconox®)
- Appropriate personal protective equipment appropriate to the contaminants of concern, such as nitrile gloves, Tyvek, boots, hardhat, safety glasses, hearing protection, etc.
- Bags of ice
- Plastic garbage bags
- Plastic sheeting
- Sufficient quantities of potable and laboratory grade deionized water for cleaning and equipment blanks
- Methanol
- Isopropyl alcohol
- Clean rags and paper towels
- Electrical tape, duct tape, and wide transparent tape
- Hand soap
- Regular, ballpoint, and indelible pens
- Hollow braid polyethylene rope

After providing adequate notification (lab, state and/or federal agencies), performing the presampling maintenance and calibration, obtaining the site and well keys, and packing the supplies and equipment, the field activities are ready to be performed.

"AFTER" – PROJECT FILE REVIEW & CREATION

It is the responsibility of each field crew member to review his/her own field notes and time sheet for accuracy and completeness. All errors to the field notes should be corrected, dated, and initialed for Project Manager review. Once reviewed by the field team member, the Project Field Book, all field forms, photographs, chain-of-custodies etc. must be

photocopied, scanned (if required), downloaded, etc. and then given to the Project Manager in an organized file folder in a timely manner. Avoiding delay during this step is critical, especially when there are severe time constraints for the project.

REFERENCES

1. Wilson, Neal. *Soil Water and Ground Water Sampling*, 1995

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FIELD OPERATING PROCEDURES

Calibration & Maintenance of Portable Particulate Meter

FOP 084.0

CALIBRATION AND MAINTENANCE OF PORTABLE PARTICULATE METER

PURPOSE

This guideline describes a method for calibration of a portable particulate meter, specifically the Thermo Electron Corporation MIE DataRAM 4 (Model DR-4000). The DataRAM 4 measures the concentration of airborne particulate matter (liquid or solid), as well as mean particle size, air temperature, and humidity, providing direct and continuous readout as well as electronic recording of the information. This parameter is of interest both as a general indicator of air quality, and because of its pertinence to community air monitoring typically required at most construction/remediation/investigation sites. The DataRAM covers a wide measurement range from 0.0001 mg/m^3 to 400 mg/m^3. With its large capacity internal data logging capabilities with data retrieval on screen or downloaded, the DataRAM can store up to 50,000 data points, including individual point averages, particle size, temperature, and humidity with time stamp as well as overall average and maximum concentration.

Because the DataRAM meter must be factory calibrated once a year, this guideline presents a method for start-up, operation, and maintenance, which is performed to verify instrument function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each year. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter. The user should reference the manufacturer's instruction manual prior to operating this unit.

ACCURACY & PRECISION

The calibrated accuracy of the DataRAM 4 particulate meter is within ± 2% of reading ± precision over the temperature range of -4° to 158° F (-10° to 50° C) and 10 to 95% relative humidity (non-condensing). The precision is ± 1% of reading or ± 0.001 mg/m^3, whichever

is greater (1-second averaging) and ± 0.3% of reading or ± 0.0003 mg/m^3, whichever is greater (10-second averaging).

INSTRUMENT PANEL VIEW

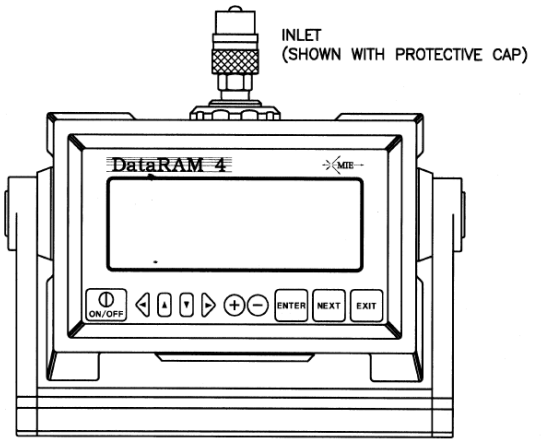


FIGURE 1. FRONT–PANEL VIEW OF DataRAM

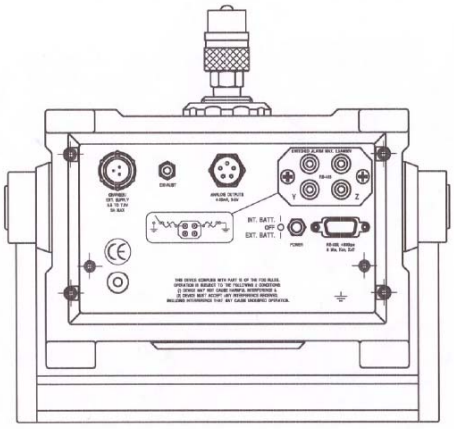


FIGURE 2. BACK–PANEL VIEW OF DataRAM

MAINTENANCE

General Guidelines

The DataRAM 4 is designed to be repaired at the factory. No user serviceable components are inside the metal enclosure of the DataRAM 4 with exception of the filter cartridge or the analytic filter holder. Access to the internal components of the unit by others than authorized MIE personnel voids warranty.

Unless a MALFUNCTION message is displayed, or other operational problems occur, the DataRAM 4 should be returned to the factory once every two years for routine check out, test, cleaning and calibration check.

Battery Charging and Cycling

If the DataRAM 4 is to be operated without its charger/power supply, i.e., deriving power from its internal battery, this battery should be fully charged before initiating a run. The

DataRAM 4 charger/power supply can be connected continuously to the instrument whether the DataRAM 4 is on or off. If the charger/power supply is not connected, the internal battery will discharge very slowly depending on storage temperature. Low storage temperature reduces battery capacity. High storage temperatures, however, reduce battery life which is of the order of 8 years at 20°C (68°F), and only 2 years at 40°C (104°F).

In general, the user should maintain the battery charge as high as possible in order to extend its charge/discharge cycling capacity (this characteristic differs from that of nickel-cadmium batteries).

Instrument Storage

If the DataRAM 4 is to be stored for an extended period of time (i.e., 3 months or more), place the 3-position switch on the back panel in its OFF position (mid-position), in order to minimize gradual battery discharge. This will have no effect on data retention or internal clock function. It is recommended, however, that the battery be recharged every 3 months in order to prolong battery life.

During storage always snap on quick-connect cap over the instrument inlet to protect the sensing optics from gradual dust contamination. Store DataRAM 4 in a dry environment.

Filter Replacement

To replace either of two types of filters used with DataRAM 4, place the instrument on its back rubber feet (front panel facing upward). On the bottom surface of the DataRAM, locate the large threaded plastic filter cover and holding the cross bar, rotate this cover counterclockwise. Remove cover and the filter holder within the open cavity.

HEPA Filter Cartridge Replacement

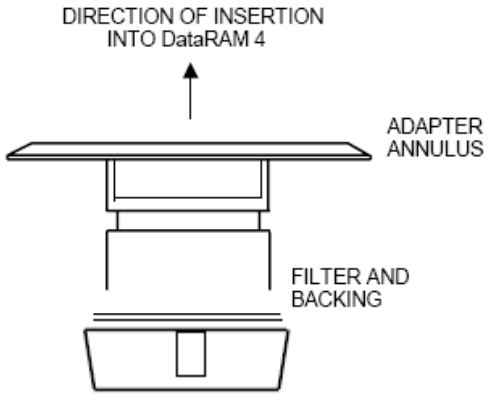
The DataRAM 4 is shipped from the factory with the HEPA filter cartridge installed. This cartridge can be identified by its metallic cover. Remove this cartridge. Clean the internal black rubber gasket against which the cartridge is normally compressed. Install new HEPA-type cartridge (MIE part no. MSA-95302) by inserting its wider ridged end first. Reposition threaded plastic cover engaging threads carefully; rotate cover clockwise, hand tightening firmly. Properly dispose of used cartridge to prevent inadvertent re-use.

Analytic Filter Installation/Replacement

In order to install or replace the analytical filter holder, proceed as follows. Remove the HEPA cartridge normally in place. Remove (separate) the inlet cover (with the blue plug) of the Millipore plastic filter holder from the rest of that holder assembly containing the white membrane filter. Insert firmly the gray plastic adapter annulus into the open face of the filter holder assembly. Remove the red plastic plug from the exhaust nipple of the filter holder assembly. Ensure that all three components of the holder assembly are fully compressed to preclude any leafage. Insert the assembly into the filter cavity of the DataRAM 4 with the gray plastic adapter annulus bearing against the internal black gasket (adapter annulus inserted first). Reposition threaded plastic cover and hand-tighten carefully and firmly. Set aside HEPA cartridge for future use.

In order to remove and/or to replace the membrane filter within its holder, remove the gray plastic adapter annulus and separate (pry apart) the two transparent plastic rings that compress the membrane filter. Make sure to remove and replace only the membrane filter (using tweezers), leaving the white backing disc in the holder. A new membrane filter should then be placed over that backing and the sealing ring should then be inserted to trap and compress the filter and backing discs. For storage, the inlet cap with the blue plug should be inserted as well as the red plug on the back of the filter holder.

Analytical filter holder with adapter annulus inserted



Cleaning of Optical Sensing Chamber

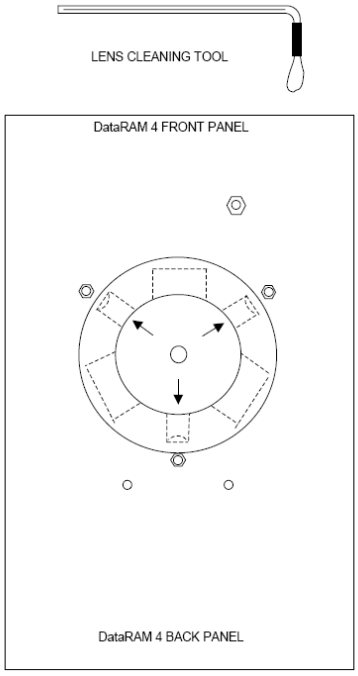
Although the DataRAM 4 incorporates filtered air shielding of the critical optical sensing surfaces, continued sampling of airborne particles at high concentrations may result in gradual build-up of contamination on those interior surfaces of the sensing chamber components. This may cause an excessively high optical background level. If this background level does becomes excessive, the DataRAM 4 will alert the user at the completion of the zeroing sequence by the display of a BACKGROUND HIGH message. If this message is presented, the DataRAM 4 can continue to be operated providing accurate measurements. However, it is then advisable to clean the front surfaces of the optical lenses within the sensing chamber at the first convenient opportunity, as described below. The tools required for this cleaning are: an intense concentrated light source (e.g., flash light) to view the inside of the sensing chamber, denatured alcohol, a soft lint-free cloth, and the special cleaning tool provided with the DataRAM 4 consisting of a cut-off cotton swab inserted in a plastic sleeve and held by a right-angle Allen wrench.

Proceed as follows to clean the lens surfaces within the sensing chamber:

- **Make sure to shut off power completely before proceeding with cleaning**
- Install the stainless steel cover on the inlet of the DataRAM 4 to protect this fitting.
- Place the DataRAM 4 upside down on a table, resting the instrument on the inlet cover and the rear protective bumper.
- Unscrew the gray plastic cover of the filter cavity on the bottom surface of the DataRAM 4.
- Remove the filter cartridge from its cavity.
- Carefully clean the black soft filter-sealing gasket within the filter cavity by wiping it with the lint-free soft cloth. Use alcohol if necessary.
- Shine the concentrated light source into the sensing chamber located about 3 cm (1¼ in.) beyond the soft-sealing gasket in the filter cavity.
- Locate the three smaller side cavities inside the sensing chamber, identified by the arrows on that figure (see page 6). These three cavities contain the lenses of the two sources and the common detector of the DataRAM 4. The frontal surfaces of these lenses are likely to require cleaning if the instrument indicates BACKGROUND HIGH.
- Wet the cotton swab of the lens-cleaning tool with alcohol (e.g., methanol, ethanol, or rubbing alcohol).

- Holding the cleaning tool by its long handle, insert this tool into the sensing chamber without touching the walls of this chamber.
- Direct the cotton swab tip towards the opening of one of the three smaller cavities as indicated by the arrows of the figure below, and insert the cotton tip into this cavity as far as it will go. Gently wipe that internal surface touched by the swab tip by a rotating motion. Carefully withdraw the swab tip from the cavity.
- Repeat previous cleaning step for the other two small cavities.
- Carefully remove the cleaning tool from the sensing chamber. Allow the alcohol to dry leaving the filter cavity open for about 15 minutes.
- Re-insert the filter cartridge into its cavity and close it with its gray plastic cover, hand-tightening it firmly. Remove the inlet cap and store on its pod on the back panel.
- Place the DataRAM 4 right side up and key ON. Proceed to check its optical background by running the ZERO/INITIALIZE check as. The message READY! should appear at the end of this check indicating that the lens contamination has been eliminated. Should the message BACKGROUND HIGH persist after completion of the above-described lens cleaning procedure, please contact the factory.

Lens cleaning tool and bottom view of open filter cavity showing location of sensor chamber lens cavities (arrows).



FACTORY CALIBRATION

For mass concentration measurements, each DataRAM 4 is factory calibrated against a set of reference monitors that, in turn, are periodically calibrated against a gravimetric standard traceable to the National Institute of Standards and Testing (NIST).

The primary factory reference method consists of generating a dust aerosol by means of a fluidized bed generator, and injecting continuously the dust into a mixing chamber from which samples are extracted concurrently by two reference filter collectors and by two master real-time monitors that are used for the routine calibration of every DataRAM 4.

The primary dust concentration reference value is obtained from the weight increase of the two filters due to the dust collected over a measured period of time, at a constant and known flow rate. The two master real-time monitors are then adjusted to agree with the reference mass concentration value (obtained from averaging the measurements of the two gravimetric filters) to within ±1%.

Three primary, NIST traceable, measurements are involved in the determination of the reference mass concentration: the weight increment from the dust collected on the filter, the sampling flow rate, and the sampling time. Additional conditions that must be met are: a) suspended dust concentration uniformity at all sampling inlets of the mixing chamber; b) identical sample transport configurations leading to reference and instrument under calibration; and c) essentially 100% collection efficiency of filters used for gravimetric reference for the particle size range of the test dust.

The test dust used for the MIE factory calibration of the DataRAM 4 is SAE Fine (ISO Fine) supplied by Powder Technology, Inc. It has the following physical characteristics (as dispersed into the mixing chamber):

- Mass median aerodynamic particle diameter: 2 to 3 μm
- Geometric standard deviation of lognormal size distribution: 2.5
- Bulk density: 2.60 to 2.65 g/cm3
- Refractive index: 1.54

In addition to the mass calibration described above, the DataRAM 4 is factory calibrated using a gas with known scattering coefficient in order to adjust the relative scattering irradiance at the two source wavelengths.

ATTACHMENTS

None

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FIELD OPERATING PROCEDURES

Field Quality Control Procedures

FOP 085.0

FIELD QUALITY CONTROL PROCEDURES

PURPOSE

In addition to traditional environmental samples (e.g., soil, groundwater, wipe, vapor etc.) described in each project work plan, site-specific field quality assurance/quality control (QA/QC) samples are typically collected and analyzed to support the required third-party data usability assessment effort of a project. Site-specific QA/QC samples generally include matrix spikes, matrix spike duplicates, blind duplicates (where appropriate), and trip blanks which accompany aqueous volatile organic compound (VOC) samples only.

The number of QA/QC field samples (blind duplicate, matrix spike/matrix spike duplicate, trip blank, field blank, or equipment blank) will be designated prior to field mobilization, but final QC sample locations will be contingent upon field conditions. This procedure outlines and discusses each QA/QC sample that may be required during a project.

PROCEDURE

A brief summary of each QA/QC sample identified above is presented below. Where appropriate, the procedure to be used to collect these samples is also presented.

- **Trip Blanks** – A sufficient number of trip blanks for VOC analysis must be prepared by the laboratory and delivered to the sampling team prior to a sampling event, typically two or three 40-ml VOA vials with organic free reagent water. One sealed blank will be carried into the field per day along with the sample containers for each day that water matrix volatile organic samples are collected. Trip blanks will be transported and handled in the same manner as the actual samples. The results of the trip blank analysis will be reviewed to evaluate if the potential for sample contamination during transportation and handling exists. The trip blanks will be analyzed for the same VOCs (and method) as the project groundwater samples.

- **Blind Duplicate** – One blind duplicate must be collected and analyzed per 20 samples collected per matrix (i.e., soil, groundwater, soil vapor, etc.). The location

of the sample collection point will not be disclosed to the analytical laboratory, therefore the field sample containers will be returned to the laboratory identified only as the "blind duplicate." The well or sample location will be recorded in the Project Field Book or handheld RuggedReader® Pocket PC and on the field data sheets, and the results will be compared to review analytical precision. Sample analysis will be identical to the original sample per the project work plan. The Blind Duplicate sample must be collected simultaneously from the same source under identical conditions as the original sample.

- **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** – A sufficient volume of sample will be collected at one sampling location per sampling event for MS/MSD analysis per matrix (i.e., soil and groundwater only). The laboratory will report the results of the MS/MSD analysis, which will be reviewed for sampling and analysis precision and accuracy. Sample analysis will be identical to the original sample per the project work plan. The MS/MSD sample must be collected simultaneously from the same source under identical conditions as the original sample.

- **Equipment (Rinsate) Blank** – In general, dedicated sampling equipment is used to minimize field decontamination time and avoid the need for equipment blanks; however there may be instances where the use of non-dedicated equipment cannot be avoided. An equipment blank will be collected for each day of sampling activity when non-dedicated sampling equipment is used. These equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment. Sample analysis for the equipment blank will consist of the most comprehensive parameter list used for risk assessment in which the non-dedicated equipment was used for environmental sample collection. During most projects, every effort to use dedicated sampling equipment should be made in order to minimize field decontamination time and avoid the need for equipment blanks. Equipment Blank sampling procedure is as follows:
    - Non-dedicated equipment are to be decontaminated in accordance with Benchmark's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures prior to use in the field. If organic-free

deionized water (generally provided by the laboratory) is not available for decontamination, equipment will be allowed to thoroughly air dry.
  - Once properly rinsed or allowed to air dry, analyte-free water (provided by the laboratory) is poured appropriately over or through the decontaminated sample collection device, collected in a sample container, and returned to the laboratory as a sample.

- **Field Blank** – A field blank is a sample of the unused final decontamination rinse water that is collected at the sampling site and returned to the laboratory as a sample. Sample analysis for the field blank will consist of the most comprehensive parameter list used during the investigation.

- **Split Sample** – A split sample is a sample that has been portioned into two or more containers from a single sample container or sample mixing container. Samples for VOC analysis should never be mixed prior to splitting.

- **Blank Wipe Samples** – There are two types of blank wipe samples, an equipment blank and a field blank that may be required per the project work plan, both are described below:
  - Equipment Blank – Required only if reusable templates are used for wipe sample collection. The decontaminated template is wiped with a hexane saturated swab. The swab is placed in the appropriate sample container and returned to the laboratory as a sample.
  - Field Blank – Clean disposable gloves are wiped with a hexane saturated swab. The swab is placed in the appropriate sample container and returned to the laboratory as a sample.

REFERENCES

Benchmark FOPs:

040 Non-disposable and Non-dedicated Sampling Equipment Decontamination

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FIELD OPERATING PROCEDURES

Treatment System Sample Collection Procedure

FOP 086.0

TREATMENT SYSTEM SAMPLE COLLECTION PROCEDURE

PURPOSE

This procedure describes the methods for collecting treatment system influent and effluent samples.

PROCEDURE

1. Decontaminate non-disposable and non-dedicated sampling equipment in accordance with the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Calibrate the pH field meter in accordance with the Benchmark Field Operating Procedure 008.0 Calibration and Maintenance of the Portable Field pH/Eh Meter.

3. Prepare sampling equipment for use while wearing appropriate protective gear (i.e., latex gloves, safety glasses).

4. Prior to collecting an influent or effluent sample, purge the line by opening the valve for 30 seconds. Collect the purge water in a container and run it through the treatment system following sample collection.

5. Collect the sample by placing a sample collection jar (vial) directly beneath the sampling port and opening the valve. Hold the vial at a slight angle and fill slowly so little to no aeration of the water can occur. Vials must be filled with zero headspace (no air bubbles) in the sample. To ensure this, after the vial has been filled, twist the cap on tightly, turn the vial upside down and lightly tap. If no air bubbles are visible, proceed with filling the next vial.

6. Pre-label all sample bottles in the field using a waterproof permanent marker in accordance with the Benchmark Sample Labeling, Storage and Shipment FOP. The following information, at a minimum, should be included on the label:

    - Project number;

- Sample identification code (as per project specifications);
- Date of sample collection (mm, dd, yy);
- Time of sample collection (military time only) (hh:mm);
- Specify "grab" or "composite" sample type;
- Sampler initials;
- Preservative(s) (if applicable); and
- Analytes for analysis (if practicable).

7. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required.

8. Collect a separate sample of approximately 200 mL into an appropriate container to measure the pH. Record the field measurement on the Sample Collection Log (sample form attached).

9. Record all pertinent field data in the Project Field Book and on the Sample Collection Log form.

10. Label, store, and ship the samples in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

11. Decontaminate all non-disposable and non-dedicated sampling equipment upon completion of the sampling event in accordance with the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

REQUIRED EQUIPMENT

- Personal protective equipment (PPE) (if applicable)
- Water quality meter
- Field forms
- Project field book

ATTACHMENTS

Sample Collection Log – Water (sample)

REFERENCES

Benchmark FOPs:

008 *Calibration and Maintenance of Portable Field pH/Eh Meter*
040 *Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046 *Sample Labeling, Storage and Shipment Procedures*

TREATMENT SYSTEM
SAMPLE COLLECTION PROCEDURE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

WATER SAMPLE COLLECTION LOG

PROJECT INFORMATION

Project Name:

Project No.:

Client:

Location:

SAMPLE DESCRIPTION

I.D.:

Matrix: ☐ SURFACE WATER ☐ STORM ☐ SEEP ☐ OTHER ☐ INFLUENT ☐ EFFLUENT

SAMPLE INFORMATION

Date Collected:

Time Collected:

Date Shipped to Lab:

Collected By:

Sample Type: ☐ POINT ☐ GRAB ☐ COMPOSITE

Sample Collection Method: ☐ DIRECT DIP ☐ SS / POLY. DIPPER ☐ PERISTALTIC PUMP ☐ POLY. DISP. BAILER ☐ ISCO SAMPLER ☐ OTHER

SAMPLING INFORMATION

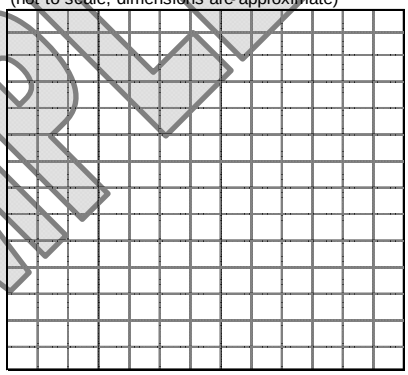
Weather:

Air Temperature:

Parameter	First	Last	Units
pH			units
Temp.			°C
Cond.			mS
Turbidity			NTU
Eh / ORP			mV
D.O.			ppm
Odor			olfactory
Appearance			visual

LOCATION SKETCH

(not to scale, dimensions are approximate)



EXACT LOCATION (if applicable)

Northing (ft)	Easting (ft)	Surface Elevation (fmsl)

SAMPLE DESCRIPTION (appearance, olfactory):

SAMPLE ANALYSIS (depth, laboratory analysis required):

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

SAMPLE

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FIELD OPERATING PROCEDURES

Outdoor Ambient Air VOC Sample Collection Procedure

FOP 090.0

OUTDOOR AMBIENT AIR VOC SAMPLE COLLECTION PROCEDURE

PURPOSE

This procedure describes the methods for collecting outdoor ambient air samples for volatile organic compound (VOC) analysis via USEPA Method TO-15 using Summa® canisters (or approved other). Typically, outdoor air samples are collected to characterize and document site-specific VOCs that may be present in outdoor ambient air. For sample collection associated with intrusive activities that may potentially release VOCs to the ambient air, sample location(s) typically are collected downwind of the intrusive activity at the perimeter of the work area and/or exclusion zone for the Site. Upwind sample location(s) may be utilized if regional facilities (e.g. gasoline service station, factories) are located proximate to the Site to assess off-site ambient VOC contributions (background).

SAMPLE COLLECTION PROCEDURES

The following actions should be taken to document conditions during outdoor air sampling and ultimately to aid in the interpretation of the analytical results:

- A site map should be prepared to indicate the outdoor ambient air sample locations including all site improvements (e.g., buildings, access roads, etc.), public roads/streets (if applicable), the location of potential VOC contributors (e.g., gasoline stations, factories, lawn movers, etc.), compass orientation (north), and scale.

- Weather conditions (e.g., precipitation, wind speed, outdoor temperature, and barometric pressure) should be reported on the Air Canister Field Record (sample attached); and

- Any pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment or dry cleaners) should be recorded.

OUTDOOR AMBIENT AIR VOC SAMPLE COLLECTION PROCEDURE

The following describes the outdoor air sampling procedure:

1. Typically, a 6-liter, passivated (inert), stainless steel, evacuated sampling sphere (e.g., Summa canister) (or approved other) will be supplied by the laboratory that will be conducting the analysis. The canister should be received from the laboratory, certified clean, evacuated, and prepared for sampling.

2. Sampling will take place in accordance with the project work plan. Selected sample locations will be sufficiently spaced to allow location(s) to be field modified, if necessary.

3. The number of Summa canisters required as well as the flow rate of the constant differential low volume flow controllers will be supplied by the laboratory in accordance with the project work plan.

4. Prior to placement, complete an Air Canister Field Record (sample attached) of each canister, which includes: project information, field staff, weather conditions, canister serial number, flow controller number, sample date(s)/time(s), shipping date(s), canister lab vacuum, field vacuum check, initial field vacuum, final field vacuum, and duration of sample collection.

5. The pressure in the canisters must be monitored with the laboratory provided pressure gauge at the beginning and the end of the sampling period as well as before and after shipment of the canisters at the laboratory. The **target final field vacuum must be approximately 5 inches of mercury. Samples with a final field vacuum of greater than 10 inches of mercury, or equal to zero, will be flagged** and usability of the data will depend on the sample volume and reporting limits that can be achieved.

6. Canisters may be placed on the ground provided there is a clear plastic sheet beneath it to prevent cross contamination. The intake tubing, however, must be positioned at a height of approximately 3 to 5-feet above grade to collect air at an elevation representative of ambient air within the breathing zone. Typically, the canister is chained and locked to a secure step ladder with the intake tubing tethered to the ladder.

7. Ship the canisters to the laboratory under chain-of-custody command within three days of sample collection so that no sample will exceed the 30-day holding time (since receipt from the lab) per USEPA TO-15.

8. Air samples will be analyzed by Gas Chromatography/Mass Spectroscopy (GC/MS) in accordance with EPA Method TO-15, or as specified. Analytical results will be reported as concentrations of each VOC at each location during each sampling event, typically in parts per billion by volume (ppbv).

9. Sample collection should take place on warm, dry days. If rain or high humidity conditions develop during sampling, the sampling event should be suspended. Temperature, barometric pressure, and wind speed should be monitored during the sampling event, for use in analysis of the results. The combination of sampling location, height, and meteorological conditions will assure that sampling will measure VOCs at their highest concentrations.

QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

Extreme care should be taken during all aspects of sample collection to ensure that sampling error is minimized and high quality data are obtained. The sampling team members should avoid actions (e.g., fueling vehicles, using permanent marking pens, and wearing freshly dry-cleaned clothing or personal fragrances), which can cause sample interference in the field. Appropriate QA/QC protocols must be followed for sample collection and laboratory analysis, such as use of certified clean sample devices, meeting sample holding times and temperatures, sample accession, chain of custody, etc. Samples should be delivered to the analytical laboratory as soon as possible after collection. In addition, laboratory accession procedures must be followed including field documentation (sample collection information and locations), chain of custody, field blanks, field sample duplicates, and laboratory duplicates, as appropriate.

Some methods require collecting samples in duplicate to assess errors. Duplicate and/or split samples should be collected in accordance with the requirements of the sampling and analytical methods being implemented.

For certain regulatory programs, a Data Usability Summary Report (DUSR) may be required to determine whether or not the data, as presented, meets the site or project specific criteria for data quality and data use. This requirement may dictate the level of QC and the category of data deliverable to request from the laboratory. Guidance on preparing a DUSR is available by contacting the NYSDEC's Division of Environmental Remediation.

New York State Public Health Law requires laboratories analyzing environmental samples collected from within New York State to have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. If ELAP certification is not currently required for an analyte (e.g., trichloroethene); then the analysis should be performed by a laboratory that has ELAP certification for similar compounds in air and uses analytical methods with detection limits similar to background (e.g., tetrachloroethene via EPA Method TO-15).

ATTACHMENTS

Air Canister Field Record (sample)

REFERENCES

United States Environmental Protection Agency. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*. Second Addition (EPA/625/R-96/010b). January 1999.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

AIR CANISTER FIELD RECORD

PROJECT INFORMATION:

Project:
Job No:
Location:
Field Staff:
Client:

SAMPLE I.D.:

Size of Canister:
Canister Serial No.:
Flow Controller No.:
Sample Date(s):
Shipping Date:
Sample Type: ☐ Indoor Air ☐ Outdoor Air
☐ Subslab, complete section below ☐ Soil Gas
Soil Gas Probe Depth:

WEATHER CONDITIONS:

Ambient Air Temp. - A.M.:
Ambient Air Temp. - P.M.:
Wind Direction:
Wind Speed:
Precipitation:

FIELD SAMPLING INFORMATION:

READING	TIME	VACUUM (inches Hg) or PRESSURE (psig)	DATE	INITIALS
Lab Vacuum (on tag)				
Field Vacuum Check [1]				
Initial Field Vacuum [2]				
Final Field Vacuum [3]				
Duration of Sample Collection				

LABORATORY CANISTER PRESSURIZATION:

Initial Vacuum (inches Hg and psia)		
Final Pressure (psia)		
Pressurization Gas		

SUBSLAB SHROUD:

Shroud Helium Concentration:
Calculated tubing volume: x 3 =
Purged Tubing Volume Concentration:
Is the purged volume concentration less than or equal to 10% in shroud?
☐ YES, continue sampling
☐ NO, improve surface seal and retest

COMPOSITE TIME (hours)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
0.5 Hours	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

NOTES:

1 Vacuum measured using portable vacuum gauge (provided by Lab)
2 Vacuum measured by canister gauge upon opening valve
3 Vacuum measured by canister gauge prior to closing valve

Signed:

ATTACHMENT B

PROJECT FORMS

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

DAILY QUALITY CONTROL REPORT

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TIME	DESCRIPTION

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS: A.M.:	IMPORTANT TELEPHONE CALLS:
P.M.:	
PERSONNEL ON SITE:	
SIGNATURE	DATE:

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

DAILY LOG	DATE			
	NO.			
	SHEET		OF	

DAILY QUALITY CONTROL REPORT
(CONTINUED)

PROJECT NAME:	PROJECT NO.

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TIME	DESCRIPTION

SIGNATURE DATE:

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DAILY LOG	DATE			
	NO.			
	SHEET		OF	

DAILY QUALITY CONTROL REPORT
(CONTINUED)

PROJECT NAME:	PROJECT NO.

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TIME	DESCRIPTION

REFERENCED PROJECT FIELD FORMS:

☐ Aquifer Test Data Sheet	☐ Impacted Soil Excavation Log	☐ Soil Gas Survey Log
☐ Chain-of-Custody Form	☐ Impacted Soil Transportation Log	☐ Step-Drawdown Test Data Sheet
☐ Construction Sample Summary Log	☐ Monitoring Well Inspection Form	☐ Survey Elevation Log
☐ Corrective Measures Report	☐ Nuclear Densitometer Field Log	☐ Tailgate Safety Meeting Form
☐ Daily Drilling Report	☐ Photographic Log	☐ Test Pit Excavation Log
☐ Drilling Safety Checklist	☐ Pipe Leakage Testing Log	☐ Underground/Overhead Utility Checklist
☐ Equipment Calibration Log	☐ Post-Closure Field Inspection Report	☐ Variance Log
☐ Field Borehole Log	☐ Pressure Packer Testing Log	☐ Water Level Monitoring Record
☐ Field Borehole/Monitoring Well Installation Log	☐ Problem Identification Report	☐ Water Quality Field Collection Log
☐ Field Investigation Report	☐ Real-Time Air Monitoring Log	☐ Water Sample Collection Log
☐ Field Slug Test Log	☐ Record of Telecom Meeting	☐ Well Abandonment/Decomm. Log
☐ Groundwater Elevation Log	☐ Sample Summary Collection Log	☐ Well Completion Detail
☐ GW Well Development and Purge Log	☐ Sediment Sample Collection Log	☐
☐ Hot Work Permit	☐ Seep Sample Collection Log	☐
☐ IDW Container Log	☐ Seepage Meter Sample Collection Log	☐

SIGNATURE DATE:

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

PREPARATORY PHASE INSPECTION CHECKLIST

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

A. Personnel Present:

	NAME	TITLE	COMPANY
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

B. Transmittals Involved

	ITEM/#	CODE	APPROVAL
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Have all items been approved? Y ___ N ___

What items have not been approved?

	ITEM/#	STATUS
1		
2		
3		
4		
5		

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

PREPARATORY PHASE INSPECTION CHECKLIST

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

C. Are all materials on hand? Y ___ N ___

Are all materials on hand in accordance with approvals? Y ___ N ___

Items not in hand or not in accordance with approvals:

	ITEM/#	STATUS
1		
2		
3		
4		
5		

D. Tests required in accordance with contract requirements

	TEST	REFERENCE
1		
2		
3		
4		
5		

Component installation checks:

	COMPONENT	ACCEPTABLE	UNACCEPTABLE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

PREPARATORY PHASE INSPECTION CHECKLIST

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

E. Accident prevention preplanning - hazard control measures

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____
10 _____

F. Approval

_____
Supervising Contractor

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

INITIAL INSPECTION CHECKLIST

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

Description and location work inspected:

Reference Contract Drawings:

Materials being used are in strict compliance with the contract plans and specifications: Y ___ N ___

If not, explain:

Procedures and/or work methods witness are in strict compliance with the requirements of the contract specifications:

Y ___ N ___

If not, explain:

Component installation checks:

	COMPONENT	ACCEPTABLE	UNACCEPTABLE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

INITIAL INSPECTION CHECKLIST

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

Workmanship is acceptable: Y ___ N ___

State areas where improvement is needed:

Safety violations and corrective action taken:

Approval

Supervising Contractor

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

FINAL INSPECTION CHECKLIST

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

Description and location work inspected:

Reference Contract Drawnings:

Items Completed:

	ITEM	DATE
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Items For Follow Up:

	ITEM	DATE FOR FOLLOW UP
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Approval

Supervising Contractor

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

DEVIATION FORM

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

Suppliers Name:	Suppliers Location:	Product or Material Location:
Specification Violated:		Drawing Violated:
Originator:		Date:
Supplier's Receipt Acknowledgement		Date:

Condition Details:

Action: Accept as is ☐ Return to seller ☐ Recify ☐ Scrap ☐

Disposition Details:

Accepted By:	Date:
Approved By:	Date:

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DAILY HEALTH AND SAFETY

Project Name: Date: Time:

Project Number: Client:

Work Activities:

HOSPITAL INFORMATION:

Name:

Address: *City:* *State:* *Zip:*

Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)

Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

VOLUME 3

QUALITY ASSURANCE/ QUALITY CONTROL PROJECT PLAN

REMEDIAL ACTION WORK PLAN COMPENDIUM VOLUME 3

QUALITY ASSURANCE/QUALITY CONTROL PROJECT PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LeRoy, New York

Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to

Unicorn Management Consultants, LLC

For

Lehigh Valley Railroad Company

Cincinnati, Ohio

TABLE OF CONTENTS

ATTACHMENTS

Worksheet #1
Title Page and Approval Page

Project Identifying Information
Site Name/Project Name Lehigh Valley Railroad Derailment Superfund Site
Site Location Gulf Road, LeRoy, New York
Site Number/Operable Unit EPA ID No. NYD986950251/Operable Unit No. 1 (Overburden Soil)
Lead Organization Project Coordinator: Francisco Trejo, Unicorn Management Consultants, LLC (UMC)
Supervising Contractor Project Manager/QAPP Preparer: Thomas H. Forbes, P.E. Benchmark Environmental Engineering & Science, PLLC Address: 2558 Hamburg Turnpike, Suite 300, Buffalo, New York 14218 Telephone Number: (716) 856-0599 E-mail Address: tforbes@benchmarkees.com Primary Field Team Leader/Health and Safety Officer: Richard L. Dubisz, Benchmark Secondary Field Team Leader: John T. Deth, Benchmark Quality Assurance Officer: Bryan C. Hann, Benchmark
Federal Regulatory Agency Remedial Project Manager: Michael Infurna, USEPA
State Regulatory Agency Remedial Project Manager: Christopher Magee, NYSDEC
Previous Documents/Investigations ▪ EPA Settlement Agreement and Order on Consent Index No. CERCLA-02-2006-2006 ▪ NYSDEC ROD, March 28, 1997 ▪ Memorandum, May 15, 2006, Comments/Issues Regarding the March 1997 ROD ▪ Spill Site Investigation Report, Rust Environmental & Infrastructure, October 1996 ▪ Lehigh Valley SVE Pilot Test, International Technology Corporation ▪ UMC RD Work Plan, October 2009 ▪ UMC Letter Response to EPA Comments on RD Work Plan, December 7, 2009 ▪ EPA Letter Approval of UMC RD Work Plan, December 9, 2009 ▪ UMC Soil Boring Logs, June 2010 ▪ Wetland Delineation Report, URS Corporation, October 2010 ▪ Final 35% Soil RD Report, March 2011 ▪ Phase I Cultural Resource Survey, Pratt & Pratt Archaeological Consultants, June 10, 2011 ▪ UMC Pre-RD Soil Data Summary Report and Addendum, December 2010 ▪ Soil Remedial Design Report, Benchmark/UMC, September 2013 ▪ Administrative Order for Remedial Action, Index CERCLA-02-2014-2010, USEPA, March 2014

Approvals

[Thomas Forbes, P.E., Benchmark, QAPP Preparer]	Date
[Francisco Trejo, UMC, Remedial Project Coordinator]	Date
[Michael Infurna, USEPA Region 2, Remedial Project Manager]	Date
[Raymond Klimcsak, USEPA Region 2, QA Coordinator]	Date
[Christopher Magee, NYSDEC, Remedial Project Manager]	Date
[Bryan C. Hann, Benchmark, Quality Assurance Officer]	Date
[Richard L. Dubisz, Benchmark, Health & Safety Officer]	Date
[John T. Deth, Benchmark, Field Team Lead]	Date
[Michael Perry, ALS Environmental, Laboratory Director]	Date
[Lisa Reyes, ALS Environmental., Quality Assurance Director]	Date
[Elizabeth Dickinson, Trillium, Inc., Third Party Data Validator]	Date

Worksheet #2
QAPP Identifying Information

This Quality Assurance Project Plan (QAPP) has been prepared on behalf of Unicorn Management Consultants, LLC (UMC) by Benchmark Environmental Engineering & Science, PLLC (Benchmark) for submittal to the United States Environmental Protection Agency, Region 2 (USEPA). Pursuant to the March 2014 Administrative Order (AO), Lehigh Valley Railroad Company (LVRR), as the voluntary Respondent for the Lehigh Valley Railroad Derailment Superfund Site, is responsible for remedial action as outlined in the AO Statement of Work (SOW). UMC is the principal consultant to the Respondent and has been designated authority to implement the subject AO SOW. Benchmark Environmental Engineering & Science, PLLC in association with TurnKey Environmental Restoration, LLC (hereafter referred to collectively as "Benchmark") is the Supervising Contractor for the implementation of Operable Unit # 1 Remedial Actions specific to overburden soil.

This QAPP was completed in general accordance with the Uniform Federal Policy for Implementing Quality Systems ("UFP-QS"), EPA-505-F-03-001, March 2005; Uniform Federal Policy for Quality Assurance Project Plans ("UFP-QAPP"), Parts 1, 2, and 3, EPA-505-B-04-900A, B, and C, March 2005, and various other documents referenced in the aforementioned guidance documents. This document is incorporated into the Remedial Action Work Plan (RAWP) as Volume 3. Associated construction quality assurance guidance has been provided in a Construction Quality Assurance Project Plan (CQAPP) provided as Volume 2 of the RAWP. Where project specific information is required by the UFP-QS guidance documents, identical sections have been provided in the QAPP and CQAPP for ease of reference.

This QAPP is submitted to the USEPA Project Manager for review and approval. Procedures described in this QAPP will be followed unless modifications and/or additions are documented in separate addenda or modification documents. Users of the information derived under the guidance of the QAPP will include LVRR, the NYSDEC, and USEPA.

Previous soil investigation work was completed under a QAPP drafted by Unicorn Management Consultants, LLC dated March 26, 2008 and an addendum dated August 28, 2009. A preliminary CQAPP was submitted as an appendix to the September 2013 Soil Remedial Design Report. This document contains quality assurance information specific to the RA exclusive of construction activities and supersedes all previous QAPP documents.

The following table provides cross-references to identify where each required QAPP element is located throughout this document.

Required QAPP Element(s) and Corresponding QAPP Section(s)	QAPP Worksheet #	Required Information
Project Management and Objectives		
2.1 Title and Approval Page	1	Title and Approval Page
2.2 Document Format and Table of Contents		
2.2.1 Document Control Format	TOC 2	-Table of Contents -QAPP Identifying Information
2.2.2 Document Control Numbering System		
2.2.3 Table of Contents		
2.2.4 QAPP Identifying Information		
2.3 Distribution List and Project Personnel Sign-Off Sheet		
2.3.1 Distribution List	3	-Distribution List
2.3.2 Project Personnel Sign-Off Sheet	4	-Project Personnel Sign-Off Sheet
2.4 Project Organization		
2.4.1 Project Organizational Chart	5	-Project Organizational Chart
2.4.2 Communication Pathways		-Communication Pathways
2.4.3 Personnel Responsibilities and Qualifications	6 7	-Personnel Responsibilities and Qualifications Table
2.4.4 Special Training Requirements and Certifications	8	-Special Personnel Training Requirements Table
2.5 Project Planning/Problem Definition		
2.5.1 Project Planning (Scoping)	9	-Project Planning Session Documentation -Project Scoping Session Participants Sheet
2.5.2 Problem Definition, Site History, and Background	10	-Problem Definition, Site History and Background
2.6 Project Quality Objectives and Measurement Performance Criteria		
2.6.1 Development of Project Quality Objectives	11 12	-Site specific PQOs -Measurement Performance Criteria Table
2.6.2 Measurement Performance Criteria		
2.7 Secondary Data Evaluation	13	-Sources of Secondary Data and Information -Secondary Data Criteria and Limitations Table
2.8 Project Overview and Schedule		
2.8.1 Project Overview	14	-Summary of Project Tasks

Required QAPP Element(s) and Corresponding QAPP Section(s)	QAPP Worksheet #	Required Information
2.8.2 Project Schedule	15 16	-Reference Limits and Evaluation Table -Project Schedule/Timeline Table
Measurement/Data Acquisition		
3.1 Sampling Tasks		
3.1.1 Sampling Process Design and Rationale	17 18 19 20 21 22	-Sampling Design and Rationale -Sample Location Map -Sample Locations and Methods/SOP Requirements Table -Field Quality Control Sample Summary Table -Sampling SOPs -Project Sampling SOP References Table -Field Equipment Calibration, Maintenance, Testing, and Inspection Table
3.1.2 Sampling Procedures and Requirements		
3.1.2.1 Sampling Collection Procedures		
3.1.2.2 Sample Containers, Volume, and Preservation		
3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures		
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures		
3.1.2.5 Supply Inspection and Acceptance Procedures		
3.1.2.6 Field Documentation Procedures		
3.2 Analytical Tasks		
3.2.1 Analytical SOPs	23 24 25	-Analytical SOPs -Analytical SOP References Table -Analytical Instrument Calibration Table -Analytical Instrument and Equipment Maintenance, Testing, and Inspection
3.2.2 Analytical Instrument Calibration Procedures		
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures		
3.2.4 Analytical Supply Inspection and Acceptance Procedures		
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures		
3.3.1 Sample Collection Documentation	26 27	-Sample Collection Documentation Handling, Tracking, and Custody SOPs -Sample Container Identification -Sample Handling Flow Diagram -Example Chain-of-Custody Form and Seal
3.3.2 Sample Handling and Tracking System		
3.3.3 Sample Custody		

Required QAPP Element(s) and Corresponding QAPP Section(s)	QAPP Worksheet #	Required Information
3.4 Quality Control Samples		
3.4.1 Sampling Quality Control Samples	26 27	-QC Samples Table -Screening/Confirmatory Analysis Decision Tree
3.4.2 Analytical Quality Control Samples		
3.5 Data Management Tasks		
3.5.1 Project Documentation and Records	29 30	-Project Documents and Records Table -Analytical Services Table -Data Management SOPs
3.5.2 Data Package Deliverables		
3.5.3 Data Reporting Formats		
3.5.4 Data Handling and Management		
3.5.5 Data Tracking and Control		
Assessment/Oversight		
4.1 Assessments and Response Actions		
4.1.1 Planned Assessments	31 32	-Assessments and Response Actions -Planned Project Assessments Table -Audit Checklists -Assessment Findings and Corrective Action Responses Table
4.1.2 Assessment Findings and Corrective Action Responses		
4.2 Quality Assurance Management Reports	33	-QA Management Reports
4.3 Final Project Report		
Data Review		
5.1 Overview		
5.2 Data Review Steps		
5.2.1 Step I: Verification	34 35 36 37	-Verification (Step I) Process Table -Validation (Steps IIa and IIb) -Usability Assessment
5.2.2 Step II: Validation		
5.2.2.1 Step IIa: Validation Activities		
5.2.2.2 Step IIb: Validation Activities		
5.3 Streamlining Data Review		
5.3.1 Data Review Steps to be Streamlined		
5.3.2 Criteria for Streamlining Data Review		
5.3.3 Amounts and Types of Data Appropriate for Streamlining		

Worksheet #3
QAPP Distribution List

Names and affiliation of those receiving copies of the QAPP:

QAPP Distribution List			
Name	**Project Responsibility**	**Affiliation**	**Document Control Number**
Michael Infurna (212) 637-4177	Remedial Project Manager	USEPA 290 Broadway, 22nd Floor New York, NY 10007-1866	
Raymond Klimcsak (212) 637-3916	CERCLA Quality Assurance Coordinator	USEPA 290 Broadway, 19th Floor New York, NY 10007-1866	
Christopher Magee (518) 402-9813	Remedial Project Manager	NYSDEC 625 Broadway Albany, New York 12233-7017	
Francisco Trejo (203) 205-9000	Project Coordinator	Unicorn Management 52 Federal Road, Suite 2C Danbury, CT 06810	
Thomas H. Forbes, P.E. (716) 856-0599	Supervising Contractor	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	
Bryan C. Hann (716) 856-0599	Supervising Contractor Quality Assurance Officer	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	
John T. Deth (716) 856-0599	Supervising Contractor Secondary Field Team Leader	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	
Richard L. Dubisz (716) 856-0599	Supervising Contractor Health & Safety Officer Primary Field Team Leader	Benchmark 2558 Hamburg Turnpike, Suite 300 Buffalo, NY 14218	

QAPP Distribution List			
Name	**Project Responsibility**	**Affiliation**	**Document Control Number**
Michael Perry (585) 288-5380	Laboratory Director	ALS Environmental 1565 Jefferson Road Building 300, Suite 360 Rochester, NY 14623	
Lisa Reyes (585) 288-5380	Laboratory QA Director	ALS Environmental 1565 Jefferson Road Building 300, Suite 360 Rochester, NY 14623	
Elizabeth Dickinson (610) 458-0289	Third Party Data Validator	Trillium, Inc. 27 LaFayette Circle Downington, PA 19335	

Worksheets #4, 7 & 8
Personnel Qualifications & Sign-Off Sheet

Signatures below document that all key project personnel performing work have read the applicable sections of the QAPP and will perform the tasks as described. Personnel responsibilities and qualifications including special training requirements and education/ experience should be noted.

Personnel Qualifications and Sign-off Sheet				
Name	**Project Title/ Role**	**Education/ Experience**	**Specialized Training/ Certification**	**Signature/Date**
Thomas Forbes	Project Manager	B.S Chemical Engineering, 25+ Years of Environmental Work Experience	NYS Licensed Professional Engineer/ HAZWOPER 40 Hour	
Bryan Hann	QA Officer	B.A. Geology, 20+ Years of Environmental Work Experience	HAZWOPER 40 Hour	
John Deth	Secondary Field Team Leader	A.A.S. Civil Engineering Technology, 30+ Years of Environmental Work Experience	HAZWOPER 40 Hour	
Richard Dubisz	Health & Safety Officer/ Primary Field Team Leader	B.S. Environmental Science, 25+ Years of Environmental Work Experience	HAZWOPER 40 Hour	

Personnel Qualifications and Sign-off Sheet				
Name	**Project Title/ Role**	**Education/ Experience**	**Specialized Training/ Certification**	**Signature/Date**

The various field and management duties and responsibilities of key project personnel, as well as training requirements (where applicable), are defined below.

Management Responsibilities

Michael Infurna, USEPA Region 2, Remedial Project Manager

The USEPA Region 2 is the lead regulatory agency responsible for all regulatory oversight and management of the project.

Christopher Magee, New York State Department of Environmental Conservation (NYSDEC), Remedial Project Manager

The NYSDEC works directly with the USEPA in regulatory oversight and management of the project.

Respondents for the Lehigh Valley Railroad Derailment Superfund Site

The respondents are assumed responsible for implementing the remedial actions. The respondents will report directly to the USEPA Region 2 Remedial Project Manager and provide the main point of contact and control for matters concerning the project.

Francisco Trejo, UMC, Project Coordinator

The Project Coordinator has the responsibility for ensuring that the project meets the USEPA's objectives. The Project Coordinator will report directly to the respondents and the EPA Project Manager and is responsible for technical and project oversight. The Project Coordinator will:

- Define/approve project objectives and develop a detailed work plan schedule.
- Establish/approve project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.

- Review and analyze overall task performance with respect to planned requirements and authorizations.
- Review and approve all deliverables before their submission to USEPA Region 2.
- Represent the project team at meetings and public hearings.

Thomas H. Forbes, P.E., Benchmark, Supervising Contractor Project Manager

The Supervising Contractor has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of contractor personnel, and subcontractors. The Supervising Contractor reports directly to the Project Coordinator. The Supervising Contractor will:

- Orient all field leaders and support staff concerning the project's special considerations.
- Provide review of contract document submittals.
- Monitor and document field progress, including community air monitoring results.
- Interface with local authorities and members of the public, as required.

Quality Assurance (QA) Responsibilities

Bryan C. Hann, Benchmark, Project QA Officer

The QA Officer will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff as necessary, to resolve any QA dispute. He is responsible for auditing the implementation of the QA program in conformance with the demands of UMC and Benchmark policies, and USEPA requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues. Specific function and duties include:

- Performing QA audits on various phases of the field operations.
- Reviewing and approving QA plans and procedures.
- Providing QA technical assistance to project staff.
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Supervising Contractor for technical operations.

- Responsible for the data validation of all sample results from the analytical laboratory.

Raymond Klimcsak, USEPA CERCLA Quality Assurance Coordinator (CQAC)

The USEPA CQAC has the responsibility to review and approve all QAPPs.

Field Responsibilities

Thomas H. Forbes, P.E., Benchmark, Supervising Contractor Project Manager

The supervising contractor will manage all field activities associated with the RA. Specific responsibilities during implementation of these tasks include:

- Coordination and oversight of field team leader(s).
- Overseeing training and qualifications.
- Manage contractors and subcontractors.
- Communicate corrective actions, budgetary, quality assurance/quality control, and health and safety issues with associated project team as required.

Richard L. Dubisz, Benchmark, Primary Field Team Leader

John T. Deth, Benchmark, Secondary Field Team Leader

The field team leader will work with the project manager to implement all field tasks associated with the project. Specific responsibilities include:

- Coordination and oversight of field staff and activities.
- Review of project specifications, provide implementation directives to field staff and certify quality assurance/quality control for field activities.
- Support QA and Health and Safety Officers in the maintenance of project compliance with approved documents.
- Communicate status and progress updates to Project Manager daily.

Richard L. Dubisz, Benchmark, Health and Safety Officer

The health and safety officer is certified in health and safety and will oversee all health and safety aspects of field activities associated with the RA. Specific responsibilities include:

- Overseeing health and safety training and maintaining qualification records for all field staff.
- Overseeing all field activities for compliance with specific project health and safety requirements.
- Initiate work stoppage(s) due to health and safety concerns, if required.

(TBD), Field Staff

Field staff may include both Site and drilling subcontractors. The Supervising Contractor will use the staff to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work. Qualifications for all staff will be established prior to work implementation by Benchmark and provided upon request.

Laboratory Responsibilities

The laboratory assigned with responsibility for chemical analyses of environmental samples is ALS Environmental located at 1565 Jefferson Road, Building 300, Suite 360 in Rochester, New York. ALS Environmental is a New York State ELAP and NELAC certified laboratory.

Karen Bunker, ALS Environmental Project Manager

As a final review prior to the release of the report, the laboratory Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/narratives are present, flags are appropriate, and project specific requirements are met. The laboratory Project Manager signs the final report and will report directly to the RA Leader. The client services manager provides a complete interface with clients from initial project specification to final deliverables.

Michael Perry, ALS Environmental Laboratory Director

The Laboratory Director is a technical advisor and is responsible for summarizing and

reporting overall unit performance. Responsibilities of the ALS Environmental Laboratory Director include:

- Provide technical, operational, and administrative leadership.
- Allocation and management of personnel and equipment resources.
- Quality performance of the facility.

Lisa Reyes, ALS Environmental Quality Assurance (QA) Program Manager

The laboratory QA Manager has the overall responsibility for data after it leaves the laboratory. The laboratory QA Manager will be independent of the laboratory but will communicate data issues through the ALS Environmental Laboratory Director. In addition, the laboratory QA Director will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Define appropriate laboratory QA procedures.
- Prepare laboratory SOPs.
- Perform internal auditing of procedures and electronic auditing of data
- Certification and accreditation activities

Gregg LaForce, ALS Environmental Sample Management Office

The laboratory Sample Management Office will report to the Laboratory Director. The data review process at the laboratory starts at the Sample Control level. Sample control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The sample control supervisor reviews the transaction of the chain-of-custody forms and the inputted information. Responsibilities of the Sample Control Supervisor will include:

- Receiving and inspecting the incoming sample containers.
- Recording the condition of the incoming sample containers.

- Signing appropriate documents.
- Verifying chain-of-custody.
- Notifying Project Manager of sample receipt and inspection.
- Entering the samples into the LIMS and labeling the samples with the LIMS assigned unique identification number and customer number.
- Distributing samples to the appropriate storage locations.

ALS Environmental Technical Staff

The next level of data review occurs with the Analysts. As results are generated, Analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the Laboratory Information Management System (LIMS). To ensure data compliance, a different analyst or supervisor performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Qualifiers are added as needed. All sample data requiring manual calculations, all GC/MS spectra and all manual integrations are reviewed. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors

- Results outside of calibration range

Unacceptable analytical results may require reanalysis of the samples and may require the involvement of the Technical Manager, Project Manager, or QA Manager. Corrective action is initiated whenever necessary. Any unresolved problems are documented and the Project Manager narrates the issues in the final report.

Elizabeth Dickinson, Trillium, Inc. Third Party Data Validator Responsibilities

Elizabeth Dickinson will be retained as a third party data validator by the Supervising Contractor to perform an independent data usability evaluation of all samples documented with NYSDEC ASP Category B/EPA Level IV deliverables. The data usability evaluation will involve review of pertinent internal and external QC data as reported by the laboratory. QC parameters that will be evaluated in reference to compliance with the analytical methods, protocols, and deliverables requirements will include those items necessary to satisfy the requirements for preparation of a Data Usability Summary Report (DUSR). The data validator has the responsibility for evaluating the data usability by examining the following:

- Completeness of the data package as defined under the requirements of NYSDEC ASP Category B/EPA Level IV.
- Compliance with required holding times.
- Sample chain-of-custody forms
- QC analysis data, including blanks, instrument tunings, calibrations, spikes, surrogate recoveries, duplicates, laboratory controls and sample data.
- Agreement between laboratory raw data and data summary sheets, with verification that correct data qualifiers were used where appropriate.

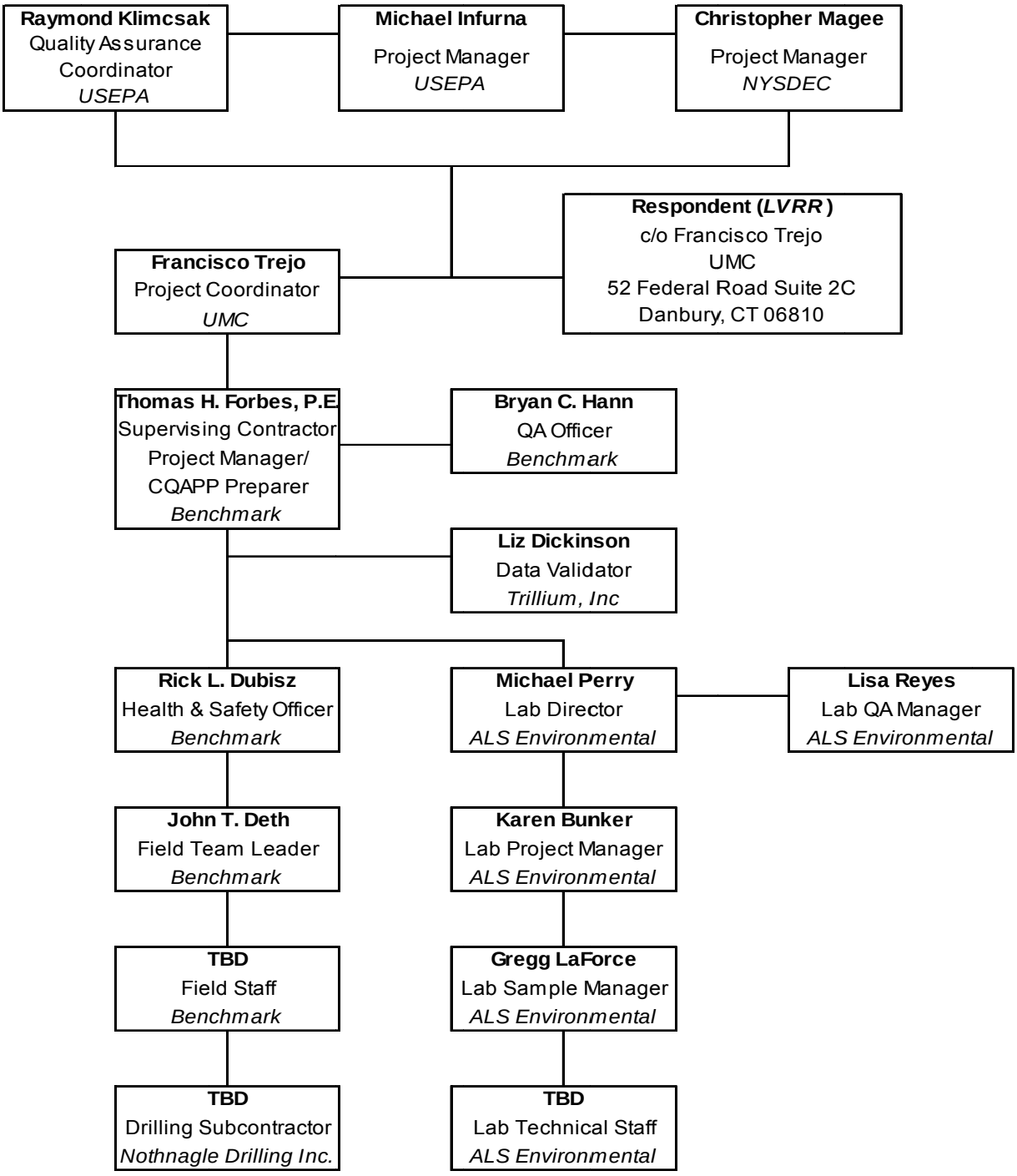
The DUSR will present the review findings with a discussion of any data deficiencies, analytical protocol deviations, and QC problems encountered. Data deficiencies, analytical method protocol deviations, and quality control problems will be described and their effect on the data presented. Recommendations for resampling/ reanalysis will be made where deemed necessary. Data qualifications will be documented for each parameter as required. Additional data validation details are presented in Worksheet #37.

Special Personnel Training Requirements

No non-routine field sampling, analysis or data validations activities are specified requiring special training or requirements for construction RA.

All field staff will require appropriate Hazardous Waste Operations and Emergency Response training and documentation as required by the Occupational Safety and Health Administration standards. The training and certifications of all staff will be documented in the front end of this Worksheet and maintained by the Supervising Contractor Health and Safety Officer.

Worksheet #5
Project Organization



Worksheet #6
Communication Pathways

Communication Driver	Organization	Title	Contact Information	Procedure
Regulatory agency	USEPA	Remedial Project Manager	Michael Infurna (212) 637-4177	• Approval of remedial actions and associated documents including this QAPP • Approval must be sought for deviation from pre-approved remedial actions & documented in writing.
Regulatory agency Interface, QAPP modifications	UMC	Project Coordinator	Francisco Trejo (203) 205-9000	• UMC project manager serves as primary regulatory point of contact • All modifications of the QAPP must be discussed and approved by the Project Coordinator • Modifications to the QAPP must be completed in writing, approved by all parties and re-submitted to the distribution list • The Project Coordinator will discuss all changes with applicable parties prior to execution of modifications • All regulatory communication will be conducted by the Project Coordinator
Field progress reports	Benchmark	Supervising Contractor Project Manager	Thomas H. Forbes, P.E. (716) 856-0599	• Verbal and/or written field progress reports must be generated by the Supervising Contractor on a daily basis. • Approval must be sought for deviations from pre-approved scope of work

Communication Driver	Organization	Title	Contact Information	Procedure
Stop work due to safety issues	Benchmark	Supervising Contractor Health & Safety Officer	Richard L. Dubisz (716) 856-0599	• Immediate verbal communication of safety issues and pre-approval of non-eminent field corrective actions is required.
QA corrective actions	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• The QA Officer has the authority to stop field work and/or implement corrective actions as necessary to address QA issues.
Field corrective actions	Benchmark	Supervising Contractor Field Team Leader	Richard L. Dubisz John T. Deth (716) 856-0599	• All field corrective actions must be pre-approved by the Supervising Contractor Project Manager and will be implemented by the Field Team Leader.
Sample receipt variances	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• Immediate verbal communication of sample receipt variances is required. • The QA Officer will communicate with the Supervising Contractor Project Manager and advise corrective actions. • All sample receipt variances will be documented in writing in the sample chain of custody.
Laboratory quality control variances/ analytical corrective actions	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• Immediate verbal communication of laboratory quality control variances is required. • All communication regarding analytical corrective actions will be documented in the laboratory report.

Communication Driver	Organization	Title	Contact Information	Procedure
Data verification issues/data review corrective actions	Benchmark	Supervising Contractor QA Officer	Bryan C. Hann (716) 856-0599	• Immediate verbal communication of data verification issues is required. • All communication regarding data review corrective actions will be documented in the data verification report. • All quality assurance issues identified by the third party validator will be addressed by the QA officer.

Worksheet #9
Project Scoping Session Participants Sheet

Date of Session: June 11, 2013

Scoping Session Purpose: Review the purpose and expected results of the project; the environmental decisions that need to be made; the project quality objectives necessary to achieve expected results and support environmental decisions; the sampling, analytical, and data review activities that will be performed; and the final products and deliverables for the project.

Name	Organization	Title/Role	Email/Phone
Michael O'Connor	Unicorn	Manager of Environmental Projects	moconnor@unicornmgt.com (203) 205-9000
Francisco Trejo	Unicorn	Project Coordinator	ftrejo@unicornmgt.com (203) 205-9000
Thomas H. Forbes, P.E.	Benchmark	Principal Engineer	tforbes@benchmarkees.com (716) 856-0599
Nathan T. Munley	Benchmark	Sr. Project Scientist	nmunley@benchmarkees.com (716) 856-0599
Holly A. Akers	Benchmark	Project Engineer	hakers@benchmarkees.com (716) 856-0599

The results of the project scoping session are presented throughout this QAPP.

Date of Session Two: April 10, 2014

Scoping Session Purpose: Review scope of Remedial Action Work Plan and project implementation including the project schedule, deliverable delegation, any changes in project details, and newly assigned personnel.

Name	Organization	Title/Role	Email/Phone
Michael O'Connor	Unicorn	Manager of Environmental Projects	moconnor@unicornmgt.com (203) 205-9000
Francisco Trejo	Unicorn	Project Coordinator	ftrejo@unicornmgt.com (203) 205-9000
Thomas H. Forbes, P.E.	Benchmark	Principal Engineer	tforbes@benchmarkees.com (716) 856-0599

The results of the project scoping sessions are presented throughout this QAPP.

Worksheet #10
Conceptual Site Model

A conceptual site model is provided as Section 1.3 (page 3) in the Soil Remedial Design Report dated September 2013.

The problem to be addressed by the project: Elevated concentrations of chlorinated volatile organic compounds have been detected throughout the Spill Area overburden soil.

Worksheet #11
Project/Data Quality Objectives

The remedial actions outlined in the Soil RD Report and addressed in this QAPP include several phases, each with quality objectives. Construction-related tasks are detailed in the CQAPP included as Volume 2 of the RAWP.

Systematic Planning Process:

1. State the problem: Elevated concentrations of chlorinated volatile organic compounds have been detected throughout the Spill Area overburden soil.
2. Identify the goals of the study: the ultimate goal of the soil remedial design is to achieve the Remedial Action Objectives (RAOs) in overburden soil across the Spill Area.
3. Identify information inputs: see Worksheet #17 Sampling Design and Rationale.
4. Define the boundaries of the study: see Worksheet #14 Project Tasks.
5. Develop the analytic approach: see Worksheet #17 Sampling Design and Rationale.
6. Specify performance or acceptance criteria: see Worksheet #12 Measurement Performance Criteria and Worksheet #14 Project Tasks.
7. Develop the detailed plan for obtaining data: see analytical data needs below and Worksheet #17: Sampling Design and Rationale.

Worksheet #12
Measurement Performance Criteria

The analytical methods to be employed during the remedial work have been based on sensitivities that allow for the comparison of the results to the RAOs or Project Action Levels. To evaluate the performance of the analytical processes, the following QA samples will be analyzed in conjunction with the field samples:

- Matrix spike/matrix spike duplicates
- Field duplicates (for field soil duplicates, the intention is to split existing sampling locations)
- Trip blank (VOC groundwater and soil samples only)
- Equipment blanks (dedicated sampling equipment will be used; therefore, equipment blanks are not required.)
- Method blanks

The results of the analyses of these QA samples will be compared to analytical method-specific criteria and determinations will be made relative to accuracy and precision of the data. The SOPs in the laboratory's QA Manual (Appendix B of the RAWP) and the data validation SOPs (described in Worksheets #36 and #37) will be used to evaluate the quality of the data. The analytical laboratory sensitivity and project criteria for each matrix, analytical group, and concentration level for samples subject to Category B/Level IV laboratory deliverables are listed below.

Matrix: Soil			
Analytical Group: 5035/8260 TCL VOCs			
Concentration Level: Low			
Data Quality Indicator	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**	**QC Sample Assesses Error for Sampling, Analytical or Both**
Precision – Overall	Field Duplicates	RPD ≤ 30%	Both
Precision - Lab	Laboratory Duplicates	RPD ≤ 30%	Analytical
Accuracy/Bias	Internal Standards	50-200% Recovery	Analytical
Accuracy/Bias	Surrogate Spikes	1,2-dichloroethane-d4 61-145% 4-bromofluorobenzene 28-150% dibromofluoromethane 63-138% Toluene-d8 66-138%	Analytical
Accuracy/Bias Combination	Equipment Blanks[2], Field Blanks, Method Blanks & Instrument Blanks	No target compounds ≥ QL	Both
Sensitivity	Matrix Spike	Compound Specific – See Laboratory Manual	Analytical

[1]Accuracy goals vary depending on the compound being analyzed (see Worksheet #15).
[2]Dedicated sampling equipment will be used. No equipment blanks are planned.

Matrix: Soil Vapor			
Analytical Group: TO-15 TCL VOCs			
Concentration Level: Low			
Data Quality Indicator	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**	**QC Sample Assesses Error for Sampling, Analytical or Both**
Precision – Overall	Field Duplicates	RPD ≤ 20%	Both
Precision - Lab	Laboratory Duplicates	RPD ≤ 25%	Analytical
Accuracy/Bias	Internal Standards	60% - 140%	Analytical
Accuracy/Bias	Surrogate Spikes	Limits 70% - 130%	Analytical
Accuracy/Bias Combination	Method Blank	No target compounds ≥ QL	Both

Construction-related project analytical (air samples collected during intrusive activities, water treatment system samples, and soil import characterization) is detailed in the CQAPP included as Volume 2 of the RAWP.

Worksheet #13
Secondary Data Evaluation

The current Site conceptual model has been developed based on secondary data. A secondary data evaluation has been performed as follows:

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Historical site information and soil descriptors. Based on the availability of more recent site characterization data, the analytical data provided in the report was not relied upon.	Spill Site Soil Investigation Report, October 1996	NYSDEC/ Rust Environmental and Infrastructure	Provided for historical context	Based on the limited scope and context of data use, no limitations were identified.
Although evaluated for information pertaining to the design and application of ex situ SVE, no reliable data was established.	Lehigh Valley SVE Pilot Test, April 1999	NYSDEC/ International Technology Corporation	Provided for historical context	Data from this source was not relied upon.
Evaluate whether a wetland mitigation plan will be required for remedial activities.	Wetland Delineation Report, October 2010	URS Corporation	No indicators of wetland hydrology or areas dominated by hydrophytic vegetation were observed within the Spill Area.	No known limitations.
Soil characterization & contamination delineation	Soil Data Summary Report Pre-Remedial Design Activities, December 2010	UMC	The extents and characteristics of soil contamination will be relied on in the design and scope of the remedial actions	Data collected and validated under EPA-approved methods. No known limitations.

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Compliance with the National Historic Preservation Act, 16 U.S.C. § 470.	Phase I Cultural Resource Survey, June 2011	Pratt & Pratt Archaeological Consultants	No evidence of significant cultural resources was identified within the Spill Area.	No known limitations.
Remedial Design	Soil Remedial Design Report, September 2013	Benchmark/UMC	Design specifications will be used for implementation	No known limitations

Worksheet #14
Project Tasks

Initially, an SVE pilot test will be installed and operated. Data collected during the pilot testing will be used to verify the full-scale SVE system designs. Based on the revised designs, the North and South Systems will be installed and operated for a period of approximately two years. Those tasks associated with construction of the pilot and full scale systems are detailed in the CQAPP provided as Volume 2 of the RAWP.

A limited subsurface investigation will be completed at select locations across the Spill Area to confirm remedial progress. The limited subsurface investigation will be expanded to a full post-remedial subsurface investigation once the RAOs have been confirmed at the initial sampling locations. Exclusive of construction tasks, the specific objectives and activities planned for each phase of remedial actions are as follows:

Pilot System Testing

The objectives of the pilot treatability testing are to:

- Collect data to estimate radius of influence (ROI) and soil vapor flow velocities at different applied vacuums to confirm the layout of the full-scale SVE system.
- Assess possible anisotropy in the extraction point ROI.
- Optimize the SVE system operation for efficient contaminant extraction.
- Determine the expected range of volatile organic compound (VOC) concentrations in the extracted soil vapor for estimating the VOC mass removal rate for full-scale design.
- Evaluate the application of granular activated carbon (GAC) control efficiencies for the SVE emission controls.
- Evaluate the disposal/treatment needs for liquid condensate collection.
- Maintain the site activity controls necessary to meet particulate and VOC air quality requirements.

The scope of work for the pilot test consists of the following tasks, further detailed in the RD Report:

- Install the pilot test (see CQAPP).

- Complete system pilot testing/performance monitoring, including:
  - Vacuum step testing
  - Constant rate vacuum testing
- Modify full-scale system design, as necessary.

Anticipated Start Date: August 2014
Deliverables (see Worksheet #29): Pilot Test Summary Report, Revised Soil Remedial Design Report (if necessary)

Full Scale SVE System Installations & Operation

The objective of the full scale SVE system operation is to reduce the concentration of trichloroethene (TCE) and 1,2-dichloroethene (1,2-DCE) in the soil to meet the RAOs. Specific objectives of system operation include:

- Confirming operational efficacy.
- Optimizing system operation for efficient contaminant extraction.
- Maintaining the SVE effluent emission controls.
- Maintaining liquid knock-out collection.
- Collecting data for determination of remedial action completion and system deactivation.

The full-scale system installations will include site work as detailed in the Soil RD Report incorporating modifications as necessary from the pilot testing results. The full scale activities will include:

- Construction of the full scale hybrid *in situ* SVE system (see CQAPP)
- Development of as-built drawings of all system components.
- Maintaining the site activity controls necessary to meet particulate and VOC air quality requirements.
- Completing performance monitoring across the full system.
- Modifying system operation for optimization.

- Fine tuning the effluent emission control maintenance schedule.
- Post-construction maintenance of the Site, system, and storm water Erosion Control Plan/SWPPP measures.

Anticipated Start Date: March 2015
Deliverables (see Worksheet #29): Monthly Progress Reports, SVE System Start-Up Report, Remedial Action Report, Data Usability Summary Report

Post-Remedial Soil Characterization

The objective of post-remedial soil characterization is to confirm that the RAOs have been achieved. A limited subsurface investigation will be completed to evaluate the remedial progress of the Spill Area following the observation of a significant decline in the SVE system effluent TCE and 1,2-DCE concentrations. Once RAOs have been achieved during the limited soil characterization, the soil characterization will be expanded to a full subsurface investigation.

Soil characterization will include:

- Deactivation of the SVE system for a minimum period of 72 hours prior to site work.
- Advancement of up to 35 soil borings.
- Field characterization of soil samples as outlined in the Soil RD Report and Worksheets #17 and #18.
- Submission of up to 35 soil samples for chemical analyses.

Anticipated Start Date: March 2017
Deliverables (see Worksheet #29): Initial Subsurface Investigation Report, Remedial Action Report, Data Usability Summary Report

Worksheet #15

Project Action Limits and Laboratory Specific Detection/Quantitation Limits

The following tables outline the analytical methods and requirements for Spill Area characterization and SVE system effluent samples subject to Category B/Level IV laboratory deliverables. Construction-related data is summarized in the CQAPP included as Volume 2 of the RAWP.

Matrix: Soil				
Analytical Group: 5035/8260 TCL VOCs				
Concentration Level: Low				
Analyte	**Lab Method Detection Limit (µg/kg)**	**Lab Method Reporting Limit (µg/kg)**	**Lab Replicate Precision Difference (%)**	**Accuracy Limit (%)**
1,1,1-trichloroethane	0.73	5	30	65-127
1,1,2,2-tetrachloroethane	0.81	5	30	71-134
1,1,2-trichloroethane	0.73	5	30	76-123
1,1,-dichloroethene	1.3	5	30	64-124
1,1-dichloroethane	1.3	5	30	75-126
1,2,3-trichlorobenzene	0.62	5	30	70-139
1,2,4-trichlorobenzene	0.59	5	30	68-136
1,2-dibromo-3-chloropropane	1.9	5	30	56-138
1,2-dibromoethane	1.2	5	30	73-125
1,2-dichlorobenzene	0.61	5	30	77-125
1,2-dichloroethane	0.61	5	30	75-132
1,2-dichloropropane	0.97	5	30	79-124
1,3-dichlorobenzene	0.63	5	30	74-130
1,4-dichlorobenzene	0.56	5	30	75-129
1,4-dioxane	19	100	30	59-152
2-butanone	2.3	5	30	70-131
2-hexanone	1.2	5	30	59-144
4-methyl-2-pentanone	0.98	5	30	65-138
acetone	2.8	5	30	55-143
benzene	0.29	5	30	75-124
bromochloromethane	1.4	5	30	79-125
bromodichloromethane	0.61	5	30	77-127

Matrix: Soil				
Analytical Group: 5035/8260 TCL VOCs				
Concentration Level: Low				
Analyte	**Lab Method Detection Limit (µg/kg)**	**Lab Method Reporting Limit (µg/kg)**	**Lab Replicate Precision Difference (%)**	**Accuracy Limit (%)**
bromoform	0.93	5	30	61-144
bromomethane	1.4	5	30	46-133
carbon disulfide	1.2	5	30	70-147
carbon tetrachloride	0.92	5	30	62-134
chlorobenzene	0.29	5	30	77-124
chlorodibromomethane	0.73	5	30	69-133
chloroethane	2.9	5	30	66-136
chloroform	1.3	5	30	75-126
chloromethane	0.4	5	30	52-145
cis-1,3-dichloropropene	0.9	5	30	73-120
cyclohexane	1.4	5	30	54-135
dichlorodifluoromethane	1.9	5	30	46-146
ethyl benzene	0.23	5	30	70-130
freon 113	1.2	5	30	59-127
isopropylbenzene	0.67	5	30	72-145
methyl acetate	1.8	5	30	66-138
methyl cyclohexane	1.2	5	30	57-131
methyl tert butyl ether	0.94	5	30	69-124
methylene chloride	0.57	5	30	75-122
o xylene	0.48	5	30	71-127
p/m xylene	1.1	10	30	70-130
styrene	0.3	5	30	71-127
tert-butylbenzene	0.58	5	30	66-134
tetrachloroethene	0.88	5	30	67-133
toluene	0.67	5	30	72-127
cis-1,2-dichloroethene	0.95	5	30	75-127
trans-1,2-dichloroethene	0.86	5	30	69-125
trans-1,3-dichloropropene	0.2	5	30	68-120
trichloroethene	1	5	30	72-128
trichlorofluoromethane	0.66	5	30	62-138
vinyl chloride	1.8	5	30	58-152

Project Action Limits (defined as the RAOs) are established at 7,000 parts per billion (ppb) for TCE and 3,000 ppb for total 1,2-DCE. The remainder of the TCL VOC compounds detected during the subsurface investigation will be compared to the 6NYCRR Part 375 Soil Cleanup Objectives (SCOs) for Restricted-Commercial Use (Table 375-6.8(b)) where applicable. The comparison to the Part 375 SCOs will be provided for informational purposes only.

Matrix: Air
Analytical Group: TO-15 TCL VOCs
Concentration Level: Low

Analyte	Lab Method Detection Limit ($\mu g/m^3$)	Lab Method Reporting Limit ($\mu g/m^3$)	Lab Replicate Precision Difference (%)	Accuracy Limit (%)
1,1,1-trichloroethane	0.017	0.600	25	70-130
1,1,2,2-tetrachloroethane	0.010	0.150	25	70-130
1,1,2-trichloroethane	0.019	0.600	25	70-130
1,1,-dichloroethene	0.007	0.440	25	70-130
1,1-dichloroethane	0.010	0.450	25	70-130
1,2,3-trichlorobenzene*				
1,2,4-trichlorobenzene	0.010	1.080	25	70-130
1,2-dibromo-3-chloropropane				
1,2-dibromoethane	0.010	0.170	25	70-130
1,2-dichlorobenzene	0.013	1.30	25	70-130
1,2-dichloroethane	0.017	0.450	25	70-130
1,2-dichloropropane	0.011	0.510	25	70-130
1,3-dichlorobenzene	0.018	1.30	25	70-130
1,4-dichlorobenzene	0.009	1.30	25	70-130
1,4-dioxane	0.173	5.0	25	70-130
2-butanone	0.021	0.650	25	70-130
2-hexanone	0.010	0.450	25	70-130
4-methyl-2-pentanone	0.009	0.900	25	70-130
acetone	0.059	5.0	25	70-130
benzene	0.006	0.350	25	70-130
bromochloromethane**				
bromodichloromethane	0.021	0.150	25	70-130
bromoform	0.032	1.1	25	70-130
bromomethane	0.015	0.430	25	70-130
carbon disulfide	0.066	0.340	25	70-130
carbon tetrachloride	0.013	0.070	25	70-130
chlorobenzene	0.011	0.510	25	70-130
chlorodibromomethane	0.026	0.190	25	70-130
chloroethane	0.580	0.580	25	70-130
chloroform	0.009	0.540	25	70-130
chloromethane	0.016	0.450	25	70-130

Matrix: Air				
Analytical Group: TO-15 TCL VOCs				
Concentration Level: Low				
Analyte	**Lab Method Detection Limit ($\mu g/m^3$)**	**Lab Method Reporting Limit ($\mu g/m^3$)**	**Lab Replicate Precision Difference (%)**	**Accuracy Limit (%)**
cis-1,3-dichloropropene	0.014	1.00	25	70-130
cyclohexane	0.011	0.760	25	70-130
dichlorodifluoromethane	0.016	1.09	25	70-130
ethyl benzene	0.010	0.950	25	70-130
freon 113	0.018	0.170	25	70-130
isopropylbenzene*				
methyl acetate*				
methyl cyclohexane*				
methyl tert butyl ether	0.012	0.790	25	70-130
methylene chloride	0.020	0.380	25	70-130
o xylene	0.011	0.950	25	70-130
p/m xylene	0.012	1.90	25	70-130
styrene	0.008	0.940	25	70-130
tert-butylbenzene*				
tetrachloroethene	0.026	0.080	25	70-130
toluene	0.009	0.410	25	70-130
cis-1,2-dichloroethene	0.016	0.440	25	70-130
trans-1,2-dichloroethene	0.005	0.440	25	70-130
trans-1,3-dichloropropene	0.011	0.500	25	70-130
trichloroethene	0.022	0.060	25	70-130
trichlorofluoromethane	0.016	0.620	25	70-130
vinyl chloride	0.012	0.060	25	70-130

Project Action Limits for the downwind ambient perimeter air sample have been established at 14,000 $\mu g/m^3$ for TCE and 188,000 $\mu g/m^3$ for cis-1,2-DCE.

*Outside of the calibration for TO-15, excluded from laboratory provided data.
**Internal Standard

Worksheet #16
Project Schedule

Individual schedules for the RAWP, Pilot Test, SVE System Construction, and Post-Remedial Project are included as Figures 11a through 11d, respectively.

Worksheet #17

Sampling Design and Rationale

The remedial actions outlined in the Soil RD Report will require data collection throughout the SVE pilot test, full-scale SVE operation, and subsequent subsurface investigations for confirmation of remedial progress. The sampling design and rationale for construction related activities are detailed in Volume 2 of the RAWP Compendium.

Task	Data Need		Data Uses		Number or Frequency of Samples	Compliance Reference Concentration	Points of Compliance/ Sample Locations
	Target Analyte	Matrix/ Laboratory Deliverable Category (A or B)	Remedy Methods of Interest	Criteria			
Pilot Test SVE operation	Method TO-15 TCL VOCs	Air *Category B*	SVE System	Effluent treatability and full scale remedial design specifications and costs	One pre- and one post- emission control treatment sample collected during the constant rate vacuum test	Not Applicable (See Section 7.2.4 of the RD)	Sample port located at pilot test SVE blower effluent (pre vapor-phase carbon treatment)
Full SVE system operation	Method TO-15 TCL VOCs	Air *Category B*	SVE Systems	SVE system recovery calculations & emission control loading	Start-up 1-South 2-North	Not Applicable (See Section 7.2.4 of the RD)	North and South System SVE blower effluent (pre and post vapor-phase carbon treatment)
	Method TO-15 TCL VOCs	Air *Category B*	SVE Systems	Emission control loading and efficacy	One post- emission control treatment SVE system effluent sample	NYS SGC (See Section 4.0 of the RD)	North and South System SVE emission control effluent

Task	Data Need		Data Uses		Number or Frequency of Samples	Compliance Reference Concentration	Points of Compliance/Sample Locations
	Target Analyte or Characteristic	Matrix/ Laboratory Deliverable Category (A or B)	Remedy Methods of Interest	Criteria to be Considered			
Full SVE System Operation	Method TO-15 TCL VOCs	Air *Category B*	SVE Systems	SVE system recovery calculations	Semi-Annual	Not Applicable (See Section 7.2.4 of the RD)	North and South System SVE blower effluents (pre vapor-phase carbon treatment)
Condensate Treatment Systems	Method 8260 TCL VOCs	Water *Category A*	SVE Systems	Discharge water quality	One effluent sample prior to discharge for each of two systems	NYSDEC TOGS 1.1.1	Condensate treatment system effluent
Post-remedial compliance sampling	Methods 5035/8260C TCL VOCs	Soil *Category B*	Remedial Progress Confirmation	Soil quality compliance	Up to 35 samples will be collected across the Site	7.0 ppm TCE 3.0 ppm 1,2-DCE	Proposed sample locations are depicted on Figure 10 of the RAWP

The analytical SOPs and sampling procedures are presented in Worksheet #23 and #21, respectively.

Worksheet #18
Sampling Locations and Methods

The sampling locations are discussed throughout the Soil Remedial Design Report narrative and are depicted on the RAWP Figure 10, Proposed Post Remedial Soil Sampling Locations. Procedures for sample collection and field measurements throughout all phases of the remedial actions are described below. Construction-related sampling locations and methods are included in the CQAPP, Volume 2 of the RAWP. Additional details are provided in the Field Operating Procedures (FOPs) included in Attachment A.

Extracted Soil Vapor Sampling – SVE Operation

The soil vapor extracted during both the pilot test and full-scale SVE system operation will be collected from sample ports located at the SVE blower effluent (prior to vapor-phase carbon treatment) and at the emission control effluents. One sample will be collected from each location during the pilot test constant rate vacuum test. An additional three samples will be collected from each sample location (pre- and post-emission control) following start-up; one from the South System and one from each of the two portions of the North System. Additional samples will be collected from the pre-treatment sample location at each system semi-annually thereafter or in response to significant changes in system operation or system effluent field Photoionization Detector (PID) readings. Monthly samples will be collected from the emission control effluents throughout operation of the systems. All vapor samples will be collected in pre-cleaned, batch certified, 6-liter passivated canisters supplied by ALS Environmental.

Before collecting a sample, readings taken from the laboratory-supplied pressure gauge will be recorded. After verifying the vacuum, a piece of new silicone tubing will be used to connect the barbed fitting on the sampling port to the barbed fitting on the Summa canister. Extracted soil vapor samples will be collected as grab samples; time-compositing flow controllers will not be used. Samples will be collected by opening the valves on the sampling port and Summa canister and allowing the canister to fill. Because the pressure at the sampling port will be less than atmospheric pressure, a negative pressure will be maintained

in the canister after sample collection. The remaining vacuum in the canister will be measured with the laboratory-supplied pressure gauge and recorded.

Sampling canisters will be packaged in laboratory-supplied boxes and delivered to ALS Environmental under COC protocol. The laboratory-supplied pressure gauge will be returned with the sampling canisters and used by ALS Environmental to check the canister vacuum upon receipt at the laboratory. Samples will be analyzed for VOCs by EPA Method TO-15.

Condensate Treatment Systems – SVE Operation

A 55-gallon liquid phase granular activated carbon (GAC) treatment system will be available in the SVE system trailer for the treatment of condensate collected from the system moisture separators. Prior to discharge, a treatment system effluent sample will be collected to verify the discharge water quality. The sample will be collected by directly filling VOA vials and placed in a cooler on ice for delivery to ALS Environmental under COC protocol. A laboratory-supplied trip blank will accompany the VOA vials from and to the laboratory. The trip blank and samples will be analyzed by ALS Environmental for TCL VOCs EPA Method 8260C.

Soil Sampling – Post-Remedial Subsurface Investigation

The soil borings will be advanced to allow for visual/olfactory/PID assessment of subsurface conditions as well as to obtain representative soil samples for chemical characterization as discussed below. Soil borings will be advanced with a direct push drill rig (or equivalent) to the top of bedrock. An allocation of each soil sample will be field screened in approximate 2-foot depth intervals for the presence of VOCs using a field PID as a procedure for ensuring the health and safety of personnel, and to identify potentially impacted soil samples for laboratory analysis. A separate, undisturbed allocation of each sample will be placed in pre-cleaned laboratory provided sample bottles and cooled to 4ºC±2ºC in the field.

Upon reaching the completion of each soil boring, PID, visual, and olfactory results will be reviewed. The sample interval identified as the most impacted (i.e., greatest PID scan result

and/or evidence of visual/olfactory impact) will be selected for chemical analysis. If differentiable impacts are noted within a particular soil boring, additional samples may be collected from more than one depth interval to characterize the impacts in that soil boring location. In the event that either the impacts are ubiquitous from grade to final depth or no impacts were identified, the soil samples for laboratory analysis will be collected from the interval of the depth of highest impacts from samples collected during the UMC 2010 Pre-RD investigation. Soil samples will be collected using an EnCore® sampler or equivalent. Immediately after collection, soil samples will be placed in a cooler on ice and delivered to ALS Environmental under COC protocol within 48 hours of collection. A laboratory-supplied trip blank will accompany the VOA vials from and to the laboratory. The trip blank and samples will be analyzed for TCL VOCs by EPA Methods 5035/8260C.

Worksheet #19 and 30

Analytical Containers, Preservation, and Hold Times

Sample Matrix	Parameter (Analytical Method) *Laboratory Deliverable Category*	Number of Samples (Including Field QC Samples)	Sampling SOP	Sample Containers (number per sample, size and type)	Sample Preservation (temperature, light, chemical)	Maximum Holding Time
Air (SVE System Effluents)	VOCs (Compendium TO-15) *Category B*	Pilot Test -1 Full Scale – 3	089.0	6L Summa® canister	None	30 days
Water (Condensate Treatment Systems)	TCL VOCs (SW846 Method 8260C) *Category A*	2	086.0	3-40 mL Glass Vials	HCl (1:1) to pH < 2, Cool to 0-6ºC	14 days
Soil[2,3] (Site Investigation)	TCL VOCs (SW846 Methods 5035/8260B) *Category B*	Up to 35	057.0	3-5g EnCore®	Cool to 0-6ºC	48 hours from collection to preservation, 14 days

[1]Please see Appendix B of the RAWP for Analytical Method SOPs.
[2]A minimum of one field duplicate per 20 samples will be collected per analytical group per matrix per sampling procedure per sampling event.
[3]One trip blank sample will be provided per cooler containing VOA samples.

Worksheet #20
Field Quality Control Summary

Field Sample Quality Control

QC Sample	Frequency	Acceptance Criteria	Corrective Action(s)
Trip Blank	One per cooler containing soil and/or water samples	No detections at concentrations greater than ½ the reporting limit	Review storage and handling procedures. Alter procedures as necessary. Qualify associated sample results per Region 2 guidance.
Field Duplicate	One duplicate per 20 samples collected.	RPD≤50% for analytes present in both samples at concentrations greater than 2 times the reporting limit.	Review analysis procedures and similarity of samples.

RPD = relative percent difference

$$RPD = 100\frac{|X_1 - X_2|}{\overline{X}}$$

Where X_1 and X_2 are values for sample 1 and 2, respectively and $\overline{X}$ is a sample mean.

Quality controls associated with field construction activities are included in the CQAPP (Volume 2 of the RAWP).

Worksheet #21
Field Standard Operating Procedures

Project Field Operating Procedures (FOPs):	
No.	**Sampling FOP Name**
001.1	Abandonment of Borehole Procedures
011.1	Calibration and Maintenance of Portable Photoionization Detector
013.0	Composite Sample Collection Procedure for Non-Volatile Organic Analysis
018.0	Drilling & Excavation Equipment Decontamination
026.1	Hollow Stem Auger (HSA) Drilling Procedures
046.0	Sample Labeling, Storage, and Shipment Procedures
047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
054.2	Soil Description Procedures Using the Visual-Manual Method
057.0	Soil Sample Collection for VOC Analysis – EnCore Sampling
076.0	"Before Going Into the Field" Procedure
078.0	Geoprobe Drilling Procedures
085.0	Field Quality Control Procedures
086.0	Treatment System Sampling Procedures
089.0	SVE System Sample Collection Procedure

Worksheet #22

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment Calibration and Corrective Action

Instrument	Calibration Activity	Frequency	Acceptance Criteria	Corrective Action	SOP or FOP Reference
MiniRAE 2000 PID or similar with 10.6 eV lamp	Calibration with a 10 ppmv trichloroethylene standard	Prior to arrival on site, at the start of each day, when temperature fluctuate more than 10 degrees	Response should be within 0.5 ppm of calibration gas standard	Replace any filters, clean lamp, return to manufacturer or supplier for repairs	011.0
Dwyer Digital Thermo Anemometer Model 471B or similar	Must be calibrated at factory	Annually	Factory Determined	Factory Determined	Not Applicable

Inspection/Acceptance Requirements for Supplies and Consumables

Supplies	Inspection Frequency	Type of Inspection	Responsible Party	Corrective Action
Calibration gas for PID	During mobilization preparation	Verify positive pressure in canister	Sampler	Replace or fill canister
Chains of custody for samples	During mobilization preparation	Verify that appropriate type and number of forms will accompany samples	Sampler	Obtain additional copies as necessary before sampling
Vacuum box sampler	During mobilization preparation	Verify equipment is in working condition	Sampler	Replace or repair damaged equipment
Anemometer	During mobilization preparation	Verify equipment is in working condition, check batteries	Sampler	Replace or repair defective equipment
Tedlar bags	During mobilization preparation	Verify bags are not damaged	Sampler	Replace damaged bags
Soil and water sampling glassware	Upon receipt	Verify containers are not damaged and contain preservative	Sampler	Request new containers
Summa Canisters	Upon receipt	Verify canisters are not damaged and appropriate cleaning certifications are	Sampler	Do not use rejected canisters. Obtain additional canisters from

Worksheet #23

Analytical Standard Operating Procedures

Analytical Method Reference: **Includes document title, method name/number, revision number and date**	
No.	**Analytical Method Name**
1a	USEPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS) Method TO-15, Second Edition, January 1999
2a	USEPA Solid & Hazardous Waste Method SW-846, Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, Method 5035, Update IVB, January 3, 2008
3a	USEPA Solid & Hazardous Waste Methods SW-846, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8260B, Update IVB, January 3, 2008
4a	USEPA Solid & Hazardous Waste Methods SW-846, Semi-volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8270D, Update IVB, January 3, 2008
5a	USEPA Solid & Hazardous Waste Methods SW-846, Organochlorine Pesticides by Gas Chromatography, Method 8081B, Update IVB, January 3, 2008
6a	USEPA Solid & Hazardous Waste Methods SW-846, Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Method 8082A, January 3, 2008.
7a	USEPA Solid & Hazardous Waste Methods SW-846, Inductively Coupled Plasma-Atomic Emission Spectrometry, Method 6010C, Update IVB, January 3, 2008
8a	USEPA Solid & Hazardous Waste Methods SW-846, Flame Atomic Absorption Spectrophotometry, Method 7000B, Update IVB, January 3, 2008

Project Analytical Standard Operating Procedures (SOPs):
Standard Operating Procedure ID VOC-8260, Volatile Organic Compounds by GC/MS, Reference Method 8260C, Rev. 12, Effective 8/20/2012
Standard Operating Procedure ID VOC-TO-15, Volatile Organic Compounds in Air Samples Collected in Specially Prepared Canisters and Gas Collection Bags by Gas Chromatography/Mass Specrometry (GC/MS), Reference Method TO-15, Rev. 3, Effective 10/2/2012

Copies of the laboratory analytical SOPs are included in Appendix C of the RAWP.

Worksheet #24
Analytical Instrument Calibration Table

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
GC/MS (TO-15)	Tuning criteria	Every day of analysis, including initial calibration	Bromofluorobenzene (BFB) spectrum must meet criteria in Table 1 of the TO-15 SOP.	Re-evaluate BFB spectrum before analyzing samples, reanalyze BFB. Retune Instrument if new spectrum fails.	VOC-TO-15
GC/MS (TO-15)	Initial calibration	Before sample analysis	Relative standard deviation (RSD) of the response factors ≤30%. If a target analyte cannot meet the % RSD criteria for relative response factor calibration, then linear regression may be used with at least 5 calibration points and a correlation coefficient of 0.99 or greater.	Recalibrate and repeat initial calibration. If linear regression fails, prepare a new set of calibration standards and repeat.	VOC-TO-15
GC/MS (TO-15)	ICV sample	After every sample	Average response factor must be within 30% of initial calibration.	Repeat ICV. If second ICV is not within criteria, investigate possible causes of failure or recalibrate instrument.	VOC-TO-15
GC/MS (TO-15)	Continuing calibration verification (CCV/LCS)	Before sample analysis	Percent difference of the continuing calibration response factor from the initial calibration response factor must be ≤30%.	If the CCV/LCS analysis fails a second time, recalibrate instrument.	VOC-TO-15

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
GC/MS (8260C)	ICAL	Prior to sample analysis.	1.RSD of RFs <20% each target or 2. LR CC≥0.99 or 3. Non-LR r≥0.99 (6pt 2nd order; 7pt 3rd order)	Correct problem – recalibrate if necessary.	VOC-8260
GC/MS (8260C)	ICV	Immediately following ICAL	All project analytes within 30% of true value.	Correct problem and verify second source standard. Rerun ICV. Repeat ICAL if reanalysis fails.	VOC-8260
GC/MS (8260C)	Tune	Prior to ICAL and at beginning of each 12 hour period	Specific Ion Criteria in SOP.	Retune instrument and verify.	VOC-8260
GC/MS (8260C)	CCV	Beginning of each 12 hour period	1. Minimum RFs as per SOP (Table 4 of method 8260C). 2.%Difference/Drift for all target compounds: ≤20%D. 3.EICP area within -50% to 100% of ICAL midpoint standard. 4.Internal standards must have retention time ± 30 seconds from retention time of the midpoint standard in the ICAL. Non-detect samples may be reported with a high-bias CCV.	Correct problem then rerun CCV. If that fails, then repeat ICAL.	VOC-8260

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

The analytical instrument and equipment maintenance, testing and inspection information is presented in Sections 13.0 and 14.0 of the ALS Environmental Quality Assurance Manual included as Appendix B of the RAWP.

Worksheet #26
Sample Handling System

Sampling Organization: TBD
Laboratory: ALS Environmental
Method of Sample Delivery: TBD
Number of Days From Reporting to Sample Disposal: At least 60 days

Activity	Organization and title or position of person responsible for the activity	SOP Reference
Sample Labeling	Sampler - TBD	046.0
Chain-of-Custody Completion	Sampler – TBD	046.0
Packaging	Sampler – TBD	046.0
Shipping Coordination	Sampler – TBD	046.0
Sample receipt, inspection, and log-in	ALS Environmental – TBD	SMO-GEN
Sample custody and storage	ALS Environmental – TBD	SMO-ICOC
Sample disposal	ALS Environmental – TBD	SMO-SPLDIS

Worksheet #27
Sample Custody Requirements

The procedures that will be used to maintain sample custody and integrity for the project include the use of COC forms, sample identification, custody seals, laboratory sample receipt forms, and laboratory sample transfer forms. The following describes the sample custody procedure that will be implemented during the remedial work:

Sample Identification Procedures: All samples collected for the project will be identified using the format specified in FOP #046.0; Sample Labeling, Storage, and Shipment Procedures..

Sample ID example: **GW051402047**

- **GW** Sample matrix: GW = groundwater; SW = surface water; SUB subsurface soil; SS = surface soil; SED = sediment; L = leachate; A = air
- **05** Month of sample collection
- **14** Day of sample collection
- **02** Year of sample collection
- **047** Consecutive sample number

Field Sample Custody/Tracking Procedures: The field sample custody/tracking procedures are detailed in FOP #046.0; Sample Labeling, Storage, and Shipment Procedures.

Laboratory Sample Custody/Tracking Procedures: Following receipt of the samples, the laboratory will accept, log, and maintain COC in accordance with the custody procedures described in the laboratory manual (see Appendix B of the RAWP).

Chain-of-Custody Procedures: A sample COC form and applicable procedures are detailed in FOP #046.0; Sample Labeling, Storage, and Shipment Procedures.

Field Screening Samples

All field screening-level analyses will be completed on-Site by field personnel.

Worksheet #28
Analytical Quality Control and Corrective Action

QC Item	Frequency	Methodology	Acceptance Criteria	Corrective Action
Laboratory method blank (TO-15)	1 per batch of up to 20 samples.	A canister is pressurized with nitrogen or zero air, humidified, and analyzed.	Free of target analyte contamination at or above the reporting limit.	Evaluate system to eliminate sources of contamination and reanalyze blank. If sample carryover has occurred, reanalyze samples with positive results for the contaminant <5X blank concentration.
Internal Standard (IS) (TO-15)	Each Sample	Measured amounts of certain compounds added after preparation of a sample.	Internal standard area counts for the CCV must be within 60-140% of the midpoint of the initial calibration, and for samples and QC samples, must be within 60-140% of the CCV area counts. Retention times of the internal standards must be within ±20 seconds of the most recent calibration (CCV or midpoint ICAL).	Correct any instrument malfuntions, dilute sample if matrix related, reanalyze as needed. Flag if problem cannot be resolved.

QC Item	Frequency	Methodology	Acceptance Criteria	Corrective Action
Laboratory duplicate (TO-15)	Each day of analysis	Two aliquots of the sample same are prepared and analyzed in the same manner.	RPD<25% for analytes detected in original and duplicate.	Repeat analysis.
Canister leak check (TO-15)	Before analysis	Measure the vacuum of the canister over a period of 24 hours.	Vacuum must not increase more than 2 “Hg.	Determine and repair source of leak.
Canister cleaning certification (TO-15)	One per batch of 20 or fewer canisters or each if individual certification required.	Analyze canister using the appropriate analytical method SOP.	Target analytes must not be present above Reporting Limits.	Re-clean and re-certify entire batch of canisters.
Method Blank (8260)	1 per batch of up to 20 samples.	An aliquot of reagent water is analyzed.	No analytes detected > reporting limit (RL). For common laboratory contaminants, no analytes detected >5x RL. Samples < RL may be reported with failed MB.	Reprep and reanalyze the method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, sample data associated with the failed MB must be flagged and explained in the case narrative.
LCS (8260)	One per batch of up to 20 samples.	Reagent water is spiked with target compounds at specified concentrations and analyzed.	QC acceptance criteria specified in Worksheet #12. Samples <RL may be reported with an LCS greater than its high recovery limit.	Correct problem, reprep and reanalyze LCS and all samples in associated batch for failed analytes. If reanalysis cannot be performed, flag and explain in the case narrative.

QC Item	Frequency	Methodology	Acceptance Criteria	Corrective Action
Surrogate spike (8260)	All field and QC samples	Measured amounts of certain compounds added during preparation of a sample.	4-bromofluorobenzene 28-150% Toluene-d8 66-138% Dibromofluoromethane 63-138% 1,2-Dichloroethane-d4 61-145%	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, or historical results verify interference, reanalysis may not be necessary. If surrogates are diluted more than 10 times, report with flag
Matrix Spike/Matrix Spike Duplicate (8260)	One pair per 12-hour window or 20-sample batch, whichever is more frequent .	Measured amounts of target compounds added during preparation of a sample.	Recovery QC Acceptance Criteria same as LCS. RPD ≤30% between MS and MSD.	Recovery - assume matrix interference if LCS is acceptable. RPD - Examine chromatogram for interferences. Examine sample for possible heterogeneity.
Internal Standards Verification (8260)	Every field sample, standard, and QC sample	Measured amounts of certain compounds added after preparation of a sample	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning. If corrective action fails in field samples, flag analytes associated with the non-compliant IS.

Worksheet #29
Project Documents and Records

A field book will be used to compile information collected during the field work portion of the project, including sampling conditions, observations, and deviations from SOPs or this QAPP. When available, sampling forms will be used to document sampling activities.

At the analytical laboratory, samples are to be recorded in a permanently bound sample log-in notebook and a laboratory notebook, specific for each instrument. The laboratory will provide a full data package including: sample data; COC forms; QA/QC narratives; internal standard area summaries; calibration summaries; surrogate recovery summaries; all applicable CLP or equivalent forms and raw data; and data pertaining to blanks, matrix spikes, laboratory control, and duplicate samples. Full data packages will be provided for all samples analyzed. If demonstration of system cleanliness by analysis of an instrument blank is required, these records must be included in the data package. Records of the most recent quarterly verifications of the method limit of detection and limit of quantitation studies must be submitted with or prior to the data package.

Data will be provided by the laboratory in a digital format and appended to project reports as appropriate. The data usability summary report will be provided by the data validator and also appended to reports as appropriate. The deliverables associated with the project are detailed in the Soil RD Report and include the following:

- Pilot Test Report
- SVE System Start-Up Report
- Monthly Progress Reports
- Initial Subsurface Investigation Report
- Remedial Action Report
- Data Usability Summary Report

Data will be stored in electronic format on UMC's office secure local area network located at 52 Federal Road, Suite 2C, Danbury, Connecticut.

Worksheet #31, 32, and 33
Assessments and Corrective Action

Field Tasks

During field activities, the field team is responsible for completing tasks in accordance with specified methods and SOPs. The Supervising Contractor will be responsible for understanding the field program objectives and checking the completion of tasks. If a task is performed in a way that deviates from specified methods or SOPs, the field team will complete a Deviation Form describing the method or SOP deviation, the rationale for the deviation, and any corrective actions that may be required. An example deviation form is provided in Attachment B. Deviations will be reported as soon as possible to the QA Officer for review. If the deviation results in serious consequences for data integrity, the Project Coordinator may require corrective actions, such as collecting and analyzing additional samples.

If any unexpected circumstances are encountered in the field, the Project Coordinator will be contacted before the field activity proceeds. Field tasks will be documented by field staff and overseen in the field by the Supervising Contractor. The Supervising Contractor will be responsible for carrying out corrective actions as directed by the Project Coordinator. The Project Coordinator may consult with the Respondent, USEPA, NYSDEC, or other stakeholders before providing direction regarding corrective actions or changes to the scope of work.

Laboratory Tasks

The analytical laboratory is responsible for ensuring that all laboratory tasks are completed in accordance with specified methods and SOPs. The laboratory must maintain its NELAC certification throughout the course of the project.

Modifications to QAPP

Major modifications to this QAPP must have prior approval by the USEPA Project Manager.

Worksheet #34
Data Verification and Validation Inputs

Description	Verification (Completeness)	Validation (Conformance to Specifications)
Planning Documents/Records		
RAWP	X	
Soil Remedial Design Report	X	
Field SOPs	X	
Laboratory SOPs	X	
Field Records		
Field Logbooks	X	X
Equipment Calibration Records	X	X
Chain of Custody Forms	X	X
Sampling diagrams/surveys	X	X
Drilling logs	X	X
Relevant correspondence	X	
Change orders/deviations	X	X
Field audit reports	X	X
Field corrective action reports	X	X
Analytical Data Package		
Cover sheet	X	X
Case narrative	X	X
Internal laboratory chain of custody	X	X
Sample receipt records	X	X
Sample chronology	X	X
Communication records	X	X
Copies of lab notes	X	X
Corrective action reports	X	X
Definition of laboratory qualifiers	X	X
Documentation of QC results	X	X
Documentation of method deviations	X	X
Instrument calibration reports	X	X
QC sample raw data	X	X
QC summary report	X	X
Raw data	X	X
Electronic data deliverable	X	X

Worksheet #35
Data Verification Procedures

Field notes, sampling forms, and deviation forms will be reviewed for errors and omissions by the sampler, Supervising Contractor, and QA Officer. Field notes will be compared to COC documents and laboratory reports to verify that all samples intended for laboratory analysis were sent to the laboratory and analyzed.

Field analytical data will be used solely for screening; therefore, no comparison with laboratory analytical results will be performed. Field analytical data will be evaluated by the Field Leader and the QA Officer based on the observed performance of the screening equipment and any required deviations from the applicable SOP.

The laboratory data verification process will include both the review by the QA Officer as discussed above and during the usability assessment discussed in Worksheet #37.

Worksheet #36
Data Validation Procedures

The QA Officer will evaluate the field records for consistency and review pertinent QC information on these records. Deviation reports will be reviewed for consistency with field records to determine if appropriate corrective actions have been completed and if these deviations impact project goals. A field data validation report will be included as an appendix to appropriate reports. All original field forms will be electronically filed by UMC.

Analytical data generated by the laboratory will be reviewed for data completeness by Trillium, Inc., a subcontracted data validator. In accordance with the SOW, the data subject to Category B/Level IV deliverables will be validated according to the procedures stated in the USEPA Region 2 Validating Volatile Organic Compounds by SW-846 Method 8260B (SOP #HW-24 Revision 2). These guidelines do not address air sample results; therefore, the USEPA Region 2 Volatile Organic Analysis of Ambient Air in Canister by Method TO-15 (SOP #HW-31) will be used to evaluate air sample data. Where required, other EPA-approved equivalent procedures may be used. Data validation will verify compliance with sample hold time requirements, proper COC documentation, acceptable detection limits, internal standard recoveries, and laboratory control sample recoveries.

Data validation is a process by which laboratory-reported data are subjected to a comprehensive, technically oriented evaluation by personnel experienced in the analysis and review of sample data from environmental matrices. Non-compliance with the method specifications may be noted where relevant.

During the validation process, laboratory data are verified against all available supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data validator. Raw data is examined in detail to check calculations, compound identification, and/or transcription errors. Validated results are either qualified or unqualified; if results are unqualified, this means that the reported values may be used without reservation. Final validated results are annotated with the qualification codes.

The data validator will evaluate the data precision, accuracy, and completeness as described below.

- Accuracy: The amount of agreement between the true value of a parameter and the measured value. Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. To assess the accuracy of the laboratory measurements, the trueness of instrumental calibrations will be evaluated by assessment of linearity and differences of daily calibrations to the linearity measurement; the percent recovery will be calculated for all spiked analytes, including internal standards, surrogates, and target analytes; and the accuracy of the analytical system near the detection limits will be taken into account. The control limits for percent recovery of spike compounds and surrogates are listed in the laboratory SOP corresponding to the specific analytical method used for analysis.
- Precision: The measurement of the agreement between samples from the same population. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Precision can be expressed as the relative standard deviation (RSD) between independent samples or as the relative percent difference (RPD) between duplicate samples.
- Completeness: The measure of the amount of validated data obtained compared to that which was expected to be obtained. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of a data set. For completeness requirements, valid results are all results not qualified with an "R" flag. An "R" flag placed on the data by the data validator indicates that the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria. Results with an "R" flag that are replaced by other analyses, as in the case of diluted analyses, are not included in the assessment of completeness. A target completeness goal of at least 90% is anticipated.

The results of each component of the data review will be summarized in the final report. A table summarizing the QC results will be included, as well as any revisions or qualifiers deemed necessary.

Where appropriate and/or where advised by the analytical laboratory, data may be accepted as is, accepted but qualified, or rejected ("R") if it is determined not to be of sufficient quality for this project. Data validation, acceptance, and qualification decisions will be made by the QA Officer.

Worksheet #37
Usability Assessment

The results of the data validation will be used to prepare a data usability assessment, which will be included in the final project reports. The data usability assessment will summarize the findings of the data validation.

Deviations or specific data qualifications identified by Data Validation Services, Inc. will be discussed in terms of their effect on the pilot test decision-making process. Data usability will be determined based on the data verification and data validation processes described in Worksheets #34-36. If deviations are identified that may cause data to be unusable, additional samples may be collected and screened/analyzed to provide useable data. If no significant deviations are identified, the data will be used to complete the applicable reports as specified on Worksheet #29.

All associated QA/QC efforts will be summarized in the appropriate reports detailed in Worksheet #29 including assessments of field and analytical data quality and usability.

ATTACHMENT A

FIELD OPERATING PROCEDURES

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FIELD OPERATING PROCEDURES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FOP Number	Description
001.1	Abandonment of Borehole Procedures
011.1	Calibration and Maintenance of Portable Photoionization Detector
013.0	Composite Sample Collection Procedure for Non-Volatile Organic Analysis
018.0	Drilling and Excavation Equipment Decontamination Procedures
026.1	Hollow Stem Auger (HSA) Drilling Procedures
046.0	Sample Labeling, Storage and Shipment Procedures
047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
054.2	Soil Description Procedures Using The Visual-Manual Method
057.0	Soil Sample Collection for VOC Analysis - EnCore Sampling
076.0	"Before Going Into the Field" Procedure
078.0	Geoprobe Drilling Procedures
085.0	Field Quality Control Procedures
086.0	Treatment System Sample Procedure
089.0	SVE System Sample Collection Procedure

Notes:

1. FOPs are identified by the sequential FOP number and revision number. For example, FOP number 097.3 indicates FOP

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FIELD OPERATING PROCEDURES

Abandonment of Borehole Procedures

FOP 001.1

ABANDONMENT OF BOREHOLE PROCEDURE

PURPOSE

Soil borings that are not completed as monitoring wells will be plugged by filling the holes with a cement/bentonite grout. Field staff will calculate the borehole volume and compare it to the final installed volume of grout to evaluate whether bridging or loss to the formation has occurred. These calculations and the actual volume placed will be noted on the Boring Log.

PROCEDURE

1. Determine most suitable seal materials. Grout specifications generally have mixture ratios as follows:

   Grout Slurry Composition (% Weight)

1.5 to 3.0%	-	Bentonite (Quick Gel)
40 to 60 %	-	Cement (Portland Type I)
40 to 60 %	-	Potable Water

2. Calculate the volume of the borehole base on the bit or auger head diameter plus 10% and determine the volume of grout to be emplaced. Generally, the total mixed volume is the borehole volume plus 20%.

3. Identify the equipment to be used for the preparation and mixing of the grout. Ensure the volume of the tanks to be used for mixing has been measured adequately. Document these volumes on the Well Abandonment/Decommissioning Log (sample attached).

4. Identify the source of the water to be used for the grout and determine its suitability for use. In particular, water with high sulfate, or chloride levels or heated water should not be used. These types of waters can cause operational difficulties or modify the set-up for the grout.

5. Identify the equipment to be used for emplacing the grout. Ensure that the pump to be used has adequate pressure to enable complete return to surface.

6. Identify the volumes to be pumped at each stage or in total if only one stage is to be used.

7. Prepare the borehole abandonment plan and discuss the plan and activities with the drilling contractor prior to beginning any mixing activities.

8. Begin mixing the grout to be emplaced.

9. Record the type and amount of materials used during the mixing operation. Ensure the ratios are within specifications tolerance.

10. Begin pumping the grout through the return line bypass system to confirm all pump and surface fittings are secure.

11. Initiate downhole pumping from the bottom of the borehole. Record the times and volumes emplaced on the Well Abandonment/Decommissioning Log (sample attached).

12. Document the return circulation of grout. This may be facilitated by using a colored dye or other tagging method if a mudded borehole condition exists prior to grout injection.

13. Identify what procedures will be used for grouting in the upper 3 feet. When casing exists in the borehole, decisions are required as to the timing for removal and final disposition of the casing. Generally, it will not be removed prior to grouting because of the potential for difficult access and loss of circulation in the upper soil or rock layers. Accordingly, when cement return is achieved at surface, the casing is commonly removed and the borehole is topped off with grout or soils. If casing removal is not possible or not desired, the casing left in place should be cut off at a depth of 5 feet or greater below ground surface. If casing is not present during grouting, the grout level in the borehole is topped off after the rods or tremie pipe is removed.

14. Clear and clean the surface near the borehole.

15. The uppermost five feet of the borehole at the land surface should be filled with material physically similar to the natural soils. The surface of the borehole should be restored to the condition of the area surrounding the borehole. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness, grassed areas will be seeded, and topsoil will be used in other areas. All solid waste materials generated during the decommissioning process must be disposed of properly.

16. A follow-up check at each site should be made within one week to 10 days of completion. It should be noted that on occasion, the grout and/or surface material may settle over several days. If settling occurs, additional material physically similar to surrounding materials (i.e., asphalt, concrete, or soil) must be used to match the existing grade.

17. Document borehole and/or well/piezometer decommissioning activities on a Well Abandonment/Decommissioning Log (sample attached).

ATTACHMENTS

Well Abandonment/Decommissioning Log (sample)

REFERENCES

ASTM D 5299: *Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.*

NYSDEC, July 1988, *Drilling and Monitoring Well Installation Guidance Manual.*

NYSDEC, November 2009, *CP-43: Groundwater Monitoring Well Decommissioning Policy.*

Driscoll, F.G., 1987, *Groundwater and Wells*, Johnson Division, St. Paul, Minnesota, 1089 p.

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WELL ABANDONMENT/ DECOMMISSIONING LOG

PROJECT INFORMATION	WELL INFORMATION
Project Name:	WELL I.D.:
Client:	Stick-up (fags):
Project Job Number:	Total Depth (fbgs):
Date:	Screen Interval (fbgs):
Weather:	Well Material:
	Diameter (inches):
BM/TK Personnel:	
Drilling Company:	Drilling Company Personnel:
Drill Rig Type:	

DECOMMISSIONING PROCEDURES

Time	Description of Field Activities

SAMPLE

PREPARED BY: DATE:

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FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Photoionization Detector (PID)

FOP 011.1

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

PURPOSE

This procedure describes a general method for the calibration and maintenance of a portable photoionization detector (PID). The PID detects and initially quantifies a reading of the volatile organic compound (VOC) concentration in air. The PID is used as a field-screening tool for initial evaluation of soil samples and for ambient air monitoring of compounds with ionization potentials (IP) less than the PID lamp electron voltage (eV) rating. The IP is the amount of energy required to move an electron to an infinite distance from the nucleus thus creating a positive ion plus an electron. It should be noted that all of the major components of air (i.e., carbon dioxide, methane, nitrogen, oxygen etc.) have IP's above 12 eV. As a result, they will not be ionized by the 9.8, 10.6, or 11.7 eV lamps typically utilized in field PIDs. The response of the PID will then be the sum of the organic and inorganic compounds in air that are ionized by the appropriate lamp (i.e., 9.8, 10.6 or 11.7 eV). Attached to this FOP is a table summarizing common organic compounds and their respective IPs.

Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Compound-specific calibration methods should be selected on a project-by-project basis to increase the accuracy of the instrument. The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the MiniRAE 2000 Portable VOC Monitor equipped with a 10.6 eV lamp. The actual equipment to be used in the field will be equivalent or similar. The following information is provided for general reference; the equipment-specific manufacturer's manual should be followed with precedence over this FOP.

Note: The PID indicates total VOC concentration readings that are normalized to a calibration standard, so actual quantification of individual compounds is not provided. In addition, the PID response to compounds is highly variable, dependent on ionization potential of the compound, and the presence or absence of other compounds.

ACCURACY

The MiniRAE 2000 is accurate to ± 2 ppm or 10% of the reading for concentrations ranging from 0-2,000 ppm and ± 20% of the reading at concentrations greater than 2,000 ppm. Response time is less than two seconds to 90 percent of full-scale. The operating temperature range is 0 to 45° C and the operating humidity range is 0 to 95 % relative humidity (non-condensing).

CALIBRATION PROCEDURE

The calibration method and correction factor, if applicable, will be selected on a project-by-project basis and confirmed with the Project Manager prior to the start of field work.

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the PID according to the manufacture's specifications.

2. Calibrate the PID using a compressed gas cylinder or equivalent containing the calibration standard, a flow regulator, and a tubing assembly. In addition, a compressed gas cylinder containing zero air ("clean" air) may be required if ambient air conditions do not permit calibration to "clean air".

3. Fill two Tedlar® bags equipped with a one-way valve with zero-air (if applicable) and the calibration standard gas.

4. Assemble the calibration equipment and actuate the PID in its calibration mode.

5. Select the appropriate calibration method. Calibration may be completed with two methods: 1) where the calibration standard gas is the same as the measurement gas (no correction factor is applied) or 2) where the calibration standard gas is not the same as the measurement gas and a correction factor will be applied. An isobutylene standard gas must be used as the calibration standard gas for the use of correction factors with the MiniRAE 2000. See below for additional instructions for calibration specific to use with or without correction factors.

Calibrating Without a Correction Factor

Navigate within the menu to select the "cal memory" for the specific calibration standard gas prior to calibration. The default gas selections for the MiniRAE 2000 are as follows:

Cal Memory #0	Isobutylene
Cal Memory #1	Hexane
Cal Memory #2	Xylene
Cal Memory #3	Benzene
Cal Memory #4	Styrene
Cal Memory #5	Toluene
Cal Memory #6	Vinyl Chloride
Cal Memory #7	Custom

The calibration standard gas for Cal Memory #1-7 may be toggled for selection of any of the approximately 100 preprogrammed calibration standard gases for use without an applied correction factor (i.e., the calibration gas must be the same as the measurement gas).

Calibrating With a Correction Factor

Navigate within the menu to select the "Cal Memory".

Select "Cal Memory #0" and toggle for selection of any of the approximately 100 preprogrammed chemicals. During calibration, the unit requests isobutylene gas and displays the isobutylene concentration immediately following calibration, but when the unit is returned to the normal reading mode, it displays the selected chemical and applies the correction factor.

If the pre-programmed list does not include the desired chemical or a user-defined measurement gas and correction factor is desired, toggle Cal Memory #0 to "user defined custom gas". A list of approximately 300 correction factors is attached in Technical Note 106 generated by MiniRAE.

6. Once the PID settings have been verified, connect the PID probe to the zero air calibration bag (or calibrate to ambient air if conditions permit) and wait for a stable indication.

7. Connect the PID probe to the calibration standard bag. Measure an initial reading of the standard and wait for a stable indication.

8. Keep the PID probe connected to the calibration standard bag, calibrate to applicable concentration (typically 100 ppm with isobutylene) with the standard and wait for a stable indication.

9. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish

maintenance schedules and component replacement. Information will include, at a minimum:

- Time, date and initials of the field team member performing the calibration
- The unique identifier for the meter, including manufacturer, model, and serial number
- The calibration standard and concentration
- Correction factors used, if any
- The brand and expiration date of the calibration standard gas
- The instrument readings: before and after calibration
- The instrument settings (if applicable)
- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

MAINTENANCE

- The probe and dust filter of the PID should be checked before and after every use for cleanliness. Should instrument response become unstable, recalibration should be performed. If this does not resolve the problem, access the photoionization bulb and clean with the manufacturer-supplied abrasive compound, then recalibrate.

- The PID battery must be recharged after each use. Store the PID in its carrying case when not in use. Additional maintenance details related to individual components of the PID are provided in the equipment manufacturer's instruction manual. If calibration or instrument performance is not in accordance with specifications, send the instrument to the equipment manufacturer for repair.

- Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

ATTACHMENTS

Table 1; Summary of Ionization Potentials
Equipment Calibration Log (sample)
Technical Note TN-106

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
A		
2-Amino pyridine	8	
Acetaldehyde	10.21	
Acetamide	9.77	
Acetic acid	10.69	X
Acetic anhydride	10	
Acetone	9.69	
Acetonitrile	12.2	X
Acetophenone	9.27	
Acetyl bromide	10.55	
Acetyl chloride	11.02	X
Acetylene	11.41	X
Acrolein	10.1	
Acrylamide	9.5	
Acrylonitrile	10.91	X
Allyl alcohol	9.67	
Allyl chloride	9.9	
Ammonia	10.2	
Aniline	7.7	
Anisidine	7.44	
Anisole	8.22	
Arsine	9.89	
B		
1,3-Butadiene (butadiene)	9.07	
1-Bromo-2-chloroethane	10.63	X
1-Bromo-2-methylpropane	10.09	
1-Bromo-4-fluorobenzene	8.99	
1-Bromobutane	10.13	
1-Bromopentane	10.1	
1-Bromopropane	10.18	
1-Bromopropene	9.3	
1-Butanethiol	9.14	
1-Butene	9.58	
1-Butyne	10.18	
2,3-Butadione	9.23	
2-Bromo-2-methylpropane	9.89	
2-Bromobutane	9.98	
2-Bromopropane	10.08	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Bromothiophene	8.63	
2-Butanone (MEK)	9.54	
3-Bromopropene	9.7	
3-Butene nitrile	10.39	
Benzaldehyde	9.53	
Benzene	9.25	
Benzenethiol	8.33	
Benzonitrile	9.71	
Benzotrifluoride	9.68	
Biphenyl	8.27	
Boron oxide	13.5	X
Boron trifluoride	15.56	X
Bromine	10.54	
Bromobenzene	8.98	
Bromochloromethane	10.77	X
Bromoform	10.48	
Butane	10.63	X
Butyl mercaptan	9.15	
cis-2-Butene	9.13	
m-Bromotoluene	8.81	
n-Butyl acetate	10.01	
n-Butyl alcohol	10.04	
n-Butyl amine	8.71	
n-Butyl benzene	8.69	
n-Butyl formate	10.5	
n-Butyraldehyde	9.86	
n-Butyric acid	10.16	
n-Butyronitrile	11.67	X
o-Bromotoluene	8.79	
p-Bromotoluene	8.67	
p-tert-Butyltoluene	8.28	
s-Butyl amine	8.7	
s-Butyl benzene	8.68	
sec-Butyl acetate	9.91	
t-Butyl amine	8.64	
t-Butyl benzene	8.68	
trans-2-Butene	9.13	
C		

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
1-Chloro-2-methylpropane	10.66	X
1-Chloro-3-fluorobenzene	9.21	
1-Chlorobutane	10.67	X
1-Chloropropane	10.82	X
2-Chloro-2-methylpropane	10.61	X
2-Chlorobutane	10.65	X
2-Chloropropane	10.78	X
2-Chlorothiophene	8.68	
3-Chloropropene	10.04	
Camphor	8.76	
Carbon dioxide	13.79	X
Carbon disulfide	10.07	
Carbon monoxide	14.01	X
Carbon tetrachloride	11.47	X
Chlorine	11.48	X
Chlorine dioxide	10.36	
Chlorine trifluoride	12.65	X
Chloroacetaldehyde	10.61	X
α -Chloroacetophenone	9.44	
Chlorobenzene	9.07	
Chlorobromomethane	10.77	X
Chlorofluoromethane (Freon 22)	12.45	X
Chloroform	11.37	X
Chlorotrifluoromethane (Freon 13)	12.91	X
Chrysene	7.59	
Cresol	8.14	
Crotonaldehyde	9.73	
Cumene (isopropyl benzene)	8.75	
Cyanogen	13.8	X
Cyclohexane	9.8	
Cyclohexanol	9.75	
Cyclohexanone	9.14	
Cyclohexene	8.95	
Cyclo-octatetraene	7.99	
Cyclopentadiene	8.56	
Cyclopentane	10.53	
Cyclopentanone	9.26	
Cyclopentene	9.01	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Cyclopropane	10.06	
m-Chlorotoluene	8.83	
o-Chlorotoluene	8.83	
p-Chlorotoluene	8.7	
D		
1,1-Dibromoethane	10.19	
1,1-Dichloroethane	11.12	X
1,1-Dimethoxyethane	9.65	
1,1-Dimethylhydrazine	7.28	
1,2-Dibromoethene	9.45	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12.2	X
1,2-Dichloroethane	11.12	X
1,2-Dichloropropane	10.87	X
1,3-Dibromopropane	10.07	
1,3-Dichloropropane	10.85	X
2,2-Dimethyl butane	10.06	
2,2-Dimethyl propane	10.35	
2,3-Dichloropropene	9.82	
2,3-Dimethyl butane	10.02	
3,3-Dimethyl butanone	9.17	
cis-Dichloroethene	9.65	
Decaborane	9.88	
Diazomethane	9	
Diborane	12	X
Dibromochloromethane	10.59	
Dibromodifluoromethane	11.07	X
Dibromomethane	10.49	
Dibutylamine	7.69	
Dichlorodifluoromethane (Freon 12)	12.31	X
Dichlorofluoromethane	12.39	X
Dichloromethane	11.35	X
Diethoxymethane	9.7	
Diethyl amine	8.01	
Diethyl ether	9.53	
Diethyl ketone	9.32	
Diethyl sulfide	8.43	
Diethyl sulfite	9.68	
Difluorodibromomethane	11.07	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Dihydropyran	8.34	
Diiodomethane	9.34	
Diisopropylamine	7.73	
Dimethoxymethane (methylal)	10	
Dimethyl amine	8.24	
Dimethyl ether	10	
Dimethyl sulfide	8.69	
Dimethylaniline	7.13	
Dimethylformamide	9.18	
Dimethylphthalate	9.64	
Dinitrobenzene	10.71	X
Dioxane	9.19	
Diphenyl	7.95	
Dipropyl amine	7.84	
Dipropyl sulfide	8.3	
Durene	8.03	
m-Dichlorobenzene	9.12	
N,N-Diethyl acetamide	8.6	
N,N-Diethyl formamide	8.89	
N,N-Dimethyl acetamide	8.81	
N,N-Dimethyl formamide	9.12	
o-Dichlorobenzene	9.06	
p-Dichlorobenzene	8.95	
p-Dioxane	9.13	
trans-Dichloroethene	9.66	
E		
Epichlorohydrin	10.2	
Ethane	11.65	X
Ethanethiol (ethyl mercaptan)	9.29	
Ethanolamine	8.96	
Ethene	10.52	
Ethyl acetate	10.11	
Ethyl alcohol	10.48	
Ethyl amine	8.86	
Ethyl benzene	8.76	
Ethyl bromide	10.29	
Ethyl chloride (chloroethane)	10.98	X
Ethyl disulfide	8.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Ethyl ether	9.51	
Ethyl formate	10.61	X
Ethyl iodide	9.33	
Ethyl isothiocyanate	9.14	
Ethyl mercaptan	9.29	
Ethyl methyl sulfide	8.55	
Ethyl nitrate	11.22	X
Ethyl propionate	10	
Ethyl thiocyanate	9.89	
Ethylene chlorohydrin	10.52	
Ethylene diamine	8.6	
Ethylene dibromide	10.37	
Ethylene dichloride	11.05	X
Ethylene oxide	10.57	
Ethylenelmine	9.2	
Ethynylbenzene	8.82	
F		
2-Furaldehyde	9.21	
Fluorine	15.7	X
Fluorobenzene	9.2	
Formaldehyde	10.87	X
Formamide	10.25	
Formic acid	11.05	X
Freon 11 (trichlorofluoromethane)	11.77	X
Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane)	11.3	X
Freon 113 (1,1,2-trichloro-1,2,2-trifluororethane)	11.78	X
Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)	12.2	X
Freon 12 (dichlorodifluoromethane)	12.31	X
Freon 13 (chlorotrifluoromethane)	12.91	X
Freon 22 (chlorofluoromethane)	12.45	X
Furan	8.89	
Furfural	9.21	
m-Fluorotoluene	8.92	
o-Fluorophenol	8.66	
o-Fluorotoluene	8.92	
p-Fluorotoluene	8.79	
H		
1-Hexene	9.46	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Heptanone	9.33	
2-Hexanone	9.35	
Heptane	10.08	
Hexachloroethane	11.1	X
Hexane	10.18	
Hydrazine	8.1	
Hydrogen	15.43	X
Hydrogen bromide	11.62	X
Hydrogen chloride	12.74	X
Hydrogen cyanide	13.91	X
Hydrogen fluoride	15.77	X
Hydrogen iodide	10.38	
Hydrogen selenide	9.88	
Hydrogen sulfide	10.46	
Hydrogen telluride	9.14	
Hydroquinone	7.95	
I		
1-Iodo-2-methylpropane	9.18	
1-Iodobutane	9.21	
1-Iodopentane	9.19	
1-Iodopropane	9.26	
2-Iodobutane	9.09	
2-Iodopropane	9.17	
Iodine	9.28	
Iodobenzene	8.73	
Isobutane	10.57	
Isobutyl acetate	9.97	
Isobutyl alcohol	10.12	
Isobutyl amine	8.7	
Isobutyl formate	10.46	
Isobutyraldehyde	9.74	
Isobutyric acid	10.02	
Isopentane	10.32	
Isophorone	9.07	
Isoprene	8.85	
Isopropyl acetate	9.99	
Isopropyl alcohol	10.16	
Isopropyl amine	8.72	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Isopropyl benzene	8.69	
Isopropyl ether	9.2	
Isovaleraldehyde	9.71	
m-Iodotoluene	8.61	
o-Iodotoluene	8.62	
p-Iodotoluene	8.5	
K		
Ketene	9.61	
L		
2,3-Lutidine	8.85	
2,4-Lutidine	8.85	
2,6-Lutidine	8.85	
M		
2-Methyl furan	8.39	
2-Methyl napthalene	7.96	
1-Methyl napthalene	7.96	
2-Methyl propene	9.23	
2-Methyl-1-butene	9.12	
2-Methylpentane	10.12	
3-Methyl-1-butene	9.51	
3-Methyl-2-butene	8.67	
3-Methylpentane	10.08	
4-Methylcyclohexene	8.91	
Maleic anhydride	10.8	X
Mesityl oxide	9.08	
Mesitylene	8.4	
Methane	12.98	X
Methanethiol (methyl mercaptan)	9.44	
Methyl acetate	10.27	
Methyl acetylene	10.37	
Methyl acrylate	9.9	
Methyl alcohol	10.85	X
Methyl amine	8.97	
Methyl bromide	10.54	
Methyl butyl ketone	9.34	
Methyl butyrate	10.07	
Methyl cellosolve	9.6	
Methyl chloride	11.28	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Methyl chloroform (1,1,1-trichloroethane)	11	X
Methyl disulfide	8.46	
Methyl ethyl ketone	9.53	
Methyl formate	10.82	X
Methyl iodide	9.54	
Methyl isobutyl ketone	9.3	
Methyl isobutyrate	9.98	
Methyl isocyanate	10.67	X
Methyl isopropyl ketone	9.32	
Methyl isothiocyanate	9.25	
Methyl mercaptan	9.44	
Methyl methacrylate	9.7	
Methyl propionate	10.15	
Methyl propyl ketone	9.39	
α -Methyl styrene	8.35	
Methyl thiocyanate	10.07	
Methylal (dimethoxymethane)	10	
Methylcyclohexane	9.85	
Methylene chloride	11.32	X
Methyl-n-amyl ketone	9.3	
Monomethyl aniline	7.32	
Monomethyl hydrazine	7.67	
Morpholine	8.2	
n-Methyl acetamide	8.9	
N		
1-Nitropropane	10.88	X
2-Nitropropane	10.71	X
Naphthalene	8.12	
Nickel carbonyl	8.27	
Nitric oxide, (NO)	9.25	
Nitrobenzene	9.92	
Nitroethane	10.88	X
Nitrogen	15.58	X
Nitrogen dioxide	9.78	
Nitrogen trifluoride	12.97	X
Nitromethane	11.08	X
Nitrotoluene	9.45	
p-Nitrochloro benzene	9.96	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
O		
Octane	9.82	
Oxygen	12.08	X
Ozone	12.08	X
P		
1-Pentene	9.5	
1-Propanethiol	9.2	
2,4-Pentanedione	8.87	
2-Pentanone	9.38	
2-Picoline	9.02	
3-Picoline	9.02	
4-Picoline	9.04	
n-Propyl nitrate	11.07	X
Pentaborane	10.4	
Pentane	10.35	
Perchloroethylene	9.32	
Pheneloic	8.18	
Phenol	8.5	
Phenyl ether (diphenyl oxide)	8.82	
Phenyl hydrazine	7.64	
Phenyl isocyanate	8.77	
Phenyl isothiocyanate	8.52	
Phenylene diamine	6.89	
Phosgene	11.77	X
Phosphine	9.87	
Phosphorus trichloride	9.91	
Phthalic anhydride	10	
Propane	11.07	X
Propargyl alcohol	10.51	
Propiolactone	9.7	
Propionaldehyde	9.98	
Propionic acid	10.24	
Propionitrile	11.84	X
Propyl acetate	10.04	
Propyl alcohol	10.2	
Propyl amine	8.78	
Propyl benzene	8.72	
Propyl ether	9.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Propyl formate	10.54	
Propylene	9.73	
Propylene dichloride	10.87	X
Propylene imine	9	
Propylene oxide	10.22	
Propyne	10.36	
Pyridine	9.32	
Pyrrole	8.2	
Q		
Quinone	10.04	
S		
Stibine	9.51	
Styrene	8.47	
Sulfur dioxide	12.3	X
Sulfur hexafluoride	15.33	X
Sulfur monochloride	9.66	
Sulfuryl fluoride	13	X
T		
o-Terphenyls	7.78	
1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112)	11.3	X
1,1,1-Trichloroethane	11	X
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	11.78	X
2,2,4-Trimethyl pentane	9.86	
o-Toluidine	7.44	
Tetrachloroethane	11.62	X
Tetrachloroethene	9.32	
Tetrachloromethane	11.47	X
Tetrahydrofuran	9.54	
Tetrahydropyran	9.25	
Thiolacetic acid	10	
Thiophene	8.86	
Toluene	8.82	
Tribromoethene	9.27	
Tribromofluoromethane	10.67	X
Tribromomethane	10.51	
Trichloroethene	9.45	
Trichloroethylene	9.47	
Trichlorofluoromethane (Freon 11)	11.77	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Trichloromethane	11.42	X
Triethylamine	7.5	
Trifluoromonobromo-methane	11.4	X
Trimethyl amine	7.82	
Tripropyl amine	7.23	
V		
o-Vinyl toluene	8.2	
Valeraldehyde	9.82	
Valeric acid	10.12	
Vinyl acetate	9.19	
Vinyl bromide	9.8	
Vinyl chloride	10	
Vinyl methyl ether	8.93	
W		
Water	12.59	X
X		
2,4-Xylidine	7.65	
m-Xylene	8.56	
o-Xylene	8.56	
p-Xylene	8.45	

FOP 011.0

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name: _____ Date: _____

Project No.: _____

Client: _____ Instrument Source: ☐ BM ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	POST CAL. READING	SETTINGS
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00 7.00 10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	9706000145[illegible]		< 0.4 [illegible] [illegible]00 800		
☐ Sp. Cond. meter	uS mS		Myron L Company Ultra Meter 6P	[illegible]		_____ mS @ 25 °C		
☐ PID	ppm		MinRAE 20[illegible]			open air zero _____ ppm Iso. Gas		MIBK response factor = 1.0
☐ Dissolved Oxygen	ppm		YSI Model 5[illegible]					
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

SAMPLE

ADDITIONAL REMARKS: _____

PREPARED BY: _____ **DATE:** _____

Correction Factors, Ionization Energies*, And Calibration Characteristics

Correction Factors and Ionization Energies

RAE Systems PIDs can be used for the detection of a wide variety of gases that exhibit different responses. In general, any compound with ionization energy (IE) lower than that of the lamp photons can be measured.* The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. In our PIDs, correction factors can be used in one of three ways:

1) Calibrate the monitor with isobutylene in the usual fashion to read in isobutylene equivalents. Manually multiply the reading by the correction factor (CF) to obtain the concentration of the gas being measured.

2) Calibrate the unit with isobutylene in the usual fashion to read in isobutylene equivalents. Call up the correction factor from the instrument memory or download it from a personal computer and then call it up. The monitor will then read directly in units of the gas of interest.

3) Calibrate the unit with isobutylene, but input an equivalent, "corrected" span gas concentration when prompted for this value. The unit will then read directly in units of the gas of interest.

* *The term "ionization energy" is more scientifically correct and replaces the old term "ionization potential." High-boiling ("heavy") compounds may not vaporize enough to give a response even when their ionization energies are below the lamp photon energy. Some inorganic compounds like H_2O_2 and NO_2 give weak response even when their ionization energies are well below the lamp photon energy.*

Example 1:
With the unit calibrated to read isobutylene equivalents, the reading is 10 ppm with a 10.6 eV lamp. The gas being measured is butyl acetate, which has a correction factor of 2.6. Multiplying 10 by 2.6 gives an adjusted butyl acetate value of 26 ppm. Similarly, if the gas being measured were trichloroethylene (CF = 0.54), the adjusted value with a 10 ppm reading would be 5.4 ppm.

Example 2:
With the unit calibrated to read isobutylene equivalents, the reading is 100 ppm with a 10.6 eV lamp. The gas measured is m-xylene (CF = 0.43). After downloading this factor, the unit should read about 43 ppm when exposed to the same gas, and thus read directly in m-xylene values.

Example 3:
The desired gas to measure is ethylene dichloride (EDC). The CF is 0.6 with an 11.7 eV lamp. During calibration with 100 ppm isobutylene, insert 0.6 times 100, or 60 at the prompt for the calibration gas concentration. The unit then reads directly in EDC values.

Conversion to mg/m^3

To convert from ppm to mg/m^3, use the following formula:

$$\text{Conc.}\ (mg/m^3) = \frac{[\text{Conc.(ppmv)} \times \text{mol. wt. (g/mole)}]}{\text{molar gas volume (L)}}$$

For air at 25 °C (77 °F), the molar gas volume is 24.4 L/mole and the formula reduces to:

$$\text{Conc.}(mg/m^3) = \text{Conc.(ppmv)} \times \text{mol. wt. (g/mole)} \times 0.041$$

For example, if the instrument is calibrated with a gas standard in ppmv, such as 100 ppm isobutylene, and the user wants the display to read in mg/m^3 of hexane, whose m.w. is 86 and CF is 4.3, the overall correction factor would be 4.3 x 86 x 0.041 equals 15.2.

Correction Factors for Mixtures

The correction factor for a mixture is calculated from the sum of the mole fractions Xi of each component divided by their respective correction factors CFi:

$$CFmix = 1 / (X_1/CF_1 + X_2/CF_2 + X_3/CF_3 + \ldots Xi/CFi)$$

Thus, for example, a vapor phase mixture of 5% benzene and 95% n-hexane would have a CFmix of CFmix = 1 / (0.05/0.53 + 0.95/4.3) = 3.2. A reading of 100 would then correspond to 320 ppm of the total mixture, comprised of 16 ppm benzene and 304 ppm hexane.

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For a spreadsheet to compute the correction factor and TLV of a mixture see the appendix at the end of the CF table.

TLVs and Alarm Limits for Mixtures

The correction factor for mixtures can be used to set alarm limits for mixtures. To do this one first needs to calculate the exposure limit for the mixture. The Threshold Limit Value (TLV) often defines exposure limits. The TLV for the mixture is calculated in a manner similar to the CF calculation:

$$TLV\ mix = 1 / (X_1/TLV_1 + X_2/TLV_2 + X_3/TLV_3 + ... Xi/TLVi)$$

In the above example, the 8-h TLV for benzene is 0.5 ppm and for n-hexane 50 ppm. Therefore the TLV of the mixture is TLVmix = 1 / (0.05/0.5 + 0.95/50) = 8.4 ppm, corresponding to 8.0 ppm hexane and 0.4 ppm benzene. For an instrument calibrated on isobutylene, the reading corrsponding to the TLV is:

$$Alarm\ Reading = TLVmix / CFmix = 8.4 / 3.2 = 2.6\ ppm$$

A common practice is to set the lower alarm limit to half the TLV, and the higher limit to the TLV. Thus, one would set the alarms to 1.3 and 2.6 ppm, respectively.

Calibration Characteristics

a) Flow Configuration. PID response is essentially independent of gas flow rate as long as it is sufficient to satisfy the pump demand. Four main flow configurations are used for calibrating a PID:

1) **Pressurized gas cylinder (Fixed-flow regulator):** The flow rate of the regulator should match the flow demand of the instrument pump or be slightly higher.
2) **Pressurized gas cylinder (Demand-flow regulator):** A demand-flow regulator better matches pump speed differences, but results in a slight vacuum during calibration and thus slightly high readings.
3) **Collapsible gas bag:** The instrument will draw the calibration gas from the bag at its normal flow rate, as long as the bag valve is large enough. The bag should be filled with enough gas to allow at least one minute of flow (~ 0.6 L for a MiniRAE, ~0.3 L for MultiRAE).
4) **T (or open tube) method:** The T method uses a T-junction with gas flow higher than the pump draw. The gas supply is connected to one end of the T, the instrument inlet is connected to a second end of the T, and excess gas flow escapes through the third, open end of the T. To prevent ambient air mixing, a long tube should be connected to the open end, or a high excess rate should be used. Alternatively, the instrument probe can be inserted into an open tube slightly wider than the probe. Excess gas flows out around the probe.

The first two cylinder methods are the most efficient in terms of gas usage, while the bag and T methods give slightly more accurate results because they match the pump flow better.

b) Pressure. Pressures deviating from atmospheric pressure affect the readings by altering gas concentration and pump characteristics. It is best to calibrate with the instrument and calibration gas at the same pressure as each other and the sample gas. (Note that the cylinder pressure is not relevant because the regulator reduces the pressure to ambient.) If the instrument is calibrated at atmospheric pressure in one of the flow configurations described above, then 1) pressures slightly above ambient are acceptable but high pressures can damage the pump and 2) samples under vacuum may give low readings if air leaks into the sample train.

c) Temperature. Because temperature effects gas density and concentration, the temperature of the calibration gas and instrument should be as close as possible to the ambient temperature where the unit will be used. We recommend that the temperature of the calibration gas be within the instrument's temperature specification (typically 14° to 113° F or -10° to 45° C). Also, during actual measurements, the instrument should be kept at the same or higher temperature than the sample temperature to avoid condensation in the unit.

d) Matrix. The matrix gas of the calibration compound and VOC sample is significant. Some common matrix components, such as methane and water vapor can affect the VOC signal. PIDs are

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most commonly used for monitoring VOCs in air, in which case the preferred calibration gas matrix is air. For a MiniRAE, methane, methanol, and water vapor reduce the response by about 20% when their concentration is 15,000 ppm and by about 40% at 30,000 ppm. Despite earlier reports of oxygen effects, RAE PID responses with 10.6 eV lamps are independent of oxygen concentration, and calibration gases in a pure nitrogen matrix can be used. H_2 and CO_2 up to 5 volume % also have no effect.

e) Concentration. Although RAE Systems PIDs have electronically linearized output, it is best to calibrate in a concentration range close to the actual measurement range. For example, 100 ppm standard gas for anticipated vapors of 0 to 250 ppm, and 500 ppm standard for expected concentrations of 250 to 1000 ppm. The correction factors in this table were typically measured at 50 to 100 ppm and apply from the ppb range up to about 1000 ppm. Above 1000 ppm the CF may vary and it is best to calibrate with the gas of interest near the concentration of interest.

f) Filters. Filters affect flow and pressure conditions and therefore all filters to be used during sampling should also be in place during calibration. Using a water trap (hydrophobic filter) greatly reduces the chances of drawing water aerosols or dirt particles into the instrument. Regular filter replacements are recommended because dirty filters can adsorb VOCs and cause slower response time and shifts in calibration.

g) Instrument Design. High-boiling ("heavy") or very reactive compounds can be lost by reaction or adsorption onto materials in the gas sample train, such as filters, pumps and other sensors. Multi-gas meters, including EntryRAE, MultiRAE and AreaRAE have the pump and other sensors upstream of the PID and are prone to these losses. Compounds possibly affected by such losses are shown in green in the table, and may give slow response, or in extreme cases, no response at all. In many cases the multi-gas meters can still give a rough indication of the relative concentration, without giving an accurate, quantitative reading. The ppbRAE and MiniRAE series instruments have inert sample trains and therefore do not exhibit significant loss; nevertheless, response may be slow for the very heavy compounds and additional sampling time up to a minute or more should be allowed to get a stable reading.

Table Abbreviations:

CF = Correction Factor (multiply by reading to get corrected value for the compound when calibrated to isobutylene)
NR = No Response
IE = Ionization Energy (values in parentheses are not well established)
C = Confirmed Value indicated by "+" in this column; all others are preliminary or estimated values and are subject to change
ne = Not Established ACGIH 8-hr. TWA
C## = Ceiling value, given where 8-hr.TWA is not available

Disclaimer:

Actual readings may vary with age and cleanliness of lamp, relative humidity, and other factors. For accurate work, the instrument should be calibrated regularly under the operating conditions used. The factors in this table were measured in dry air at room temperature, typically at 50-100 ppm. CF values may vary above about 1000 ppm.

Updates:

The values in this table are subject to change as more or better data become available. Watch for updates of this table on the Internet at **http://www.raesystems.com**

IE data are taken from the CRC Handbook of Chemistry and Physics, 73rd Edition, D.R. Lide (Ed.), CRC Press (1993) and NIST Standard Ref. Database 19A, NIST Positive Ion Energetics, Vers. 2.0, Lias, et.al., U.S. Dept. Commerce (1993). Exposure limits (8-h TWA and Ceiling Values) are from the 2005 ACGIH Guide to Occupational Exposure Values, ACGIH, Cincinnati, OH 2005. Equations for exposure limits for mixtures of chemicals were taken from the 1997 TLVs and BEIs handbook published by the ACGIH (1997).

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	1.1	+	1.4	+	9.71	500
Acetone cyanohydrin	2-Hydroxyisobutyronitrile	75-86-5	C_4H_7NO					4	+	11.1	C5
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2.1	+	11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O	4.5	+	2.4	+	1.6	+	9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	H_3N	NR	+	9.7	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5		1.6		10.00	ne
Aniline	Aminobenzene	62-53-3	C_7H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O	0.89	+	0.58	+	0.56	+	8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzenamine, N-methyl-	N-Methylphenylamine	100-61-8	C_7H_9N			0.7				7.53	
Benzene		71-43-2	C_6H_6	0.55	+	0.53	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne
Benzyl chloride	α-Chlorotoluene, Chloromethylbenzene	100-44-7	C_7H_7Cl	0.7	+	0.6	+	0.5	+	9.14	1
Benzyl formate	Formic acid benzyl ester	104-57-4	$C_8H_8O_2$	0.9	+	0.73	+	0.66	+		ne
Boron trifluoride		7637-07-2	BF_3	NR		NR		NR		15.5	C1
Bromine		7726-95-6	Br_2	NR	+	1.30	+	0.74	+	10.51	0.1
Bromobenzene		108-86-1	C_6H_5Br			0.6		0.5		8.98	ne
2-Bromoethyl methyl ether		6482-24-2	C_3H_7OBr			0.84	+			~10	ne
Bromoform	Tribromomethane	75-25-2	$CHBr_3$	NR	+	2.5	+	0.5	+	10.48	0.5
Bromopropane,1-	n-Propyl bromide	106-94-5	C_3H_7Br	150	+	1.5	+	0.6	+	10.18	ne
Butadiene	1,3-Butadiene, Vinyl ethylene	106-99-0	C_4H_6	0.8		0.85	+	1.1		9.07	2
Butadiene diepoxide, 1,3-	1,2,3,4-Diepoxybutane	298-18-0	$C_4H_6O_2$	25	+	3.5	+	1.2		~10	ne
Butanal	1-Butanal	123-72-8	C_4H_8O			1.8				9.84	
Butane		106-97-8	C_4H_{10}			67	+	1.2		10.53	800
Butanol, 1-	Butyl alcohol, n-Butanol	71-36-3	$C_4H_{10}O$	70	+	4.7	+	1.4	+	9.99	20
Butanol, t-	tert-Butanol, t-Butyl alcohol	75-65-0	$C_4H_{10}O$	6.9	+	2.9	+			9.90	100
Butene, 1-	1-Butylene	106-98-9	C_4H_8			0.9				9.58	ne
Butoxyethanol, 2-	Butyl Cellosolve, Ethylene glycol monobutyl ether	111-76-2	$C_6H_{14}O_2$	1.8	+	1.2	+	0.6	+	<10	25
Butoxyethanol acetate	Ethanol, 2-(2-butoxyethoxy)-, acetate	124-17-4	$C_{10}H_{20}O_4$			5.6				≤10.6	
Butoxyethoxyethanol	2-(2-Butoxyethoxy)ethanol	112-34-5	$C_8H_{18}O_3$			4.6				≤10.6	
Butyl acetate, n-		123-86-4	$C_6H_{12}O_2$			2.6	+			10	150
Butyl acrylate, n-	Butyl 2-propenoate, Acrylic acid butyl ester	141-32-2	$C_7H_{12}O_2$			1.6	+	0.6	+		10
Butylamine, n-		109-73-9	$C_4H_{11}N$	1.1	+	1.1	+	0.7	+	8.71	C5
Butyl cellosolve	see 2-Butoxyethanol	111-76-2									
Butyl hydroperoxide, t-		75-91-2	$C_4H_{10}O_2$	2.0	+	1.6	+			<10	1
Butyl mercaptan	1-Butanethiol	109-79-5	$C_4H_{10}S$	0.55	+	0.52	+			9.14	0.5
Carbon disulfide		75-15-0	CS_2	4	+	1.2	+	0.44		10.07	10
Carbon tetrachloride	Tetrachloromethane	56-23-5	CCl_4	NR	+	NR	+	1.7	+	11.47	5
Carbonyl sulfide	Carbon oxysulfide	463-58-1	COS							11.18	

Cellosolve see 2-Ethoxyethanol
CFC-14 see Tetrafluoromethane
CFC-113 see 1,1,2-Trichloro-1,2,2-trifluoroethane

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Chlorine		7782-50-5	Cl_2					1.0	+	11.48	0.5
Chlorine dioxide		10049-04-4	ClO_2	NR	+	NR	+	NR	+	10.57	0.1
Chlorobenzene	Monochlorobenzene	108-90-7	C_6H_5Cl	0.44	+	0.40	+	0.39	+	9.06	10
Chlorobenzotrifluoride, 4-	PCBTF, OXSOL 100 p-Chlorobenzotrifluoride	98-56-6	$C_7H_4ClF_3$	0.74	+	0.63	+	0.55	+	<9.6	25
Chloro-1,3-butadiene, 2-	Chloroprene	126-99-8	C_4H_5Cl			3					10
Chloro-1,1-difluoroethane, 1-	HCFC-142B, R-142B	75-68-3	$C_2H_3ClF_2$	NR		NR		NR		12.0	ne
Chlorodifluoromethane	HCFC-22, R-22	75-45-6	$CHClF_2$	NR		NR		NR		12.2	1000
Chloroethane	Ethyl chloride	75-00-3	C_2H_5Cl	NR	+	NR	+	1.1	+	10.97	100
Chloroethanol	Ethylene chlrohydrin	107-07-3	C_2H_5ClO					2.9		10.52	C1
Chloroethyl ether, 2-	bis(2-chloroethyl) ether	111-44-4	$C_4H_8Cl_2O$	8.6	+	3.0	+				5
Chloroethyl methyl ether, 2-	Methyl 2-chloroethyl ether	627-42-9	C_3H_7ClO			3					ne
Chloroform	Trichloromethane	67-66-3	$CHCl_3$	NR	+	NR	+	3.5	+	11.37	10
Chloro-2-methylpropene, 3-	Methallyl chloride, Isobutenyl chloride	563-47-3	C_4H_7Cl	1.4	+	1.2	+	0.63	+	9.76	ne
Chloropicrin		76-06-2	CCl_3NO_2	NR	+	~400	+	7	+	?	0.1
Chlorotoluene, o-	o-Chloromethylbenzene	95-49-8	C_7H_7Cl			0.5		0.6		8.83	50
Chlorotoluene, p-	p-Chloromethylbenzene	106-43-4	C_7H_7Cl					0.6		8.69	ne
Chlorotrifluoroethene	CTFE, Chlorotrifluoroethylene Genetron 1113	79-38-9	C_2ClF_3	6.7	+	3.9	+	1.2	+	9.76	5
Chlorotrimethylsilane		75-77-4	C_3H_9ClSi	NR		NR		0.82	+	10.83	ne
Cresol, m-	m-Hydroxytoluene	108-39-4	C_7H_8O	0.57	+	0.50	+	0.57	+	8.29	5
Cresol, o-	o-Hydroxytoluene	95-48-7	C_7H_8O			1.0				8.50	
Cresol, p-	p-Hydroxytoluene	106-44-5	C_7H_8O			1.4				8.35	
Crotonaldehyde	*trans*-2-Butenal	123-73-9 4170-30-3	C_4H_6O	1.5	+	1.1	+	1.0	+	9.73	2
Cumene	Isopropylbenzene	98-82-8	C_9H_{12}	0.58	+	0.54	+	0.4	+	8.73	50
Cyanogen bromide		506-68-3	CNBr	NR		NR		NR		11.84	ne
Cyanogen chloride		506-77-4	CNCl	NR		NR		NR		12.34	C0.3
Cyclohexane		110-82-7	C_6H_{12}	3.3	+	1.4	+	0.64	+	9.86	300
Cyclohexanol	Cyclohexyl alcohol	108-93-0	$C_6H_{12}O$	1.5	+	0.9	+	1.1	+	9.75	50
Cyclohexanone		108-94-1	$C_6H_{10}O$	1.0	+	0.9	+	0.7	+	9.14	25
Cyclohexene		110-83-8	C_6H_{10}			0.8	+			8.95	300
Cyclohexylamine		108-91-8	$C_6H_{13}N$			1.2				8.62	10
Cyclopentane 85% 2,2-dimethylbutane 15%		287-92-3	C_5H_{10}	NR	+	15	+	1.1		10.33	600
Cyclopropylamine	Aminocyclpropane	765-30-0	C_3H_7N	1.1	+	0.9	+	0.9	+		ne
Decamethylcyclopentasiloxane		541-02-6	$C_{10}H_{30}O_5Si_5$	0.16	+	0.13	+	0.12	+		ne
Decamethyltetrasiloxane		141-62-8	$C_{10}H_{30}O_3Si_4$	0.17	+	0.13	+	0.12	+	<10.2	ne
Decane		124-18-5	$C_{10}H_{22}$	4.0	+	1.4	+	0.35	+	9.65	ne
Diacetone alcohol	4-Methyl-4-hydroxy-2-pentanone	123-42-2	$C_6H_{12}O_2$			0.7					50
Dibromochloromethane	Chlorodibromomethane	124-48-1	$CHBr_2Cl$	NR	+	5.3	+	0.7	+	10.59	ne
Dibromo-3-chloropropane, 1,2-	DBCP	96-12-8	$C_3H_5Br_2Cl$	NR	+	1.7	+	0.43	+		0.001
Dibromoethane, 1,2-	EDB, Ethylene dibromide, Ethylene bromide	106-93-4	$C_2H_4Br_2$	NR	+	1.7	+	0.6	+	10.37	ne
Dichlorobenzene, o-	1,2-Dichlorobenzene	95-50-1	$C_6H_4Cl_2$	0.54	+	0.47	+	0.38	+	9.08	25
Dichlorodifluoromethane	CFC-12	75-71-8	CCl_2F_2			NR	+	NR	+	11.75	1000
Dichlorodimethylsilane		75-78-5	$C_2H_6Cl_2Si$	NR		NR		1.1	+	>10.7	ne
Dichloroethane, 1,2-	EDC, 1,2-DCA, Ethylene dichloride	107-06-2	$C_2H_4Cl_2$			NR	+	0.6	+	11.04	10
Dichloroethene, 1,1-	1,1-DCE, Vinylidene chloride	75-35-4	$C_2H_2Cl_2$			0.82	+	0.8	+	9.79	5
Dichloroethene, c-1,2-	*c*-1,2-DCE, *cis*-Dichloroethylene	156-59-2	$C_2H_2Cl_2$			0.8				9.66	200
Dichloroethene, t-1,2-	*t*-1,2-DCE, *trans*-Dichloroethylene	156-60-5	$C_2H_2Cl_2$			0.45	+	0.34	+	9.65	200
Dichloro-1-fluoroethane, 1,1-	R-141B	1717-00-6	$C_2H_3Cl_2F$	NR	+	NR	+	2.0	+		ne
Dichloromethane	see Methylene chloride										

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Dichloropentafluoropropane	AK-225, mix of ~45% 3,3-dichloro-1,1,1,2,2-pentafluoro-propane (HCFC-225ca) & ~55% 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	442-56-0 507-55-1	$C_3HCl_2F_5$	NR	+	NR	+	25	+		ne
Dichloropropane, 1,2-		78-87-5	$C_3H_6Cl_2$					0.7		10.87	75
Dichloro-1-propene, 1,3-		542-75-6	$C_3H_4C_{12}$	1.3	+	0.96	+			<10	1
Dichloro-1-propene, 2,3-		78-88-6	$C_3H_4Cl_2$	1.9	+	1.3	+	0.7	+	<10	ne
Dichloro-1,1,1-trifluoroethane, 2,2-	R-123	306-83-2	$C_2HCl_2F_3$	NR	+	NR	+	10.1	+	11.5	ne
Dichloro-2,4,6-trifluoropyridine, 3,5-	DCTFP	1737-93-5	$C_5Cl_2F_3N$	1.1	+	0.9	+	0.8	+		ne
Dichlorvos *	Vapona; O,O-dimethyl O-dichlorovinyl phosphate	62-73-7	$C_4H_7Cl_2O_4P$			0.9	+			<9.4	0.1
Dicyclopentadiene	DCPD, Cyclopentadiene dimer	77-73-6	$C_{10}H_{12}$	0.57	+	0.48	+	0.43	+	8.8	5
Diesel Fuel		68334-30-5	m.w. 226			0.9	+				11
Diesel Fuel #2 (Automotive)		68334-30-5	m.w. 216	1.3		0.7	+	0.4	+		11
Diethylamine		109-89-7	$C_4H_{11}N$			1	+			8.01	5
Diethylaminopropylamine, 3-		104-78-9	$C_7H_{18}N_2$			1.3					ne
Diethylbenzene	See Dowtherm J										
Diethylmaleate		141-05-9	$C_8H_{12}O_4$			4					ne
Diethyl sulfide	see Ethyl sulfide										
Diglyme	See Methoxyethyl ether	111-96-6	$C_6H_{14}O_3$								
Diisobutyl ketone	DIBK, 2,2-dimethyl-4-heptanone	108-83-8	$C_9H_{18}O$	0.71	+	0.61	+	0.35	+	9.04	25
Diisopropylamine		108-18-9	$C_6H_{15}N$	0.84	+	0.74	+	0.5	+	7.73	5
Diketene	Ketene dimer	674-82-8	$C_4H_4O_2$	2.6	+	2.0	+	1.4	+	9.6	0.5
Dimethylacetamide, N,N-	DMA	127-19-5	C_4H_9NO	0.87	+	0.8	+	0.8	+	8.81	10
Dimethylamine		124-40-3	C_2H_7N			1.5				8.23	5
Dimethyl carbonate	Carbonic acid dimethyl ester	616-38-6	$C_3H_6O_3$	NR	+	~70	+	1.7	+	~10.5	ne
Dimethyl disulfide	DMDS	624-92-0	$C_2H_6S_2$	0.2	+	0.20	+	0.21	+	7.4	ne
Dimethyl ether	see Methyl ether										
Dimethylethylamine	DMEA	598-56-1	$C_4H_{11}N$	1.1	+	1.0	+	0.9	+	7.74	~3
Dimethylformamide, N,N-	DMF	68-12-2	C_3H_7NO	0.7	+	0.7	+	0.8	+	9.13	10
Dimethylhydrazine, 1,1-	UDMH	57-14-7	$C_2H_8N_2$			0.8	+	0.8	+	7.28	0.01
Dimethyl methylphosphonate	DMMP, methyl phosphonic acid dimethyl ester	756-79-6	$C_3H_9O_3P$	NR	+	4.3	+	0.74	+	10.0	ne
Dimethyl sulfate		77-78-1	$C_2H_6O_4S$	~23		~20	+	2.3	+		0.1
Dimethyl sulfide	see Methyl sulfide										
Dimethyl sulfoxide	DMSO, Methyl sulfoxide	67-68-5	C_2H_6OS			1.4	+			9.10	ne
Dioxane, 1,4-		123-91-1	$C_4H_8O_2$			1.3				9.19	25
Dioxolane, 1,3-	Ethylene glycol formal	646-06-0	$C_3H_6O_2$	4.0	+	2.3	+	1.6	+	9.9	20
Dowtherm A see Therminol® *											
Dowtherm J (97% Diethylbenzene) *		25340-17-4	$C_{10}H_{14}$			0.5					
DS-108F Wipe Solvent	Ethyl lactate/Isopar H/ Propoxypropanol ~7:2:1	97-64-3 64742-48-9 1569-01-3	m.w. 118	3.3	+	1.6	+	0.7	+		ne
Epichlorohydrin	ECH Chloromethyloxirane, 1-chloro2,3-epoxypropane	106-89-8	C_2H_5ClO	~200	+	8.5	+	1.4	+	10.2	0.5
Ethane		74-84-0	C_2H_6			NR	+	15	+	11.52	ne
Ethanol	Ethyl alcohol	64-17-5	C_2H_6O			10	+	3.1	+	10.47	1000
Ethanolamine *	MEA, Monoethanolamine	141-43-5	C_2H_7NO	5.6	+	1.6	+			8.96	3
Ethene	Ethylene	74-85-1	C_2H_4			9	+	4.5	+	10.51	ne
Ethoxyethanol, 2-	Ethyl cellosolve	110-80-5	$C_4H_{10}O_2$			1.3				9.6	5
Ethyl acetate		141-78-6	$C_4H_8O_2$			4.6	+	3.5		10.01	400
Ethyl acetoacetate		141-97-9	$C_6H_{10}O_3$	1.4	+	1.2	+	1.0	+	<10	ne
Ethyl acrylate		140-88-5	$C_5H_8O_2$			2.4	+	1.0	+	<10.3	5
Ethylamine		75-04-7	C_2H_7N			0.8				8.86	5

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Ethylbenzene		100-41-4	C_8H_{10}	0.52	+	0.52	+	0.51	+	8.77	100
Ethyl caprylate	Ethyl octanoate	106-32-1	$C_{10}H_{20}O_2$		+	0.52	+	0.51	+		
Ethylenediamine	1,2-Ethanediamine; 1,2-Diaminoethane	107-15-3	$C_2H_8N_2$	0.9	+	0.8	+	1.0	+	8.6	10
Ethylene glycol *	1,2-Ethanediol	107-21-1	$C_2H_6O_2$			16	+	6	+	10.16	C100
Ethylene glycol, Acrylate	2-hydroxyethyl Acrylate	818-61-1	$C_5H_8O_3$			8.2				≤10.6	
Ethylene glycol dimethyl ether	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		0.86		0.7		9.2	ne
Ethylene glycol monobutyl ether acetate	2-Butoxyethyl acetate	112-07-2	$C_8H_{16}O_3$			1.3				≤10.6	
Ethylene glycol, monothio	mercapto-2-ethanol	60-24-2	C_2H_6OS			1.5				9.65	
Ethylene oxide	Oxirane, Epoxyethane	75-21-8	C_2H_4O			13	+	3.5	+	10.57	1
Ethyl ether	Diethyl ether	60-29-7	$C_4H_{10}O$			1.1	+	1.7		9.51	400
Ethyl 3-ethoxypropionate	EEP	763-69-9	$C_7H_{14}O_3$	1.2	+	0.75	+				ne
Ethyl formate		109-94-4	$C_3H_6O_2$					1.9		10.61	100
Ethylhexyl acrylate, 2-	Acrylic acid 2-ethylhexyl ester	103-11-7	$C_{11}H_{20}O_2$			1.1	+	0.5	+		ne
Ethylhexanol	2-Ethyl-1-hexanol	104-76-7	C8H18O			1.9				≤10.6	
Ethylidenenorbornene	5-Ethylidene bicyclo(2,2,1)hept-2-ene	16219-75-3	C_9H_{12}	0.4	+	0.39	+	0.34	+	≤8.8	ne
Ethyl (S)-(-)-lactate see also DS-108F	Ethyl lactate, Ethyl (S)-(-)-hydroxypropionate	687-47-8 97-64-3	$C_5H_{10}O_3$	13	+	3.2	+	1.6	+	~10	ne
Ethyl mercaptan	Ethanethiol	75-08-1	C_2H_6S	0.60	+	0.56	+			9.29	0.5
Ethyl sulfide	Diethyl sulfide	352-93-2	$C_4H_{10}S$			0.5	+			8.43	ne
Formaldehyde	Formalin	50-00-0	CH_2O	NR	+	NR	+	1.6	+	10.87	C0.3
Formamide		75-12-7	CH_3NO			6.9	+	4		10.16	10
Formic acid		64-18-6	CH_2O_2	NR	+	NR	+	9	+	11.33	5
Furfural	2-Furaldehyde	98-01-1	$C_5H_4O_2$			0.92	+	0.8	+	9.21	2
Furfuryl alcohol		98-00-0	$C_5H_6O_2$			0.80	+			<9.5	10
Gasoline #1		8006-61-9	m.w. 72			0.9	+				300
Gasoline #2, 92 octane		8006-61-9	m.w. 93	1.3	+	1.0	+	0.5	+		300
Glutaraldehyde	1,5-Pentanedial, Glutaric dialdehyde	111-30-8	$C_5H_8O_2$	1.1	+	0.8	+	0.6	+		C0.05
Glycidyl methacrylate	2,3-Epoxypropyl methacrylate	106-91-2	$C_7H_{10}O_3$	2.6	+	1.2	+	0.9	+		0.5
Halothane	2-Bromo-2-chloro-1,1,1-trifluoroethane	151-67-7	$C_2HBrClF_3$					0.6		11.0	50
HCFC-22 see Chlorodifluoromethane											
HCFC-123 see 2,2-Dichloro-1,1,1-trifluoroethane											
HCFC-141B see 1,1-Dichloro-1-fluoroethane											
HCFC-142B see 1-Chloro-1,1-difluoroethane											
HCFC-134A see 1,1,1,2-Tetrafluoroethane											
HCFC-225 see Dichloropentafluoropropane											
Heptane, n-		142-82-5	C_7H_{16}	45	+	2.8	+	0.60	+	9.92	400
Heptanol, 4-	Dipropylcarbinol	589-55-9	$C_7H_{16}O$	1.8	+	1.3	+	0.5	+	9.61	ne
Hexamethyldisilazane, 1,1,1,3,3,3- *	HMDS	999-97-3	$C_6H_{19}NSi_2$			0.2	+	0.2	+	~8.6	ne
Hexamethyldisiloxane	HMDSx	107-46-0	$C_6H_{18}OSi_2$	0.33	+	0.27	+	0.25	+	9.64	ne
Hexane, n-		110-54-3	C_6H_{14}	350	+	4.3	+	0.54	+	10.13	50
Hexanol, 1-	Hexyl alcohol	111-27-3	$C_6H_{14}O$	9	+	2.5	+	0.55	+	9.89	ne
Hexene, 1-		592-41-6	C_6H_{12}			0.8				9.44	30
HFE-7100 see Methyl nonafluorobutyl ether											
Histoclear (Histo-Clear)	Limonene/corn oil reagent		m.w. ~136	0.5	+	0.4	+	0.3	+		ne
Hydrazine *		302-01-2	H_4N_2	>8	+	2.6	+	2.1	+	8.1	0.01
Hydrazoic acid	Hydrogen azide		HN_3							10.7	
Hydrogen	Synthesis gas	1333-74-0	H_2	NR	+	NR	+	NR	+	15.43	ne
Hydrogen cyanide	Hydrocyanic acid	74-90-8	HCN	NR	+	NR	+	NR	+	13.6	C4.7
Hydrogen iodide *	Hydriodic acid	10034-85-2	HI			~0.6*				10.39	
Hydrogen peroxide		7722-84-1	H_2O_2	NR	+	NR	+	NR	+	10.54	1
Hydrogen sulfide		7783-06-4	H_2S	NR	+	3.3	+	1.5	+	10.45	10
Hydroxypropyl methacrylate		27813-02-1 923-26-2	$C_7H_{12}O_3$	9.9	+	2.3	+	1.1	+		ne
Iodine *		7553-56-2	I_2	0.1	+	0.1	+	0.1	+	9.40	C0.1

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Iodomethane	Methyl iodide	74-88-4	CH_3I	0.21	+	0.22	+	0.26	+	9.54	2
Isoamyl acetate	Isopentyl acetate	123-92-2	$C_7H_{14}O_2$	10.1		2.1		1.0		<10	100
Isobutane	2-Methylpropane	75-28-5	C_4H_{10}			100	+	1.2	+	10.57	ne
Isobutanol	2-Methyl-1-propanol	78-83-1	$C_4H_{10}O$	19	+	3.8	+	1.5		10.02	50
Isobutene	Isobutylene, Methyl butene	115-11-7	C_4H_8	1.00	+	1.00	+	1.00	+	9.24	Ne
Isobutyl acrylate	Isobutyl 2-propenoate	106-63-8	$C_7H_{12}O_2$			1.5	+	0.60	+		Ne
Isoflurane	1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether, forane	26675-46-7	$C_3H_2ClF_5O$	NR	+	NR	+	48	+	~11.7	Ne
Isooctane	2,2,4-Trimethylpentane	540-84-1	C8H18			1.2				9.86	ne
Isopar E Solvent	Isoparaffinic hydrocarbons	64741-66-8	m.w. 121	1.7	+	0.8	+				Ne
Isopar G Solvent	Photocopier diluent	64742-48-9	m.w. 148			0.8	+				Ne
Isopar K Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 156	0.9	+	0.5	+	0.27	+		Ne
Isopar L Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 163	0.9	+	0.5	+	0.28	+		Ne
Isopar M Solvent	Isoparaffinic hydrocarbons	64742-47-8	m.w. 191			0.7	+	0.4	+		Ne
Isopentane	2-Methylbutane	78-78-4	C_5H_{12}			8.2					Ne
Isophorone		78-59-1	$C_9H_{14}O$					3		9.07	C5
Isoprene	2-Methyl-1,3-butadiene	78-79-5	C_5H_8	0.69	+	0.63	+	0.60	+	8.85	Ne
Isopropanol	Isopropyl alcohol, 2-propanol, IPA	67-63-0	C_3H_8O	500	+	6.0	+	2.7		10.12	200
Isopropyl acetate		108-21-4	$C_5H_{10}O_2$			2.6				9.99	100
Isopropyl ether	Diisopropyl ether	108-20-3	$C_6H_{14}O$			0.8				9.20	250
Jet fuel JP-4	Jet B, Turbo B, F-40 Wide cut type aviation fuel	8008-20-6 + 64741-42-0	m.w. 115			1.0	+	0.4	+		Ne
Jet fuel JP-5	Jet 5, F-44, Kerosene type aviation fuel	8008-20-6 + 64747-77-1	m.w. 167			0.6	+	0.5	+		29
Jet fuel JP-8	Jet A-1, F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 165			0.6	+	0.3	+		30
Jet fuel A-1 (JP-8)	F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 145			0.67					34
Jet Fuel TS	Thermally Stable Jet Fuel, Hydrotreated kerosene fuel	8008-20-6 + 64742-47-8	m.w. 165	0.9	+	0.6	+	0.3	+		30
Limonene, D-	(R)-(+)-Limonene	5989-27-5	$C_{10}H_{16}$			0.33	+			~8.2	Ne
Kerosene C10-C16 petro.distillate – see Jet Fuels		8008-20-6									
MDI – see 4,4'-Methylenebis(phenylisocyanate)											
Maleic anhydride	2,5-Furandione	108-31-6	$C_4H_2O_3$							~10.8	0.1
Mesitylene	1,3,5-Trimethylbenzene	108-67-8	C_9H_{12}	0.36	+	0.35	+	0.3	+	8.41	25
Methallyl chloride – see 3-Chloro-2-methylpropene											
Methane	Natural gas	74-82-8	CH_4	NR	+	NR	+	NR	+	12.61	Ne
Methanol	Methyl alcohol, carbinol	67-56-1	CH_4O	NR	+	NR	+	2.5	+	10.85	200
Methoxyethanol, 2-	Methyl cellosolve, Ethylene glycol monomethyl ether	109-86-4	$C_3H_8O_2$	4.8	+	2.4	+	1.4	+	10.1	5
Methoxyethoxyethanol, 2-	2-(2-Methoxyethoxy)ethanol Diethylene glycol monomethyl ether	111-77-3	$C_7H_{16}O$	2.3	+	1.2	+	0.9	+	<10	Ne
Methoxyethyl ether, 2-	bis(2-Methoxyethyl) ether, Diethylene glycol dimethyl ether, Diglyme	111-96-6	$C_6H_{14}O_3$	0.64	+	0.54	+	0.44	+	<9.8	Ne
Methyl acetate		79-20-9	$C_3H_6O_2$	NR	+	6.6	+	1.4	+	10.27	200
Methyl acrylate	Methyl 2-propenoate, Acrylic acid methyl ester	96-33-3	$C_4H_6O_2$			3.7	+	1.2	+	(9.9)	2
Methylamine	Aminomethane	74-89-5	CH_5N			1.2				8.97	5
Methyl amyl ketone	MAK, 2-Heptanone, Methyl pentyl ketone	110-43-0	$C_7H_{14}O$	0.9	+	0.85	+	0.5	+	9.30	50
Methyl bromide	Bromomethane	74-83-9	CH_3Br	110	+	1.7	+	1.3	+	10.54	1
Methyl t-butyl ether	MTBE, *tert*-Butyl methyl ether	1634-04-4	$C_5H_{12}O$			0.9	+			9.24	40
Methyl cellosolve	see 2-Methoxyethanol										
Methyl chloride	Chloromethane	74-87-3	CH_3Cl	NR	+	NR	+	0.74	+	11.22	50
Methylcyclohexane		107-87-2	C_7H_{14}	1.6	+	0.97	+	0.53	+	9.64	400
Methylene bis(phenyl-isocyanate), 4,4'- *	MDI, Mondur M		$C_{15}H_{10}N_2O_2$	Very slow ppb level response							0.005

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Methylene chloride	Dichloromethane	75-09-2	CH_2Cl_2	NR	+	NR	+	0.89	+	11.32	25
Methyl ether	Dimethyl ether	115-10-6	C_2H_6O	4.8	+	3.1	+	2.5	+	10.03	Ne
Methyl ethyl ketone	MEK, 2-Butanone	78-93-3	C_4H_8O	0.86	+	0.9	+	1.1	+	9.51	200
Methylhydrazine	Monomethylhydrazine, Hydrazomethane	60-34-4	$C_2H_6N_2$	1.4	+	1.2	+	1.3	+	7.7	0.01
Methyl isoamyl ketone	MIAK, 5-Methyl-2-hexanone	110-12-3	$C_7H_{14}O$	0.8	+	0.76	+	0.5	+	9.28	50
Methyl isobutyl ketone	MIBK, 4-Methyl-2-pentanone	108-10-1	$C_6H_{12}O$	0.9	+	0.8	+	0.6	+	9.30	50
Methyl isocyanate	CH3NCO	624-83-9	C_2H_3NO	NR	+	4.6	+	1.5		10.67	0.02
Methyl isothiocyanate	CH3NCS	551-61-6	C_2H_3NS	0.5	+	0.45	+	0.4	+	9.25	ne
Methyl mercaptan	Methanethiol	74-93-1	CH_4S	0.65		0.54		0.66		9.44	0.5
Methyl methacrylate		80-62-6	$C_5H_8O_2$	2.7	+	1.5	+	1.2	+	9.7	100
Methyl nonafluorobutyl ether	HFE-7100DL	163702-08-7, 163702-07-6	$C_5H_3F_9O$			NR	+	~35	+		ne
Methyl-1,5-pentanediamine, 2- (coats lamp) *	Dytek-A amine, 2-Methyl pentamethylenediamine	15520-10-2	C6H16N2			~0.6	+			<9.0	ne
Methyl propyl ketone	MPK, 2-Pentanone	107-87-9	$C_5H_{12}O$			0.93	+	0.79	+	9.38	200
Methyl-2-pyrrolidinone, N-	NMP, N-Methylpyrrolidone, 1-Methyl-2-pyrrolidinone, 1-Methyl-2-pyrrolidone	872-50-4	C_5H_9NO	1.0	+	0.8	+	0.9	+	*9.17*	ne
Methyl salicylate	Methyl 2-hydroxybenzoate	119-36-8	C_8H_8O3	1.3	+	0.9	+	0.9	+	~9	ne
Methylstyrene, α-	2-Propenylbenzene	98-83-9	C_9H_{10}			0.5				8.18	50
Methyl sulfide	DMS, Dimethyl sulfide	75-18-3	C_2H_6S	0.49	+	0.44	+	0.46	+	8.69	ne
Mineral spirits	Stoddard Solvent, Varsol 1, White Spirits	8020-83-5 8052-41-3 68551-17-7	m.w. 144	1.0		0.69	+	0.38	+		100
Mineral Spirits - Viscor 120B Calibration Fluid, b.p. 156-207°C		8052-41-3	m.w. 142	1.0	+	0.7	+	0.3	+		100
Monoethanolamine - see Ethanolamine											
Mustard *	HD, Bis(2-chloroethyl) sulfide	505-60-2 39472-40-7 68157-62-0	$C_4H_8Cl_2S$			0.6					0.0005
Naphtha - see VM & P Naptha											
Naphthalene	Mothballs	91-20-3	$C_{10}H_8$	0.45	+	0.42	+	0.40	+	8.13	10
Nickel carbonyl (in CO)	Nickel tetracarbonyl	13463-39-3	C_4NiO_4			0.18				<8.8	0.001
Nicotine		54-11-5	$C_{10}H_{14}N_2$			2.0				≤10.6	
Nitric oxide		10102-43-9	NO	~6		5.2	+	2.8	+	9.26	25
Nitrobenzene		98-95-3	$C_6H_5NO_2$	2.6	+	1.9	+	1.6	+	9.81	1
Nitroethane		79-24-3	$C_2H_5NO_2$					3		10.88	100
Nitrogen dioxide		10102-44-0	NO_2	23	+	16	+	6	+	9.75	3
Nitrogen trifluoride		7783-54-2	NF_3	NR		NR		NR		13.0	10
Nitromethane		75-52-5	CH_3NO_2					4		11.02	20
Nitropropane, 2-		79-46-9	$C_3H_7NO_2$					2.6		10.71	10
Nonane		111-84-2	C_9H_{20}			1.4				9.72	200
Norpar 12	n-Paraffins, mostly C_{10}-C_{13}	64771-72-8	m.w. 161	3.2	+	1.1	+	0.28	+		ne
Norpar 13	n-Paraffins, mostly C_{13}-C_{14}	64771-72-8	m.w. 189	2.7	+	1.0	+	0.3	+		ne
Octamethylcyclotetrasiloxane		556-67-2	$C_8H_{24}O_4Si_4$	0.21	+	0.17	+	0.14	+		ne
Octamethyltrisiloxane		107-51-7	$C_8H_{24}O_2Si_3$	0.23	+	0.18	+	0.17	+	<10.0	ne
Octane, n-		111-65-9	C_8H_{18}	13	+	1.8	+			9.82	300
Octene, 1-		111-66-0	C_8H_{16}	0.9	+	0.75	+	0.4	+	9.43	75
Pentane		109-66-0	C_5H_{12}	80	+	8.4	+	0.7	+	10.35	600
Peracetic acid *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$	NR	+	NR	+	2.3	+		ne
Peracetic/Acetic acid mix *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$			50	+	2.5	+		ne
Perchloroethene	PCE, Perchloroethylene, Tetrachloroethylene	127-18-4	C_2Cl_4	0.69	+	0.57	+	0.31	+	9.32	25
PGME	Propylene glycol methyl ether, 1-Methoxy-2-propanol	107-98-2	$C_6H_{12}O_3$	2.4	+	1.5	+	1.1	+		100

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
PGMEA	Propylene glycol methyl ether acetate, 1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate	108-65-6	$C_6H_{12}O_3$	1.65	+	1.0	+	0.8	+		ne
Phenol	Hydroxybenzene	108-95-2	C_6H_6O	1.0	+	1.0	+	0.9	+	8.51	5
Phosgene	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	8.5	+	11.2	0.1
Phosgene in Nitrogen	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	6.8	+	11.2	0.1
Phosphine (coats lamp)		7803-51-2	PH_3	28		3.9	+	1.1	+	9.87	0.3
Photocopier Toner	Isoparaffin mix					0.5	+	0.3	+		ne
Picoline, 3-	3-Methylpyridine	108-99-6	C_6H_7N			0.9				9.04	ne
Pinene, α-		2437-95-8	$C_{10}H_{16}$			0.31	+	0.47		8.07	ne
Pinene, β-		18172-67-3	$C_{10}H_{16}$	0.38	+	0.37	+	0.37	+	~8	100
Piperylene, isomer mix	1,3-Pentadiene	504-60-9	C_5H_8	0.76	+	0.69	+	0.64	+	8.6	100
Propane		74-98-6	C_3H_8			NR	+	1.8	+	10.95	2500
Propanol, n-	Propyl alcohol	71-23-8	C_3H_8O			5		1.7		10.22	200
Propene	Propylene	115-07-1	C_3H_6	1.5	+	1.4	+	1.6	+	9.73	ne
Propionaldehyde	Propanal	123-38-6	C_3H_6O			1.9				9.95	ne
Propyl acetate, n-		109-60-4	$C_5H_{10}O_2$			3.5		2.3		10.04	200
Propylamine, n-	1-Propylamine, 1-Aminopropane	107-10-8	C_3H_9N	1.1	+	1.1	+	0.9	+	8.78	ne
Propylene carbonate *		108-32-7	$C_4H_6O_3$			62	+	1	+	10.5	ne
Propylene glycol	1,2-Propanediol	57-55-6	$C_3H_8O_2$	18		5.5	+	1.6	+	<10.2	ne
Propylene glycol propyl ether	1-Propoxy-2-propanol	1569-01-3	$C_6H_{14}O_2$	1.3	+	1.0	+	1.6	+		ne
Propylene oxide	Methyloxirane	75-56-9 16088-62-3 15448-47-2	C_3H_6O	~240		6.6	+	2.9	+	10.22	20
Propyleneimine	2-Methylaziridine	75-55-8	C_3H_7N	1.5	+	1.3	+	1.0	+	9.0	2
Propyl mercaptan, 2-	2-Propanethiol, Isopropyl mercaptan	75-33-2	C_3H_8S	0.64	+	0.66	+			9.15	ne
Pyridine		110-86-1	C_5H_5N	0.78	+	0.7	+	0.7	+	9.25	5
Pyrrolidine (coats lamp)	Azacyclohexane	123-75-1	C_4H_9N	2.1	+	1.3	+	1.6	+	~8.0	ne
RR7300 (PGME/PGMEA)	70:30 PGME:PGMEA (1-Methoxy-2-propanol:1-Methoxy-2-acetoxypropane)	107-98-2	$C_4H_{10}O_2$ / $C_6H_{12}O_3$			1.4	+	1.0	+		ne
Sarin	GB, Isopropyl methylphosphonofluoridate	107-44-8 50642-23-4	$C_4H_{10}FO_2P$			~3					
Stoddard Solvent - see Mineral Spirits		8020-83-5									
Styrene		100-42-5	C_8H_8	0.45	+	0.40	+	0.4	+	8.43	20
Sulfur dioxide		7446-09-5	SO_2	NR		NR	+	NR	+	12.32	2
Sulfur hexafluoride		2551-62-4	SF_6	NR		NR		NR		15.3	1000
Sulfuryl fluoride	Vikane	2699-79-8	SO_2F_2	NR		NR		NR		13.0	5
Tabun *	Ethyl N, N-dimethylphosphoramidocyanidate	77-81-6	$C_5H_{11}N_2O_2P$			0.8					15ppt
Tetrachloroethane, 1,1,1,2-		630-20-6	$C_2H_2Cl_4$					1.3		~11.1	ne
Tetrachloroethane, 1,1,2,2-		79-34-5	$C_2H_2Cl_4$	NR	+	NR	+	0.60	+	~11.1	1
Tetrachlorosilane		10023-04-7	$SiCl_4$	NR		NR		15	+	11.79	ne
Tetraethyl lead	TEL	78-00-2	$C_8H_{20}Pb$	0.4		0.3		0.2		~11.1	0.008
Tetraethyl orthosilicate	Ethyl silicate, TEOS	78-10-4	$C_8H_{20}O_4Si$			0.7	+	0.2	+	~9.8	10
Tetrafluoroethane, 1,1,1,2-	HFC-134A	811-97-2	$C_2H_2F_4$			NR		NR			ne
Tetrafluoroethene	TFE, Tetrafluoroethylene, Perfluoroethylene	116-14-3	C_2F_4			~15				10.12	ne
Tetrafluoromethane	CFC-14, Carbon tetrafluoride	75-73-0	CF_4			NR	+	NR	+	>15.3	ne
Tetrahydrofuran	THF	109-99-9	C_4H_8O	1.9	+	1.7	+	1.0	+	9.41	200
Tetramethyl orthosilicate	Methyl silicate, TMOS	681-84-5	$C_4H_{12}O_4Si$	10	+	1.9	+			~10	1
Therminol® D-12 *	Hydrotreated heavy naphtha	64742-48-9	m.w. 160	0.8	+	0.51	+	0.33	+		ne
Therminol® VP-1 *	Dowtherm A, 3:1 Diphenyl oxide: Biphenyl	101-84-8 92-52-4	$C_{12}H_{10}O$ $C_{12}H_{10}$			0.4	+				1
Toluene	Methylbenzene	108-88-3	C_7H_8	0.54	+	0.50	+	0.51	+	8.82	50

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Tolylene-2,4-diisocyanate	TDI, 4-Methyl-1,3-phenylene-2,4-diisocyanate	584-84-9	$C_9H_6N_2O_2$	1.4	+	1.4	+	2.0	+		0.002
Trichlorobenzene, 1,2,4-	1,2,4-TCB	120-82-1	$C_6H_3Cl_3$	0.7	+	0.46	+			9.04	C5
Trichloroethane, 1,1,1-	1,1,1-TCA, Methyl chloroform	71-55-6	$C_2H_3Cl_3$			NR	+	1	+	11	350
Trichloroethane, 1,1,2-	1,1,2-TCA	79-00-5	$C_2H_3Cl_3$	NR	+	NR	+	0.9	+	11.0	10
Trichloroethene	TCE, Trichoroethylene	79-01-6	C_2HCl_3	0.62	+	0.54	+	0.43	+	9.47	50
Trichloromethylsilane	Methyltrichlorosilane	75-79-6	CH_3Cl_3Si	NR		NR		1.8	+	11.36	ne
Trichlorotrifluoroethane, 1,1,2-	CFC-113	76-13-1	$C_2Cl_3F_3$			NR		NR		11.99	1000
Triethylamine	TEA	121-44-8	$C_6H_{15}N$	0.95	+	0.9	+	0.65	+	7.3	1
Triethyl borate	TEB; Boric acid triethyl ester	150-46-9	$C_6H_{15}O_3B$			2.2	+	1.1	+	~10	ne
Triethyl phosphate	Ethyl phosphate	78-40-0	$C_6H_{15}O_4P$	~50	+	3.1	+	0.60	+	9.79	ne
Trifluoroethane, 1,1,2-		430-66-0	$C_2H_3F_3$					34		*12.9*	ne
Trimethylamine		75-50-3	C_3H_9N			0.9				7.82	5
Trimethylbenzene, 1,3,5- - see Mesitylene		108-67-8									25
Trimethyl borate	TMB; Boric acid trimethyl ester, Boron methoxide	121-43-7	$C_3H_9O_3B$			5.1	+	1.2	+	10.1	ne
Trimethyl phosphate	Methyl phosphate	512-56-1	$C_3H_9O_4P$			8.0	+	1.3	+	9.99	ne
Trimethyl phosphite	Methyl phosphite	121-45-9	$C_3H_9O_3P$			1.1	+		+	*8.5*	2
Turpentine	Pinenes (85%) + other diisoprenes	8006-64-2	$C_{10}H_{16}$	0.37	+	0.30	+	0.29	+	~8	20
Undecane		1120-21-4	$C_{11}H_{24}$			2				9.56	ne
Varsol – see Mineral Spirits											
Vinyl actetate		108-05-4	$C_4H_6O_2$	1.5	+	1.2	+	1.0	+	9.19	10
Vinyl bromide	Bromoethylene	593-60-2	C_2H_3Br			0.4				9.80	5
Vinyl chloride	Chloroethylene, VCM	75-01-4	C_2H_3Cl			2.0	+	0.6	+	9.99	5
Vinyl-1-cyclohexene, 4-	Butadiene dimer, 4-Ethenylcyclohexene	100-40-3	C_8H_{12}	0.6	+	0.56	+			9.83	0.1
Vinylidene chloride - see 1,1-Dichloroethene											
Vinyl-2-pyrrolidinone, 1-	NVP, N-vinylpyrrolidone, 1-ethenyl-2-pyrrolidinone	88-12-0	C_6H_9NO	1.0	+	0.8	+	0.9	+		ne
Viscor 120B - see Mineral Spirits - Viscor 120B Calibration Fluid											
V. M. & P. Naphtha	Ligroin; Solvent naphtha; Varnish maker's & painter's naptha	64742-89-8	m.w. 111 (C_8-C_9)	1.7	+	0.97	+				300
Xylene, m-	1,3-Dimethylbenzene	108-38-3	C_8H_{10}	0.50	+	0.44	+	0.40	+	8.56	100
Xylene, o-	1,2-Dimethylbenzene	95-47-6	C_8H_{10}	0.56	+	0.46	+	0.43		8.56	100
Xylene, p-	1,4-Dimethylbenzene	106-42-3	C_8H_{10}	0.48	+	0.39	+	0.38	+	8.44	100
None				1		1		1			
Undetectable				1E+6		1E+6		1E+6			

* Compounds indicated in green can be detected using a MiniRAE 2000 or ppbRAE/+ with slow response, but may be lost by adsorption on a MultiRAE or EntryRAE. Response on multi-gas meters can give an indication of relative concentrations, but may not be quantitative and for some chemicals no response is observed.

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Appendix I:
Example of Automatic Calculation of Correction Factors, TLVs and Alarm Limits for Mixtures
(Calculations performed using Excel version of this database, available on request)

Compound	CF 9.8 eV	CF 10.6 eV	CF 11.7eV	Mol. Frac	Conc ppm	TLV ppm	STEL Ppm
Benzene	0.55	0.53	0.6	0.01	1	0.5	2.5
Toluene	0.54	0.5	0.51	0.06	10	50	150
Hexane, n-	300	4.3	0.54	0.06	10	50	150
Heptane, n-	45	2.8	0.6	0.28	50	400	500
Styrene	0.45	0.4	0.42	0.06	10	20	40
Acetone	1.2	1.1	1.4	0.28	50	750	1000
Isopropanol	500	6	2.7	0.28	50	400	500
None	1	1	1	0.00	0	1	
Mixture Value:	2.1	1.5	0.89	1.00	181	56	172
TLV Alarm Setpoint when Calibrated to Isobutylene:	26 ppm	37 ppm	62 ppm		ppm	ppm	ppm
STEL Alarm Setpoint, same Calibration	86 ppm	115 ppm	193 ppm				

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BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

FIELD OPERATING PROCEDURES

Composite Sample Collection Procedure for Non-VOC Analysis

FOP 013.0

COMPOSITE SAMPLE COLLECTION PROCEDURE FOR NON-VOLATILE ORGANIC ANALYSIS

PURPOSE

This guideline addresses the procedure to be used when soil samples are to be composited in the field.

PROCEDURE

1. Transfer equal weighted aliquots of soil from individual split-spoon samples, excavator bucket, hand auger or surface soil sample location to a large precleaned stainless steel (or Pyrex glass) mixing bowl.

2. Thoroughly mix (homogenize) and break up the soil using a stainless steel scoop or trowel.

3. Spread the composite sample evenly on a stainless steel tray and quarter the sample.

4. Discard alternate (i.e., diagonal) quarters and, using a small stainless steel scoop or spatula, collect equal portions of subsample from the remaining two quarters until the amount required for the composite sample is acquired. Transfer these subsamples to a precleaned stainless steel (or Pyrex glass) mixing bowl and re-mix.

5. Transfer the composite sample to the laboratory provided, precleaned sample jars. Store any excess sample from the stainless steel tray in a separate, precleaned, wide-mouth sample jar and refrigerate for future use, if applicable.

6. Decontaminate all stainless steel (or Pyrex glass) equipment in accordance with Benchmark's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures.

7. Prepare samples in accordance with Benchmark's Sample Labeling, Storage and Shipment FOP.

8. Record all sampling details in the Project Field Book and on the Soil/Sediment Sample Collection Summary Log (sample attached).

ATTACHMENTS

Soil/Sediment Sample Collection Summary Log (sample)

REFERENCES

Benchmark FOPs:

040 *Non-disposable and Non-dedicated Sampling Equipment Decontamination*

046 *Sample Labeling, Storage and Shipment*

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

SOIL/SEDIME
SAMPLE COLLECTION SUMMARY L

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to varian location changes, depth changes, import matrix observations or description, grav thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water [illegible] d sa[illegible] uipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples coll the same day. HSL Metals can be substituted by only the Metals an[illegible] lexa[illegible] romium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionzied water lot # or distilay. manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matri[illegible] or all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' sectio*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
5. BD - Blind Duplicate - indicate location of duplicate.

SAMPLE

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FIELD OPERATING PROCEDURES

Drilling and Excavation Equipment Decontamination Procedures

FOP 018.0

DRILLING AND EXCAVATION EQUIPMENT DECONTAMINATION PROCEDURES

PURPOSE

This procedure is to be used for the decontamination of drilling and excavation equipment (i.e., drill rigs, backhoes, augers, drill bits, drill rods, buckets, and associated equipment) used during a subsurface investigation. The purpose of this procedure is to remove chemical constituents associated with a particular drilling or excavation location from this equipment. This prevents these constituents from being transferred between drilling or excavation locations, or being transported out of controlled areas.

PROCEDURE

The following procedure will be utilized prior to the use of drilling or excavation equipment at each location, and prior to the demobilization of such equipment from the site:

1. Remove all loose soil and other particulate materials from the equipment at the survey site.

2. Wrap augers, tools, plywood, and other reusable items with a plastic cover prior to transport from the site of use to the decontamination facility.

3. Transport equipment to the decontamination facility. All equipment must be decontaminated at an established decontamination facility. This facility will be placed within a controlled area, and will be equipped with necessary features to contain and collect wash water and entrained materials.

4. Wash equipment thoroughly with pressurized low-volume water or steam, supplied by a pressure washer or steam cleaner.

5. If necessary, use a brush or scraper to remove visible soils adhering to the equipment, and a non-phosphate detergent to remove any oils, grease, and/or hydraulic fluids adhering to the equipment. Continue pressure washing until all visible contaminants are removed.

6. Allow equipment to air dry.

7. Store equipment in a clean area or wrap the equipment in new plastic sheeting as necessary to ensure cleanliness until ready for use.

8. Manage all wash waters and entrained solids as described in the Benchmark Field Operating Procedure for Management of Investigation-Derived Waste.

ATTACHMENTS

none

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FIELD OPERATING PROCEDURES

Hollow Stem Auger Drilling Procedures

FOP 026.1

HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES

PURPOSE

This guideline presents a method for drilling a borehole through unconsolidated materials, including soils or overburden, and consolidated materials, including bedrock.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using hollow-stem auger methods and equipment.

1. Follow Benchmark's Field Operating Procedure for Drill Site Selection Procedure prior to implementing any drilling activity.

2. Perform drill rig safety checks with the driller by completing the Drilling Safety Checklist form (sample attached).

3. Conduct tailgate health and safety meeting with project team and drillers by completing the Tailgate Safety Meeting Form.

4. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures (i.e., PID, FID, combustible gas meter) or manufacturer's recommendations for calibration of field meters (i.e., DataRAM 4 Particulate Meter).

5. Ensure all drilling equipment (i.e., augers, rods, split-spoons) appear clean and free of soil prior to initiating any subsurface intrusion. Decontamination of drilling equipment should be in accordance with Benchmark's FOP: Drilling and Excavation Equipment Decontamination Procedures.

6. Mobilize the auger rig to the site and position over the borehole.

7. Level and stabilize the rig using the rig jacks, and recheck the rig location against the planned drilling location. If necessary, raise the jacks and adjust the rig position.

8. Place a metal or plywood auger pan over the borehole location to collect the auger cuttings. This auger pan will be equipped with a 12-inch nominal diameter hole for auger passage. As an alternative, a piece of polyethylene tarp may be used as a substitute.

9. Advance augers into the subsurface. For sampling or pilot-hole drilling, nominal 8-inch outside diameter (OD) augers should be used. The boring diameter will be approved by the Benchmark field supervisor.

10. Collect soil samples via split spoon sampler in accordance with Benchmark's Field Operating Procedure for Split Spoon Sampling.

11. Check augers periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.

12. Continue drilling until reaching the assigned total depth, or until auger refusal occurs. Auger refusal is when the drilling penetration drops below 0.1 feet per 10 minutes, with the full weight of the rig on the auger bit, and a center bit (not center plug) in place.

13. Plug and abandon boreholes not used for well installation in accordance with Benchmark's Field Operating Procedure for Abandonment of Borehole.

OTHER PROCEDURAL ISSUES

- Slip rings may be used for lifting a sampling or bit string. The string will not be permitted to extend more than 15 feet above the mast crown.

- Borings will not be over drilled (rat holed) without the express permission of the Benchmark field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.

- Potable water may be placed in the auger stem if critically necessary for borehole control or to accomplish sampling objectives and must be approved by the Benchmark Project Manager and/or NYSDEC Project Manager. Upon approval,

the potable water source and quantity used will be documented in the Project Field Book and subsequent report submittal.

ATTACHMENTS

Drilling Safety Checklist (sample)
Tailgate Safety Meeting Form (sample)

REFERENCES

Benchmark FOPs:

001 *Abandonment of Borehole Procedures*
010 *Calibration and Maintenance of Portable Flame Ionization Detector*
011 *Calibration and Maintenance of Portable Photoionization Detector*
017 *Drill Site Selection Procedure*
018 *Drilling and Excavation Equipment Decontamination Procedures*
058 *Split Spoon Sampling Procedures*

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DRILLING SAFETY CHECKLIST

Project: **Supplemental Phase II RFI/ICMs**	Date:
Project No.: **0041-009-500**	Drilling Company:
Client: **RealCo., Inc.**	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
"Kill switches" installed by the manufacturer are in operable condition and all workers at the drill site are familiar with their location and how to activate them?		
"Kill switches" are accessible to workers on both sides of the rotating stem? NOTE: Optional based on location and number of switches provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wires, "bird cages" and worn or missing sections?		
Cables are terminated at the working end with a proper eye splice, either swaged Coupling or using cable clamps?		
Cable clamps are installed with the saddle on the live or load side? Clamps should not be alternated and should be of the correct size and number for the cable size to which it is installed. Clamps are complete with no missing parts?		
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation?		
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load?		
Drive shafts, belts, chain drives and universal joints shall be guarded to prevent accidental insertion of hands and fingers or tools?		
Outriggers shall be extended prior to and whenever the boom is raised off its cradle. Hydraulic outriggers must maintain pressure to continuously support and stabilize the drill rig even while unattended.		
Outriggers shall be properly supported on the ground surface to prevent settling into the soil.		
Controls are properly labeled and have freedom of movement. Controls should not be blocked or locked in an action position.		
Safeties on any device shall not be bypassed or neutralized.		
Controls shall be operated smoothly and cables and lifting devices shall not be jerked or operated erratically to overcome resistance.		
Slings, chokers and lifting devices are inspected before using and are in proper working order? Damaged units are removed from service and are properly tagged?		
Shackles and clevises are in proper working order and pins and screws are fully inserted before placing under a load?		
High-pressure hoses have a safety (chain, cable or strap) at each end of the hose section to prevent whipping in the event of a failure?		
Rotating parts of the drill string shall be free of sharp projections or hooks, which could entrap clothing or foreign objects?		
Wire ropes should not be allowed to bend around sharp edges without cushion material.		
The exclusion zone is centered over the borehole and the radius is equal or greater than the boom height?		

SAMPLE

ITEMS TO CHECK	OK	ACTION NEEDED

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DRILLING SAFETY CHECKLIST

Project: **Supplemental Phase II RFI/ICMs**	Date:
Project No.: **0041-009-500**	Drilling Company:
Client: **RealCo., Inc.**	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
The work area around the borehole shall be kept clear of trip hazards and walking surfaces should be free of slippery material.		
Workers shall not proceed higher than the drilling deck without a fall restraining device and must attach the device in a manner to restrict fall to less than 6 feet.		
A fire extinguisher of appropriate size shall be immediately available to the drill crew. The drill crew shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to, under, by, or near power lines only in accordance with the following: .333 © (3) (ii) 50 kV or less -minimum clearance is 10 ft. For 50 kV or over - 10ft. Plus ½ in. For each additional kV **Benchmark Policy: Maintain 20 feet clearance**		
29 CFR 1910.333 © (3) (iii) While the rig is in transit with the boom in the down position, clearance from energized power lines will be maintained as follows: Less than 50 kV - 4 feet 50 to 365 kV - 10 feet 365 to 720 kV - 16 feet		

SAMPLE

Name: _____ (printed)

Signed: _____ Date: _____

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

SAMPLE

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

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FIELD OPERATING PROCEDURES

Sample Labeling, Storage, and Shipment Procedures

FOP 046.0

SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

PURPOSE

The collection and analysis of samples of environmental media, including soils, groundwater, surface water, and sediment, are the central activities of the field investigation. These samples must be properly labeled to preserve its identity, and properly stored and shipped in a manner that preserves its integrity and chain of custody. This procedure presents methods for these activities.

SAMPLE LABELING PROCEDURE

1. Assign each sample retained for analysis a unique 9-digit alphanumeric identification code or as indicated in the Project Work Plan. Typically, this code will be formatted as follows:

Sample I.D. Example: GW051402047	
GW	**Sample matrix** GW = groundwater; SW = surface water; SUB = subsurface soil; SS = surface soil; SED = sediment; L = leachate; A = air
05	Month of sample collection
14	Day of sample collection
02	Year of sample collection
047	Consecutive sample number

2. Consecutive sample numbers will indicate the individual sample's sequence in the total set of samples collected during the investigation/sampling event. The sample number above, for example, would indicate the 47th sample retained for analysis during the field investigation, collected on May 14, 2002.

3. Affix a non-removable (when wet) label to each sample container. The following information will be written on the label with black or blue ink that will not smudge when wet:

   - Project number
   - Sample ID (see Step 1 above)
   - Date of sample collection
   - Time of sample collection (military time only)
   - Specify "grab" or "composite" sample with an "X"
   - Sampler initials
   - Preservative(s) (if applicable)
   - Analytes for analysis (if practicable)

4. Record all sample label information in the Project Field Book and on a Sample Summary Collection Log (see attached samples), keyed to the sample identification number. In addition, add information regarding the matrix, sample location, depth, etc. to provide a complete description of the sample.

SAMPLE STORAGE PROCEDURE

1. Immediately after collection, placement in the proper container, and labeling, place samples to be retained for chemical analysis into resealable plastic bags.

2. Place bagged samples into an ice chest filled approximately half-full of double bagged ice. Blue ice is not an acceptable substitute for ice.

3. Maintain samples in an ice chest or in an alternative location (e.g. sample refrigerator) as approved by the Benchmark Field Team Leader until time of shipment. Periodically drain melt-water off coolers and replenish ice as necessary.

4. Ship samples on a daily basis, unless otherwise directed by the Benchmark Field Team Leader.

5. Maintain appropriate custody procedures on coolers and other sample storage containers at all times. These procedures are discussed in detail in the Project Quality Assurance Project Plan, Monitoring Plan or Work Plan.

6. Samples shall be kept in a secure location locked and controlled (i.e., locked building or fenced area) so that only the Project Field Team Leader has access to the location or under the constant visual surveillance of the same.

SAMPLE SHIPPING PROCEDURE

1. Fill out the chain-of-custody form completely (see attached sample) with all relevant information. The white original goes with the samples and should be placed in a resealable plastic bag and taped inside the sample cooler lid; the sampler should retain the copy.

2. Place a layer of inert cushioning material such as bubble pack in the bottom of cooler.

3. Place each bottle in a bubble wrap sleeve or other protective wrap. To the extent practicable, then place each bottle in a resealable plastic bag.

4. Open a garbage bag (or similar) into a cooler and place sample bottles into the garbage bag (or similar) with volatile organic analysis (VOA) vials near the center of the cooler.

5. Pack bottles with ice in plastic bags. At packing completion, cooler should be at least 50 percent ice, by volume. Coolers should be completely filled, so that samples do not move excessively during shipping.

6. Duct tape (or similar) cooler drain closed and wrap cooler completely in two or more locations to secure lid, specifically covering the hinges of the cooler.

7. Place laboratory label address identifying cooler number (i.e., 1 of 4, 2 of 4 etc.) and overnight delivery waybill sleeves on cooler lid or handle sleeve (Federal Express).

8. Sign the custody seal tape with an indelible soft-tip marker and place over the duct tape across the front and back seam between the lid and cooler body.

9. Cover the signed custody seal tape with an additional wrap of transparent strapping tape.

10. Place "Fragile" and "This Side Up" labels on all four sides of the cooler. "This Side Up" labels are yellow labels with a black arrow with the arrowhead pointing toward the cooler lid.

11. For coolers shipped by overnight delivery, retain a copy of the shipping waybill, and attach to the chain-of-custody documentation.

ATTACHMENTS

Soil/Sediment Sample Summary Collection Log (sample)
Groundwater/Surface Water Sample Summary Collection Log (sample)
Wipe Sample Summary Collection Log (sample)
Air Sample Summary Collection Log (sample)
Chain-Of-Custody Form (sample)

REFERENCES

None

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

AIR SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. SC - Summa Canister.
3. TB - Tedlar Bag (quantity).
4. No Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blanks, Field Duplicates, Field Blanks or Rinsates collected for air samples.

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

CHAIN OF CUSTODY RECORD

Project No.	Project Name					Number of Containers	VOCs	SVOCs	Metals						REMARKS
Samplers (Signature)															
No.	Date	Time	comp	grab	Sample Identification										

Possible Hazard Identification:
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal:
☐ Return to Client ☐ Disposal by Lab ☐ Archive _____(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐

QC Level:
I. ☐ II. ☐ III. ☐ Project Specific (specify):_____

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

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

WIPE SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. FD - Field Duplicate.
4. FB - Field Blank.
5. RS - Rinsate.
6. No Matrix Spike, Matrix Spike Duplicate or Matrix Spike Blanks for wipe samples.
7. Rinsates should be taken at a rate of 1 per day during wipe sampling. Only take when reusable equipment is used.
8. Wipe sample FB collected by wiping unused glove and any other sampling equipment coming into contact with sampled surface) with prepared gauze pad and place in sample jar. Take at a rate of 1 FB per 20 samples.
9. Wipe sample FDs taken adjacent to original sample at a rate of 1 FD per 20 samples.
10. **EH :** Extract and Hold

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

AIR SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. SC - Summa Canister.
3. TB - Tedlar Bag (quantity).
4. No Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blanks, Field Duplicates, Field Blanks or Rinsates collected for air samples.

SAMPLE

SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

CHAIN OF CUSTODY RECORD

Project No.	Project Name					Number of Containers	VOCs	SVOCs	Metals						REMARKS
Samplers (Signature)															
No.	Date	Time	comp	grab	Sample Identification										

Possible Hazard Identification:
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal:
☐ Return to Client ☐ Disposal by Lab ☐ Archive _____(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐

QC Level:
I. ☐ II. ☐ III. ☐ Project Specific (specify):_____

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

SAMPLE

BENCHMARK
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FIELD OPERATING PROCEDURES

Screening of Soil Samples for Organic Vapors During Drilling Activities

FOP 047.0

SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

PURPOSE

This procedure is used to screen soil samples for the presence of volatile organic constituents (VOCs) using a field organic vapor meter. These meters will be either photoionization detector (PID) or flame-ionization detector (FID) type. This screening is performed at the drilling and sampling location as a procedure for ensuring the health and safety of personnel at the site and to identify potentially contaminated soil samples for laboratory analysis. All soil samples will be field screened to provide a vertical profile of soil contamination by volatile organic substances.

PROCEDURE

1. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Collect split-spoon (or other sampler) samples in accordance with Benchmark's Split Spoon Sampling Procedure FOP.

3. When the split-spoon or other sampler is opened or accessed, shave a thin layer of material from the entire length of the core.

4. Scan the core visually and with the PID or FID noting stratification, visible staining, or other evidence of contamination.

5. Based on this initial scan of the sample, collect approximately 100 milliliters (ml) of soil using a decontaminated or dedicated stainless steel spatula, scoop, or equivalent. Place this soil into a labeled wide-mouth glass jar approximately ½ to ¾ full and seal with aluminum foil and a screw top cap. Alternatively, the soil may be placed into a clean, re-sealable plastic bag and sealed. Be sure to leave some headspace above the soil sample within the sealed container.

6. Place field screening sample (i.e., jar or bag) in a location where the ambient temperature is at least 70° Fahrenheit.

7. Leave the field screening sample bag for at least 30 minutes, but no more than 60 minutes.

8. Carefully remove the screw top cap from the jar and slowly insert the tip of the organic vapor meter (PID or FID) through the aluminum foil seal making the smallest hole possible. Alternatively, unseal a portion of the plastic bag just big enough to insert the probe of a calibrated PID.

9. Record the maximum reading in parts per million by volume (ppmv) on the Field Borehole Log or Field Borehole/Monitoring Well Installation Log form (see attached samples) (see Documentation Requirements for Drilling and Well Installation FOP), at the depth interval corresponding to the depth of sample collection.

ATTACHMENTS

Field Borehole Log (sample)
Field Borehole/Monitoring Well Installation Log (sample)

REFERENCES

Benchmark FOPs:

010 *Calibration and Maintenance of Portable Flame Ionization Detector*
011 *Calibration and Maintenance of Portable Photoionization Detector*
015 *Documentation Requirements for Drilling and Well Installation*
058 *Split Spoon Sampling Procedures*

SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD BOREHOLE LOG

PROJECT:		**Log of Boring No.:**	
BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:	SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST: / COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

Depth (bgs)	SAMPLES: Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery	PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	REMARKS

SAMPLE

ABANDONMENT:			
Volume of cement/bentonite grout required:	$V = \pi r^2 \times 7.48 =$	gallons	borehole depth = ft.
Volume of cement/bentonite grout installed:		gallons	borehole diameter = ft.
Has bridging of grout occurred?	☐ yes ☐ no		borehole radius = ft.
If yes, explain resolution:			
Method of installation:			
Project No:	**Benchmark Environmental Engineering & Science, PLLC**		Figure

SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

PROJECT:		**Log of Well No.:**	
BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:	SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST: / COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

Depth (fbgs)	SAMPLES: Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery	PID Scan (ppm)	SAMPLE DESCRIPTION (USCS Classification: Color, Moisture Condition, % of Soil Type, Plasticit… Fabric, Bedding, Weathering/Fracturing, Odor, Oth…)	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
							SURFACE ELEVATION (FMSL):	

SAMPLE

Project No:	Benchmark Environmental Engineering & Science, PLLC	Figure

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FIELD OPERATING PROCEDURES

Soil Description Procedures Using The Visual-Manual Method

FOP 054.2

SOIL DESCRIPTION PROCEDURES USING THE VISUAL-MANUAL METHOD

PURPOSE

This guideline presents a means for insuring consistent and proper field identification and description of collected soils during a project (via, split-spoon (barrel) sampler, hand auger, test pit etc.). The lithology and moisture content of each soil sample will be physically characterized by visual-manual observation in accordance with ASTM Method D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). When precise classification of soils for engineering purposes is required, the procedures prescribed in ASTM Method D2487 (Standard Practice for Classification of Soils for Engineering Purposes [Unified Soil Classification System, USCS]) will be used. The method of soil characterization presented herein describes soil types based on grain size, liquid and plastic limits, and moisture content based on visual examination and manual tests. When using this FOP to classify soil, the detail of description provided for a particular material should be dictated by the complexity and objectives of the project. However, more often than not, "after the fact" field information is required later in the project, therefore, every attempt to describe the soil as completely as possibly should be made.

Intensely weathered or decomposed rock that is friable and can be reduced to gravel size or smaller by normal hand pressure should be classified as a soil. The soil classification would be followed by the parent rock name in parenthesis. Projects requiring depth to bedrock determinations should always classify weathered or decomposed bedrock as bedrock (i.e., landfill siting). The project manager should always be consulted prior to making this determination.

PROCEDURE

Assemble necessary equipment and discuss program requirements with drilling contractor.

1. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Collect desired soil sample in accordance with appropriate Benchmark FOP (i.e., split-spoon sampling, hand augering, test pitting etc.).

3. Shave a thin layer off the entire length of the sample to expose fresh sample.

4. Photograph and scan the sample with a photoionization detector (PID) at this time, if applicable, in accordance with Benchmark's Screening of Soil Samples for Organic Vapors During Drilling Activities FOP.

5. Describe the sample using terminology presented in the Descriptive Terms section below.

6. Record all pertinent information in the Project Field Book and Field Borehole Log (sample attached) or Field Borehole/Monitoring Well Installation Log (sample attached).

7. After the sample has been described, place a representative portion of the sample in new, precleaned jars or self-sealing plastic bags for archival purposes (if required). Label the jar or bag with the sample identification number, sample interval, date, project number and store in a secure location.

8. If the soil is to be submitted to a laboratory for analysis, collect the soil sample with a dedicated stainless steel sampling tool, place the sample into the appropriate laboratory-supplied containers, and store in an ice-chilled cooler staged in a secure location in accordance with Benchmark's Sample Labeling, Storage and Shipment Procedures FOP.

9. All remaining soil from soil sample collection activities shall be containerized in accordance with Benchmark's Management of Investigative-Derived Waste (IDW) FOP and/or the Project Work Plan.

DESCRIPTIVE TERMS

All field soil samples will be described using the Unified Soil Classification System (USCS) presented in Figures 1 and 2 (attached). In addition to ASTM Method D2488, Method D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils (a.k.a., Standard Penetration Test, STP), when implemented, can also be used to classify the resistance of soils. In certain instances, it is desirable to supplement the USCS classification with a geologic interpretation of the soil sample that is supported by the soil descriptive terms presented in this section. The project manager should be consulted when making any geologic interpretation. Field test methods are provided to assist field personnel in classifying soil and are identified by a bold blue **FTM** and shaded. Classification of sampled soils will use the following ASTM descriptive terms and criteria:

- **Group Name** (USCS, see Figure 2)
- **Group Symbol** (USCS, see Figure 2) – only use if physical laboratory testing has been performed to substantiate. The USCS can be applied to most unconsolidated materials, and is represented by a two-letter symbol, except Peat (Pt).
  - The first letter includes: G (gravel), S (sand), M (silt), C (clay), and O (organic).
  - The second letter includes: P (poorly graded or uniform particle sizes), W (well graded or diversified particle sizes), H (high plasticity), and L (low plasticity).
  - Examples:
    - GW = well graded gravels and gravel-sand mixtures, little or no fines
    - GP = poorly graded gravels and gravel-sand mixtures, little or no fines
    - GM = silty gravels, gravel-sand-silt mixtures

- GC = clayey gravels, gravel-sand-clay mixtures
- SW = well graded sands and gravelly sands, little or no fines
- SP = poorly graded sands and gravelly sands, little or no fines
- SM = silty sand, sand-silt mixtures
- SC = clayey sand sand-clay mixtures
- ML = inorganic silts, very fine sands, rock flour, silty or clayey fine sands
- CL = inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
- OL = organic silts and organic silty clays of low plasticity
- MH = inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts (very rare)
- CH = inorganic clays of high plasticity, fat clays
- OH = organic clays of medium to high plasticity
- Pt = peat, muck, and other highly organic soils

- **Angularity** (ASTM D2488; Table 1)
  - Angular – particles have sharp edges and relatively planar sides with unpolished surfaces
  - Subangular – particles are similar to angular description but have rounded edges
  - Subrounded – particles have nearly planar sides but have well-rounded corners and edges
  - Rounded – particles have smoothly curved sides and no edges
- **Particle Shape** (ASTM D2488; Table 2)
  - Flat – particles with width/thickness > 3
  - Elongated – particles with length/width > 3
  - Flat and Elongated – particles meet criteria for both flat and elongated
- **Moisture Condition** (ASTM D2488; Table 3)
  - Dry – absence of moisture, dusty, dry to the touch
  - Moist – damp, but no visible water
  - Wet – visible free water, usually soil is below water table
- **Reaction with Hydrochloric Acid (HCL)** (ASTM D2488; Table 4)
  - None – no visible reaction

- Weak – some reaction, with bubbles forming slowly
- Strong – violent reaction, with bubbles forming immediately

- **Consistency of Cohesive Soils** (ASTM D2488; Table 5)
  - Very soft – squeezes between fingers when fist is closed; easily penetrated several inches by fist (SPT = 2 or less)
  - Soft – easily molded by fingers; easily penetrated several inches by thumb (SPT = 2 to 4)
  - Firm – molded by strong pressure of fingers; can be penetrated several inches by thumb with moderate effort (SPT = 4 to 8)
  - Stiff – dented by strong pressure of fingers; readily indented by thumb but can be penetrated only with great effort (SPT = 8 to 15)
  - Very stiff – readily indented by thumbnail (SPT = 15 to 30)
  - Hard – indented with difficultly by thumbnail (SPT >30)
- **Cementation** (ASTM D2488; Table 6)
  - Weak – crumbles or breaks with handling or slight finger pressure
  - Moderate – crumbles or breaks with considerable finger pressure
  - Strong – will not crumble or break with finger pressure
- **Structure (Fabric)** (ASTM D2488; Table 7)
  - Varved – alternating 1 mm to 12 mm (0.04 – 0.5 inch) layers of sand, silt and clay
  - Stratified – alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
  - Laminated – alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
  - Fissured – contains shears or separations along planes of weakness
  - Slickensided – shear planes appear polished or glossy, sometimes striated

- Blocky – cohesive soil that can be broken down into small angular lumps which resist further breakdown
- Lensed – inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
- Homogeneous or Massive – same color and appearance throughout

- **Inorganic Fine-Grained Soil Characteristics** (ASTM D2488; Table 12)

  Several field tests can be performed to determine the characteristics of fine-grained soils (material passing the No. 40 sieve), such as dry strength, dilatency, and toughness. These field testing methods are described below.

  - **Dry Strength** (ASTM D2488; Table 8)

    FTM (Dry Strength): Select enough material and moisten with water until it can be molded or shaped without sticking to your fingers (slightly below the sticky limit) into a ball about 1 inch in diameter. From this ball, form three balls about ½ inch in diameter and allow to dry in air, or sun, or by artificial means (temperature not to exceed 60° C (140° F). Soil containing natural dry lumps about ½ inch in diameter may be used in place of molded balls, however the dry strengths are usually lower. Test the strength by crushing the dry balls or lumps between your fingers using the descriptions below.

    - None – the dry specimen crumbles with the slightest pressure of handling
    - Low – the dry specimen crumbles with some finger pressure
    - Medium – the dry specimen breaks into pieces or crumbles with considerable finger pressure
    - High – the dry specimen cannot be broken with finger pressure. The specimen will break into pieces between the thumb and a hard surface.
    - Very High – the dry specimen cannot be broken between the thumb and a hard surface

  - **Dilatency** (ASTM D2488; Table 9)

    FTM (Dilatency): Place enough material in your hand to form a ball approximately ½ inch in diameter and moisten with water until it can be

molded or shaped without sticking to your fingers (slightly below the sticky limit). Smooth the ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other several times. Note the reaction of water appearing on the surface of the soil. The soil is said to have given a reaction to this test if, when it is shaken, water comes to the surface of the sample producing a smooth, shiny appearance. Squeeze the sample between the thumb and forefinger and note the reaction as follows:

- None – no visible change in the specimen
- Slow – water slowly appears on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
- Rapid – water quickly appears on the surface of the specimen during shaking and disappears upon squeezing

- **Toughness** (ASTM D2488; Table 10)

FTM (Toughness): Following the dilatency test above, shape the test specimen into an elongated pat and roll by hand on a smooth surface or between palms into a thread about 1/8 inch in diameter. Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch (e.g., near the plastic limit). Note the pressure required to roll the thread near the plastic limit as well as the strength of the thread. After the thread crumbles, lump the pieces together and knead the lump until it crumbles. Describe the toughness as follows:

- Low – only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and very soft.
- Medium – medium pressure is required to roll the thread to near the plastic limit. The thread and the lump are soft.
- High – considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump are firm.

Using the results of the dry strength, dilatency, and toughness test described above, classify the soil according to the following:

Soil Symbol	Dry Strength	Dilatency	Toughness
Silt (ML)	None to low	Slow to rapid	Low or thread cannot be formed
Lean clay (CL)	Medium to high	None to slow	Medium
Elastic Silt (MH)	Low to medium	None to slow	Low to medium
Fat Clay (CH)	High to very high	None	Low to medium high

- **Plasticity** (ASTM D2488; Table 11)

  Two field test methods can be used to determine plasticity of fine-grained soils (material passing the No. 40 sieve): the roll or thread test and the ribbon test. Each test is described below.

  FTM (Roll or Thread Test): As with the toughness test above, mix a representative portion of the soil sample with water until it can be molded or shaped without sticking to your fingers (slightly below the sticky limit). Place an elongated cylindrical sample on a nonabsorbent rolling surface (e.g., glass or was paper on a flat surface) and attempt to roll it into a thread approximately 1/8 inch in diameter. The results of this test are defined below (non-plastic to high plasticity).

  FTM (Ribbon Test): Form a roll from a handful of moist soil (slightly below the sticky limit) about ½ to ¾ inches in diameter and about 3 to 5 inches long. Place the material in the palm of your hand and, starting at one end, flatten the roll between your thumb and forefinger to form the longest and thinnest ribbon possible that can be supported by the cohesive properties of the material before breaking. If the soil sample holds together for a length of 6 to 10 inches without breaking, the material is considered to be both highly plastic and highly compressive (Fat Clay, CH). If the soil cannot be ribboned, it is non-plastic (Silt, ML or MH). If it can be ribboned only with difficulty into short lengths, it has low plasticity (Lean Clay, CL). Use the following terms to describe the plasticity of soil:

- Nonplastic (ML or MH) – a 3 mm (0.12 inches) thread cannot be rolled at any water content
- Low Plasticity (CL, ML, or MH) – the thread can barely be rolled, and crumbles easily
- Medium Plasticity (CL) – the thread is easy to roll and not much time is required to reach the plastic limit before crumbling
- High Plasticity (CH) – it takes considerable time rolling and kneading to reach the plastic limit; the thread can be rolled several times before crumbling

Note: A soil with as little as 20% clay will behave as a clayey soil. A soil needs 45% to over 60% medium to coarse sand to behave as a sandy soil. In a soil with 20% clay and 80% sand, the soil will behave as a clayey soil.

- **Relative Density of Cohesionless (Granular) Soils**
  - Very loose – easily penetrated 30 cm (1.2 inches) with 13 mm (0.5 inch) rebar pushed by hand (SPT = 0 to 4)
  - Loose – easily penetrated several cm with 13 mm (0.5 inch) rebar pushed by hand (SPT = 4 to 10)
  - Medium dense – easily to moderately penetrated with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = 10 to 30)
  - Dense – penetrated 0.3 m (1 foot) with difficulty using 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = 30 to 50)
  - Very dense – penetrated only a few cm with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = >50)
- **Color** (use Munsel® Color System, as necessary)
- **Particle Size** (see Figure 3)
  - Boulder – larger than a basketball
  - Cobble – grapefruit, orange, volleyball
  - Coarse Gravel – tennis ball, grape

- Fine Gravel – pea
- Coarse Sand – rock salt
- Medium Sand – opening in window screen
- Fine Sand – sugar, table salt
- Fines (silt and clay) – cannot visually determine size (unaided)

- **Gradation**
  - Well Graded (GW, SW) – full range and even distribution of grain sizes present
  - Poorly-graded (GP, SP) – narrow range of grain sizes present
  - Uniformly-graded (GP, SP) – consists predominantly of one grain size
  - Gap-graded (GP-SP) – within the range of grain sizes present, one or more sizes are missing

- **Organic Material** – Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread of the toughness test will be spongy.
  - PEAT – 50 to 100 percent organics by volume, primary constituent
  - Organic (soil name) – 15 to 50 percent organics by volume, secondary organic constituent
  - (Soil name) with some organics – 5 to 15 percent organics by volume, additional organic constituents

- **Fill Materials** – All soils should be examined to see if they contain materials indicative of man-made fills. Man-made fill items should be listed in each of the soil descriptions. Common fill indicators include glass, brick, dimensioned lumber, concrete, pavement sections, asphalt, metal, plastics, plaster etc. Other items that could suggest fill include buried vegetation mats, tree limbs, stumps etc. The soil description for a fill material should be followed by the term "FILL", i.e., for a sandy silt with some brick fragments the description would be "SANDY

SILT (ML), with brick fragments (Fill)". The size and distribution of fill indicators should be noted. The limits (depth range) of fill material should be determined and identified at each exploration location.

- **Other Constituents/Characteristics**
  - Additional constituents and/or pertinent soil characteristics not included in the previous categories should be described depending on the scope and objectives of the project. Observations that may be discussed include:
    - Oxide staining
    - Odor
    - Origin
    - Presence of root cast
    - Presence of mica
    - Presence of gypsum
    - Presence of calcium carbonate
    - Percent by volume of cobbles & boulders with size description and appropriate rock classification
  - Other pertinent information from the exploratory program should be recorded, if it would be useful from a biddability/constructability perspective. The conditions that should be listed include caving or sloughing, difficulty in drilling and groundwater infiltration.

SOIL DESCRIPTIONS

Generally, soil descriptions collected during most investigations are not intended for civil engineering (construction) purposes, but rather for hydrogeologic and contaminant transport purposes. As such, the ASTM visual-manual assessments are somewhat limited in that they are only performed in order to indicate important information about potential hydraulic properties of a soil. Soil descriptions should be concise, stressing major constituents and

characteristics, and should be given in a consistent order and format. The following order is recommended:

- Soil name. The basic name of the predominant grain size and a single-word modifier indicating the major subordinate grain size (i.e., mostly clay with some silt). The feel test can be used to determine the texture of the soil by rubbing some moist soil between your fingers; sand feels gritty, silt feels smooth, and clays feel sticky. The terms representing percentages of grain size to be used include:
    - Trace – particles are present, but estimated to be less than 5%
    - Few – 5 to 10%
    - Little – 15 to 25%
    - Some – 30 to 45%
    - Mostly – 50 to 100%
- Color (using Munsell® charts, as necessary). Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. It the sample contains layers or patches of varying colors (e.g., mottled), this shall be noted and all representative colors shall be described. The color shall be described for moist samples, however if the color represents a dry condition, it must be stated as such in the log. Generally, colors become darker as the moisture content increases and lighter as the soil dries. Examples include:
    - Some fine-grained soils (OL, OH) with dark drab shades of brown or gray, including almost black, contain organic colloidal matter.
    - In contrast, clean, bright looking shades of gray, olive green, brown, red, yellow, and white are associated with inorganic soils.
    - Gray-blue or gray- and yellow-mottled colors frequently result from poor drainage.
    - Red, yellow, and yellowish brown result from the presence of iron oxides.

  - White to pink may indicate considerable silica, calcium carbonate, or aluminum compounds.

- Field moisture condition as dry, moist, or wet;
- Gradation or Plasticity. Granular soils (i.e., sands or gravels) should be described as well-graded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soils (i.e., silts and clays) should be described as non-plastic, low, medium, or high, depending on the results of the manual evaluation for dry strength, dilatency, toughness, and plasticity discussed previously.
- Consistency/Density. An estimate of consistency of a cohesive soil or density of a granular soil, usually based on the SPT results (see Descriptive Terms section of this FOP);
- Soil Structure or Mineralogy. Description of discontinuities, inclusions, and structures, including joints, fissures, and slickensides.
- Odor. Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum, chemical, etc.), it should be noted in the log.
- Other important geologic information such as consolidation, gravel size and shape, visible internal structure, root holes, mica, odors, etc.

The first step when describing soil is to determine if the sample is predominantly fine-grained or coarse-grained (see Figures 3 and 4). Coarse-grained soils are relatively easy to identify, however descriptions of fine-grained soils can be more difficult, requiring additional field tests to assist the field geologist arrive at the proper soils classification (see **FTMs** under Descriptive Terms above). These tests are explained in detail in the ASTM Standard D2488 and briefly herein. Generally, the differentiation between silt and clay is based on plasticity and "texture". However, tests for dry strength and dilatency, along with plasticity,

can be very helpful and are recommended in the ASTM Standard. If additional tests are performed, in addition to plasticity, to classify the fines, record them with the soil description on the logs. Doing this will assist the reader (i.e., Project Manager) to follow the logic used to describe a soil (e.g., medium plasticity, low dry strength = elastic silt [MH]; not a lean clay [CL]).

Fines described in the classification should be modified by their plasticity (e.g., non-plastic fines, low plasticity fines, etc.) reserving the words "silt" and "clay" for the soil name.

In summary, adhering to the ASTM Standard and the guidelines outlined in this FOP will provide uniformity in soil descriptions provided by all field personnel. Prior to mobilization to the field, field staff should make sure to have laminated copies of the ASTM Standard flow charts and tables as well as this FOP (as necessary). Some examples of complete soil descriptions are as follows:

Coarse-grained Soil

POORLY GRADED FINE SAND w/ SILT: Dark grey, wet, mostly fine sand with some non-plastic fines, some iron-stained mottling, laminated, medium dense

Fine-grained Soil

LEAN CLAY: Dark reddish/brown, moist, mostly fines, medium plasticity, firm, no dilatency, medium dry strength, root holes.

Soil/Fill (option 1) – visual evidence of fill

FILL: Black, moist, mostly fines with some fine sand, slag, cinders, metal, brick, non-plastic, loose when disturbed, strong odor

Soil/Fill (option 2) – no visual evidence of fill, suspected reworked material

FILL (reworked): Black, moist, mostly fines with some fine sand and few coarse angular gravel, non-plastic, hard, loose when disturbed, mild odor

BORING AND MONITORING WELL INSTALLATION LOGS

Currently, Benchmark utilizes WinLoG software to construct subsurface logs and a template of the log is included in this FOP as an example. One of the most important functions of a boring/monitoring well installation log, besides transmitting the soil description, is to indicate where the "data" (soil samples) were collected, giving the reader an idea of how reliable or representative the description is. On each sample log, depths of attempted and recovered or non-recovered interval are shown. Odor, if noted, should be considered subjective and not necessarily indicative of specific compounds or concentrations.

Remember: all field logs should be NEAT, ACCURATE, and LEGIBLE. Don't forget that the well completion diagram completed for each well requires details of the surface completion (i.e., flush-mount, stick-up etc.). It is the responsibility of the field staff to double-check each log (i.e., soil names, classifications, well construction details etc.) prior to implementing into a final report. A registered professional (i.e., professional engineer, PE or professional geologist, PG) must review each log and will be ultimately responsible for its content and accuracy.

REQUIRED EQUIPMENT

- Knife
- Engineer's rule/measuring tape

- Permanent marker
- Pre-cleaned wide-mouth sample jars (typically provided by the driller)
- Pre-cleaned wide-mouth laboratory sample jars (provided by the laboratory)
- Stainless steel sampling equipment (i.e., spoons, spatulas, bowls etc.)
- 10x hand lens
- Hydrochloric acid
- ASTM D2488 flow charts (preferably laminated)
- ASTM D2488 test procedures (Tables 1 through 12) (preferably laminated)
- Camera (disposable, 35 mm or digital)
- Munsell soil color chart (as necessary)
- Project Field Book/field forms

ATTACHMENTS

Figure 1; Field Guide for Soil and Stratigraphic Analysis
Figure 2; USCS Soil Classification Flow Chart (modified from ASTM D2488)
Figure 3; Illustration of Particle Sizes
Figure 4; Grain-Size Scale (Modified Wentworth Scale)

Field Borehole Log (sample)

REFERENCES

American Society for Testing and Materials, 2008a. *ASTM D1586: Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.*

American Society for Testing and Materials, 2010. *ASTM D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).*

American Society for Testing and Materials, 2009a. *ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*

State of California, Department of Transportation, Engineering Service Center, Office of Structural Foundations, August 1996. *Soil & Rock Logging Classification Manual (Field Guide), by Joseph C. de Larios.*

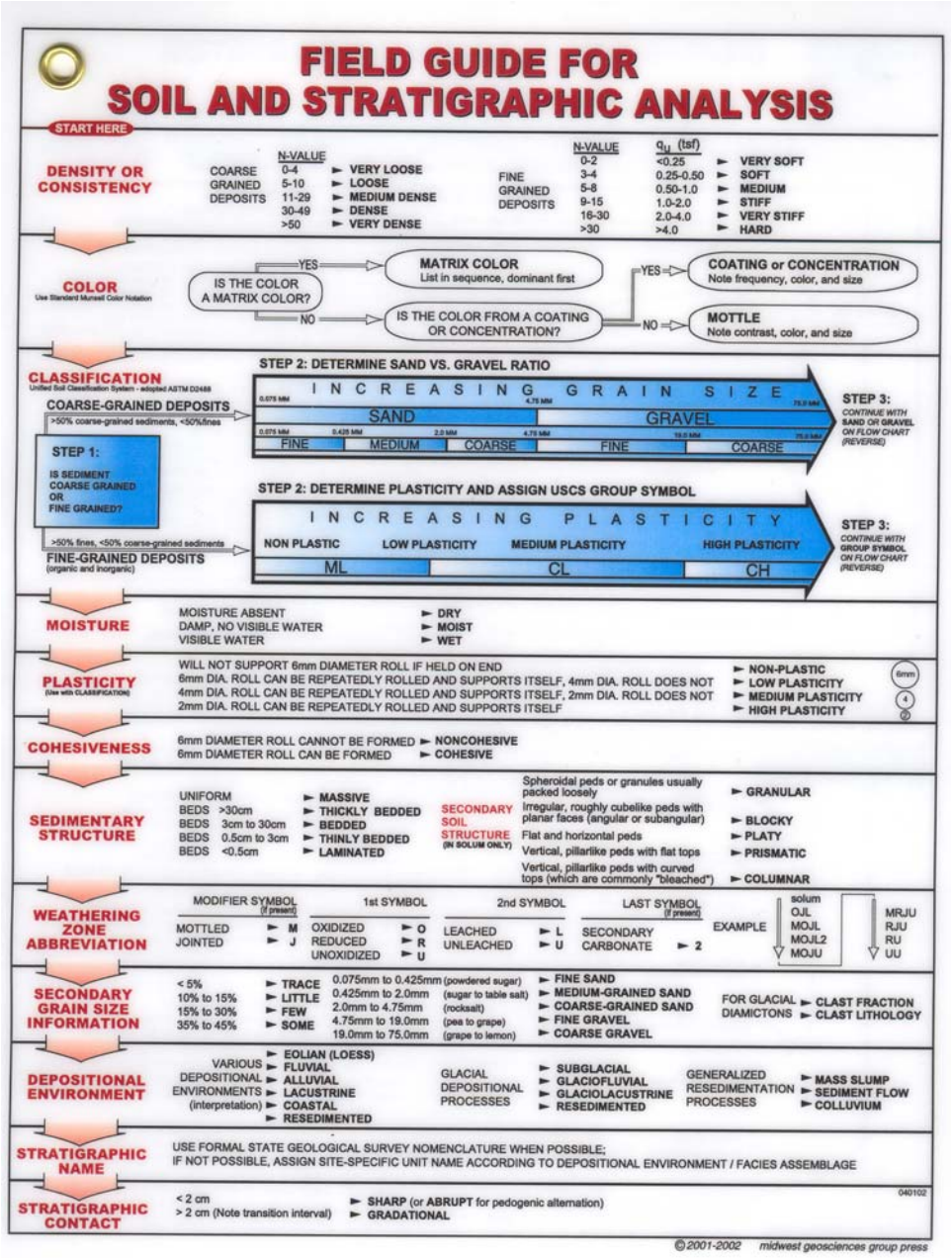
Benchmark FOPs:

010 Calibration and Maintenance of Portable Flame Ionization Detector
011 Calibration and Maintenance of Portable Photoionization Detector
015 Documentation Requirements for Drilling and Well Installation
025 Hand Augering Procedures
032 Management of Investigation-Derived Waste
046 Sample Labeling, Storage and Shipment Procedures
047 Screening of Soil Samples for Organic Vapors During Drilling Activities
058 Split-Spoon Sampling Procedures
065 Test Pit Excavation and Logging Procedures

SOIL DESCRIPTION PROCEDURES USING THE VISUAL-MANUAL METHOD

FIGURE 1

FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS



SOIL DESCRIPTION PROCEDURES USING THE VISUAL-MANUAL METHOD

FIGURE 2

USCS SOIL CLASSIFICATION FLOW CHART (MODIFIED FROM ASTM D2488)

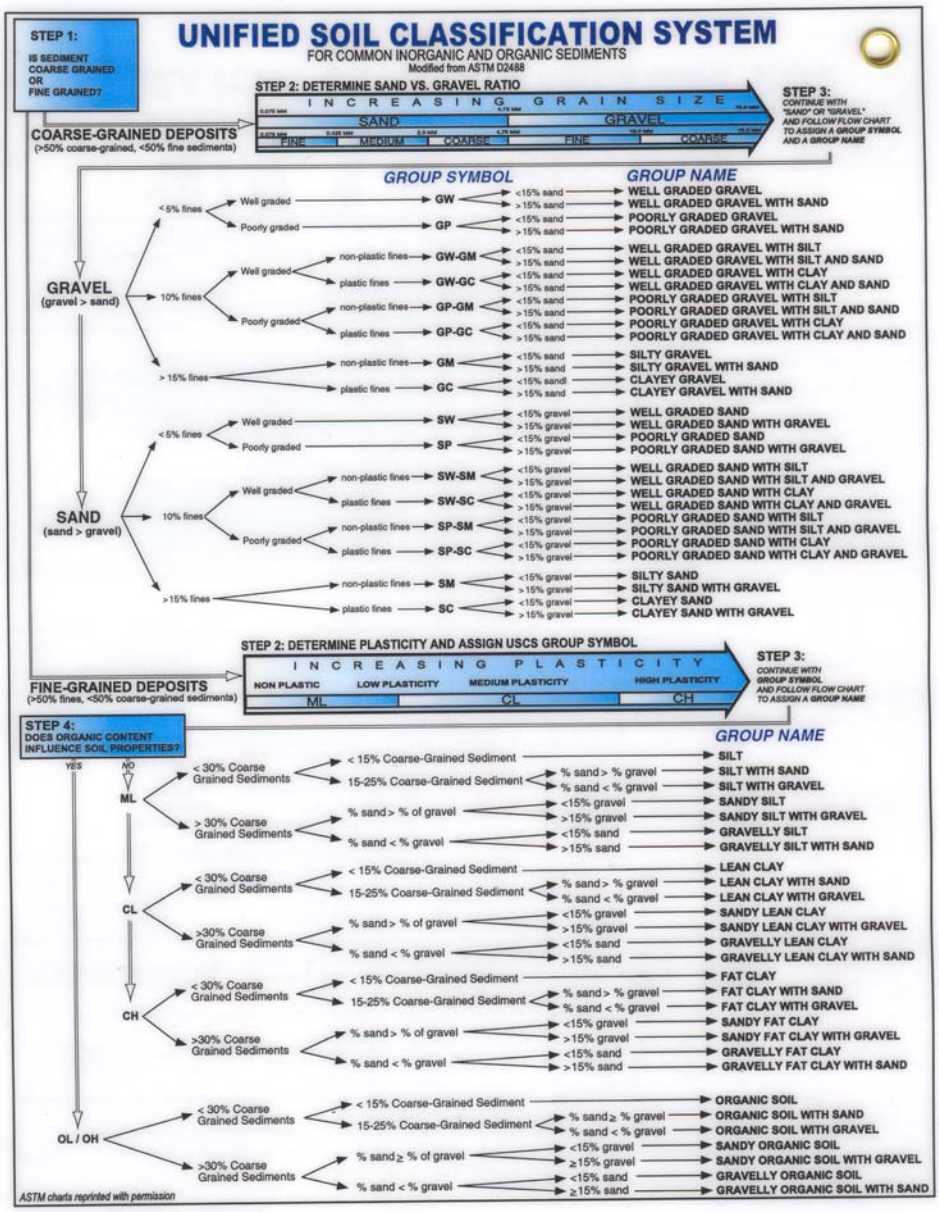


FIGURE 3

ILLUSTRATION OF PARTICLE SIZES

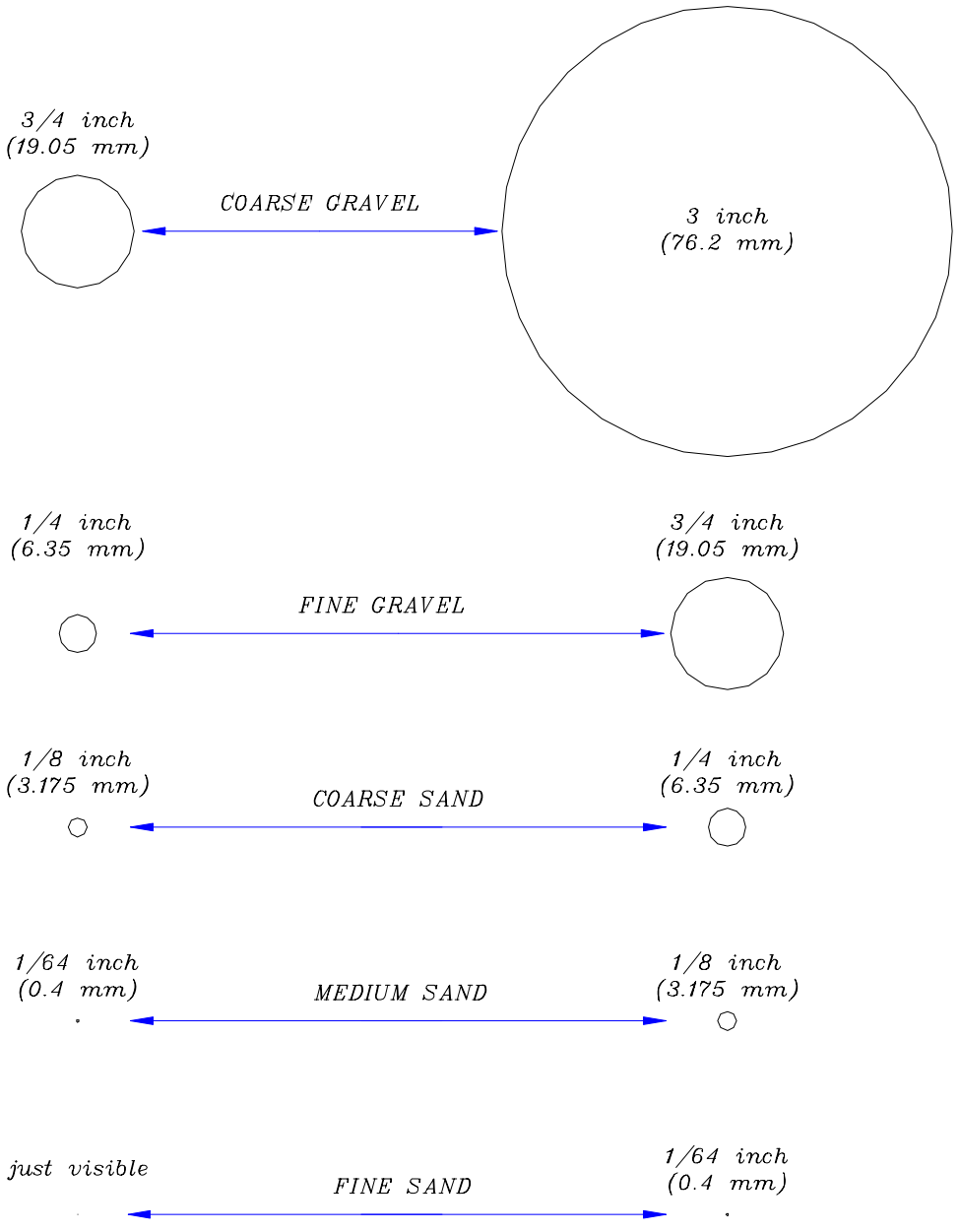


FIGURE 4

GRAIN-SIZE SCALE (MODIFIED WENTWORTH SCALE)

Grain size refers to the physical dimensions of particles of rock or other solid. This is different from the crystallite size, which is the size of a single crystal inside the solid (a grain can be made of several single crystals). Grain sizes can range from very small colloidal particles, through clay, silt, sand, and gravel, to boulders. Size ranges define limits of classes that are given names in the Wentworth scale used in the United States. The Krumbein *phi* (φ) scale, a modification of the Wentworth scale created by W. C. Krumbein, is a logarithmic scale computed by the equation: $\varphi = -\log_2(\text{grain size in mm})$.

φ scale	Size range (metric)	Size range (approx. inches)	Aggregate name (Wentworth Class)
< −8	> 256 mm	> 10.1 in	Boulder
−6 to −8	64–256 mm	2.5–10.1 in	Cobble
−5 to −6	32–64 mm	1.26–2.5 in	Very coarse gravel
−4 to −5	16–32 mm	0.63–1.26 in	Coarse gravel
−3 to −4	8–16 mm	0.31–0.63 in	Medium gravel
−2 to −3	4–8 mm	0.157–0.31 in	Fine gravel
−1 to −2	2–4 mm	0.079–0.157 in	Very fine gravel
0 to −1	1–2 mm	0.039–0.079 in	Very coarse sand
1 to 0	½–1 mm	0.020–0.039 in	Coarse sand
2 to 1	¼–½ mm	0.010–0.020 in	Medium sand
3 to 2	125–250 µm	0.0049–0.010 in	Fine sand
4 to 3	62.5–125 µm	0.0025–0.0049 in	Very fine sand
8 to 4	3.90625–62.5 µm	0.00015–0.0025 in	Silt
> 8	< 3.90625 µm	< 0.00015 in	Clay
<10	< 1 µm	< 0.000039 in	Colloid

In some schemes "gravel" is anything larger than sand (>2.0 mm), and includes "granule", "pebble", "cobble", and "boulder" in the above table. In this scheme, "pebble" covers the size range 4 to 64 mm (−2 to −6 φ).

FOP 054.2

SOIL DESCRIPTION PROCEDURES
USING THE VISUAL-MANUAL METHOD

Project No: **Borehole Number:**

Project:

Client: *Logged By:*

Site Location: *Checked By:*

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

Benchmark Environmental Engineering & Science, PLLC
726 Exchange Street, Suite 624
Buffalo, NY
(716) 856-0599

SUBSURFACE PROFILE			SAMPLE						
Elev. /Depth	Symbol	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol	PID VOCs ppm 0 25 50	Lab Sample	Well Completion Details or Remarks
0.0 / 0.0		Ground Surface							

SAMPLE

Drilled By: *Hole Size:*
Drill Rig Type: *Stick-up:*
Drill Method: *Datum:*

Drill Date(s): *Sheet: 1 of 1*

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

FIELD OPERATING PROCEDURES

Soil Sample Collection for VOC Analysis (EnCore Sampling)

FOP 057.0

SOIL SAMPLE COLLECTION FOR VOC ANALYSIS – ENCORE SAMPLING

BACKGROUND AND PURPOSE

This procedure describes the methods for collecting soil samples for VOC analysis to ensure that the sample adequately represents the VOC concentrations in the soil in accordance with SW-846 Method 5035A (effective July 1, 2002). These compounds tend to volatilize from the soil after disturbance or introduction to the atmosphere. Therefore, care must be exercised to ensure that the sample collected is not altered during the collection and storage procedures. A variety of sampling options are allowed and Appendix A of Method 5035A provides details regarding the many options available for sample collection. The collection and preservation procedures are intended to prevent loss of VOCs during sample transport, handling and analysis.

Method 5035A is a method designed for volatile sample collection and analysis of soils and solid wastes for volatile organic compounds. This method is described in Update III to the Third Edition of SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, and is required for all analytical methods using purge and trap techniques (8021, 8015B, and 8260B). Alternative protocols may be used in some states (including New York), however this method is strongly recommended.

The volatile analysis is performed over two ranges:

	GC/MS (µg/kg)	GC (µg/kg)
Low Level	5 – 300	Not Available
High Level	>250	>20

The different levels require different sampling techniques. The low level method can only handle samples within a specific concentration range (these samples CANNOT be diluted), therefore a high level sample MUST be collected to ensure that all the target analytes can be quantified.

Naturally occurring carbonates in some soils may cause effervescence (foaming) on contact with the sodium bisulfate (NaHSO4) solution used as preservative for the low-level preparation. This interference makes it necessary for the laboratory to use the high-level prep or an alternative technique for low level. Check with the NYSDEC to discuss acceptable options.

Typically, analytical laboratories will support the following options for the two levels:

Option	No. of Containers	Sample Size (g)	Holding Time (days)
A – Low Level EnCore™ Samplers	3*	5	14**
B – High Level EnCore™ Sampler	1*	5	14**
C – High Level Methanol vial w/syringe	1	10	14

* Additional EnCore™ Samplers are required for MS/MSD.

** The sample MUST be extracted and preserved in sodium bisulfate or methanol within 48 hours of collection.

NOTE: The EnCore™ Sampler is disposable – it can only be used ONCE. It CANNOT be cleaned and/or reused. The samplers MUST be used in conjunction with an EnCore™ T-handle.

PROCEDURE

The preferred method for collecting and storing a soil sample for VOC analysis is using the EnCore™ method. This field procedure is described in this FOP.

1. The sampling team should reference the manufacturers' directions prior to sample collection (attached).

    a. Ensure that the EnCore™ Sampler is present at the sampling location before collecting the sample from the borehole or surface sample location. The necessary parts of the EnCore™ Sampler will consist of three disposable coring bodies, three disposable caps, and a reusable stainless steel T-handle.

    b. Retrieve the sampling tool from the borehole or sample location.

    c. Expose a surface of the soil sample. For Shelby tube samples, this would require the extrusion of the sample. For split spoon samples, this would require the spoon be disassembled and opened. If liners are being used in conjunction with a split spoon or solid barrel sampler, this would require the removal of the liners from the sampler, so that the soil at the liner's end is exposed.

    d. Following the manufacturer's directions for the use of the EnCore™ Sampler (attached), collect three aliquots of soil from the exposed soil surface, using the three coring bodies. After the collection of each aliquot, cap and label each aliquot. The manufacturer's direction for use of the EnCore™ Sampler are attached

2. If the use of the EnCore™ Sampler is not possible due to soil texture (e.g. gravels) the sample must be field preserved with acid and methanol in accordance with SW-846 Method 5035A.

3. If the soil material is too coarse for sampling with the EnCore™ Sampler and contains excessive calcium carbonate material that reacts with the acid preservative, the sample will be retained in the brass or stainless steel liner of the split-spoon sampler or similar device. The ends of these liners will be covered with Teflon™ rounds, capped and sealed with tape.

4. Record all information associated with sample collection in the Project Field Book.

5. The samples will be labeled, stored and shipped in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures. The samples are shipped overnight for delivery and preservation at the laboratory.

ATTACHMENTS

EnCore™ Sampling Procedure (manufacturers instructions)

REFERENCES

Benchmark FOPs:
046 Sample Labeling, Storage and Shipment Procedures

ATTACHMENT

EnCore™ Sampling Procedure (manufacturers instructions)

Disposable En Core® Sampler

Sampling Procedures

Using The En Core® T-Handle

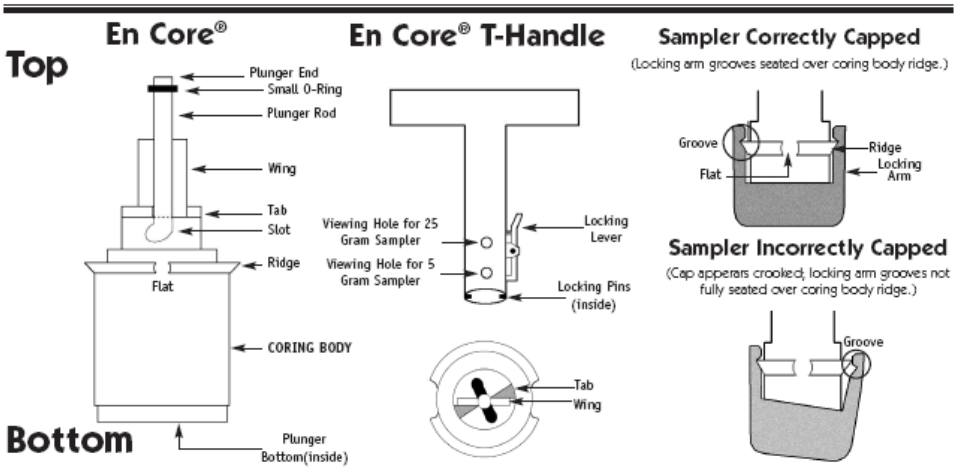
En Novative Technologies, Inc.
1241 Bellevue Street
Green Bay, WI 54302
Phone: 920-465-3960 • Fax: 920-465-3963
Toll Free: 888-411-0757
www.ennovativetech.com

NOTE:

1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.

2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!

3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)



BEFORE TAKING SAMPLE:

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

2. Depress **locking lever** on En Core T-Handle. Place coring body, **plunger end first**, into open end of T-Handle, *aligning the (2) **slots** on the coring body with the (2) **locking pins** in the T-Handle*. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.

TAKING SAMPLE:

3. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle **viewing hole**. Remove Sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while it is still on T-handle. *Push* **cap** over **flat** area of **ridge** *and twist* to lock **cap** in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram).**

PREPARING SAMPLER FOR SHIPMENT:

5. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.

Disposable En Core® Sampler

EXTRUSION PROCEDURES

USING THE En Core® EXTRUSION TOOL

CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.

1. Use a pliers to break locking arms on cap of En Core Sampler. Do not remove cap at this time. **(CAUTION: Broken edges will be sharp.)**

2. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.

3. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)

4. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. To release soil core, remove cap from Sampler and push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE* SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

PRINCIPLE OF USE. The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

QUALITY CONTROL. The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

WARRANTY. En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b)Samplers that have been opened, taken apart or mishandled; (c)Samplers not used in accordance with the directions; and (d)Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

LIMITATION OF LIABILITY. IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE, DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.

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The En Core™ Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending.

* Viton® is a registered trademark of DuPont Dow Elastomers.

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FIELD OPERATING PROCEDURES

"Before Going Into The Field" Procedure

FOP 076.0

"BEFORE & AFTER" PROJECT PROCEDURES FOR FIELD PERSONNEL

PURPOSE

This procedure describes the required field and office activities to be preformed "before and after" project assignments by field personnel. Field activities may include, but are not limited to, drilling oversight, excavation contractor oversight, matrix sample collection (e.g., soil, sediment, groundwater, surface water, wipe, and/or air), third party oversight, and site reconnaissance to name a few. Office activities may include, but are not limited to, photocopying field book entries, completing all field forms, tabulating collected field and laboratory data, and preparation of report text.

The primary goal of this procedure is to eliminate delays and unnecessary budgetary "strain" due to a lack of preparedness and knowledge of the site by the field team members. This procedure also seeks to streamline the preparation and transfer of field information/data from field personnel to the Project Manager upon field work completion.

PROJECT ASSIGNMENT

During the initial meeting with the Project Manager, several questions should be raised by the field team member and answered by the Project Manager. A pad of paper and pen should be in hand to record all pertinent job information. At a minimum, the following questions should be answered:

1. *What is the job number?*
2. *Who is the client and the on-site representative (if applicable)?*
3. *What is the name of the project?*
4. *What are the job responsibilities and how should they be accomplished?*
5. *How much time do I have to complete the assigned tasks?*
6. *Are there any project required documents? What are they?*

Any deviation from the above questions should be approved by the Project Manager prior to contravention, not at the end of the day or following the project completion.

"BEFORE" CHECKLISTS

Checklists should be developed and used so that all of the required steps prior to going into the field are undertaken. A good checklist will include:

- Adequate review of the documents listed in this FOP
- Any documents, equipment, and supplies presented in this FOP
- Providing adequate notification to the laboratory (so that holding times are not exceeded) and to the owner of the site and the primary regulatory agency (usually in writing) that a round of sampling is to commence in order to facilitate sampling and allow for a sampling audit or split sampling.
- Specifying and documenting the equipment maintenance and calibration undertaken prior to going into the field relative to the sampling event.
- Checking and calibrating the equipment.
- Listing the documents, equipment, and supplies required to collect samples at the site as presented in this FOP.

Prior to going into the field, sampling personnel should reacquaint themselves with the sampling plan. The review is undertaken so that the required specific protocol such as sampling from the least to the most contaminated wells, knowing where quality control samples are to be taken, knowing the disposition of purge water, etc., is understood and followed.

The amount of equipment maintenance and calibration required prior to going into the field should be clearly specified in the presampling equipment maintenance and calibration checklists, which are based on the manufacturer's recommendations, sampling objectives, and prior experience. Maintenance and calibration performed before sampling must be

documented to provide evidence that the equipment was adequately maintained and calibrated and to keep a permanent record of equipment servicing and performance.

A list of all the documents, equipment, and supplies required for the sampling event should be prepared and used. It can be frustrating and time consuming to forget equipment and supplies, so some up-front preparation is warranted. The following sections provide a list of the documentation, equipment, and supplies, which should assist in preparing a site-specific equipment and supply checklist. Once prepared, the checklist and project requirements should be reviewed with the Project Manager.

"BEFORE" DOCUMENTATION SUMMARY

Prior to going into the field, the field team should review and understand all of the project documents including, but not limited to:

- The Health and Safety Plan (HASP)
- The Site Analytical Plan (SAP), Sampling Plan, or similar document
- The Quality Assurance Project Plan (QAPP)
- The Work Plan
- Project specific Field Operating Procedures and field forms
- Site Maps
- Equipment operation manuals
- Chain-of-Custody forms
- Shipping labels and custody seals
- Any reference materials (i.e., conversion tables, volume calculation, etc.). The Pocket Ref, Third Edition by Thomas Glover is a great source for the field.

If at any time, the field team does not understand the project required protocol, procedures, sample locations, etc.; the Project Manager should be consulted for clarification.

"BEFORE" EQUIPMENT SUMMARY

Prior to going into the field, the field team should review the following equipment checklist, noting that project specific equipment may not be included in this list:

- Water level indicator
- Pumps, sample tubing, flow controllers, power cord(s), batteries, compressors, generators, etc.
- Bailers (disposable, PVC, stainless steel, glass), rope
- Flow-through cell
- Field meters with adequate calibration solutions (pH/Eh meter, conductivity meter, dissolved oxygen meter, turbidity meter, batteries, etc.)
- Garden hose
- Explosive gas meter and/or photoionization detector (PID) with calibration supplies
- Complete set of hand tools including a sharp knife, screw drivers, pliers, hacksaw, flashlight, large pipe wrench, hammer, bolt cutters, and replacement locks
- Fish hook with weight and string
- Field filtering equipment and supplies
- Decontamination supplies, such as scrub brushes, Alconox®, distilled water, potable water, 5-gallon bucket, paper towels, aluminum foil
- 5-gallon bucket(s)
- Measuring cup
- Sample bottles/containers (with extras) and preservatives
- Stainless steel spoons, trowels, shovels
- Shipping containers (i.e., coolers)
- Clipboard
- Calculator
- Water resistant clock or watch with second hand
- First aid kit

"BEFORE" SUPPLIES SUMMARY

Prior to going into the field, the field team should review the following supplies checklist, noting that project specific supplies may not be included in this list:

- Laboratory grade non-phosphate detergent (Alconox®)
- Appropriate personal protective equipment appropriate to the contaminants of concern, such as nitrile gloves, Tyvek, boots, hardhat, safety glasses, hearing protection, etc.
- Bags of ice
- Plastic garbage bags
- Plastic sheeting
- Sufficient quantities of potable and laboratory grade deionized water for cleaning and equipment blanks
- Methanol
- Isopropyl alcohol
- Clean rags and paper towels
- Electrical tape, duct tape, and wide transparent tape
- Hand soap
- Regular, ballpoint, and indelible pens
- Hollow braid polyethylene rope

After providing adequate notification (lab, state and/or federal agencies), performing the presampling maintenance and calibration, obtaining the site and well keys, and packing the supplies and equipment, the field activities are ready to be performed.

"AFTER" – PROJECT FILE REVIEW & CREATION

It is the responsibility of each field crew member to review his/her own field notes and time sheet for accuracy and completeness. All errors to the field notes should be corrected, dated, and initialed for Project Manager review. Once reviewed by the field team member, the Project Field Book, all field forms, photographs, chain-of-custodies etc. must be

photocopied, scanned (if required), downloaded, etc. and then given to the Project Manager in an organized file folder in a timely manner. Avoiding delay during this step is critical, especially when there are severe time constraints for the project.

REFERENCES

1. Wilson, Neal. *Soil Water and Ground Water Sampling*, 1995

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FIELD OPERATING PROCEDURES

Geoprobe Drilling Procedures

FOP 078.0

GEOPROBE DRILLING PROCEDURES

PURPOSE

This guideline presents a method for direct-push drilling a borehole through unconsolidated materials, including soils or overburden.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using direct-push methods and equipment.

1. Follow Benchmark's Field Operating Procedure (FOP) for Drill Site Selection Procedure prior to implementing any drilling activity.

2. Perform drill rig safety checks with the driller by completing the Drilling Safety Checklist form (sample attached).

3. Conduct tailgate health and safety meeting with project team and drillers by completing the Tailgate Safety Meeting Form (sample attached).

4. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's FOPs or manufacturers recommendations.

5. Ensure all drilling equipment (i.e., rods, 4-foot sampler, dedicated PVC sleeves) appear clean and free of soil prior to initiating any subsurface intrusion. Decontamination of drilling equipment should be in accordance with Benchmark's Drilling and Excavation Equipment Decontamination Procedures FOP.

6. Mobilize the Geoprobe™ rig to the site and position over the borehole.

7. Level and stabilize the rig and recheck the rig location against the planned drilling location.

8. Fully advance the sampler into the subsurface using an ATV-mounted direct-push Geoprobe™ drill rig and 1.5-inch diameter sampler, typically 4-feet in length and fitted with a dedicated PVC sleeve, for each four-foot core of soil.

9. Retrieve the 4-foot sample core from the driller, place on a piece of polyethylene tarp, and cut open using a sharp utility knife.

10. Visually characterize each 4-foot soil core using the Unified Soil Classification System (USCS) in accordance with Benchmark's Soil Description Procedures Using the USCS FOP.

11. Scan each 4-foot core for total volatile organic vapors with a calibrated Photovac 2020 PID equipped with a 10.6 eV lamp, and report any visual and/or olfactory observations. Record PID scan measurements in the Project Field Book and appropriate field forms.

12. If required, collect a representative soil sample for headspace determinations. In general, soil samples representative of each 4-foot core interval are collected, placed in a sealable plastic bag, and kept at or near room temperature (approximately 65-70° F) for a minimum of 15 minutes prior to measurement. Record PID headspace determination measurements in the Project Field Book and appropriate field forms.

13. Check sampler and rods periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.

14. Continue drilling until reaching the assigned total depth, or until sampler refusal occurs. Sampler refusal is when the drilling penetration drops below 0.1 feet per 2 minutes, with the full weight of the rig on the sampler.

15. Plug and abandon boreholes not used for temporary well installation in accordance with Benchmark's Field Operating Procedure for Abandonment of Borehole. Boreholes to be used as temporary wells should be completed in accordance with Benchmark's Temporary Well (Piezometer) Construction Procedures FOP.

16. Decontaminate all non-dedicated drilling tools between boring locations using potable tap water and a phosphate-free detergent (i.e., Alconox™) in accordance with Benchmark's Drilling and Excavation Equipment Decontamination Procedures FOP.

OTHER PROCEDURAL ISSUES

- Borings will not be over drilled (rat holed) without the express permission of the Benchmark field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.

- Potable water may be placed in the sampler stem if critically necessary for borehole control or to accomplish sampling objectives. This will be performed only with the express permission of the Benchmark field supervisor.

ATTACHMENTS

Drilling Safety Checklist (sample)
Tailgate Safety Meeting Form (sample)

REFERENCES

Benchmark FOPs:

001 *Abandonment of Borehole Procedures*
017 *Drill Site Selection Procedure*
018 *Drilling and Excavation Equipment Decontamination Procedures*
054 *Soil Description Procedures Using the USCS*
077 *Temporary Well (Piezometer) Construction Procedures*

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DRILLING SAFETY CHECKLIST

Project: **Supplemental Phase II RFI/ICMs**	Date:
Project No.: **0041-009-500**	Drilling Company:
Client: **RealCo., Inc.**	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
"Kill switches" installed by the manufacturer are in operable condition and all workers at the drill site are familiar with their location and how to activate them?		
"Kill switches" are accessible to workers on both sides of the rotating stem? NOTE: Optional based on location and number of switches provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wires, "bird cages" and worn or missing sections?		
Cables are terminated at the working end with a proper eye splice, either swag Coupling or using cable clamps?		
Cable clamps are installed with the saddle on the live or load side? Clamps should alternated and should be of the correct size and number for the cable size to which installed. Clamps are complete with no missing parts?		
Hooks installed on hoist cables are the safety type with a functional prevent accidental separation?		
Safety latches are functional and completely span the entire th ok ve positive action to close the throat except when manually ed fo nec disconnecting a load?		
Drive shafts, belts, chain drives and universal jo be to prevent accidental insertion of hands and fingers or tools		
Outriggers shall be extended prior to and w sed cradle. Hydraulic outriggers must maintain pressure to d ize the drill rig even while unattended.		
Outriggers shall be properly supporte und su o p settling into the soil.		
Controls are properly lab ave fre ntr ontrols should not be blocked or locked in an p on.		
Safeties on any device sha zed.		
Controls shall be operated smoothly and ca ifting devices shall not be jerked or operated erratically to overcome res		
Slings, chokers and lifting devices are d before using and are in proper working order? Damaged units are removed from service and are properly tagged?		
Shackles and clevises are in proper working order and pins and screws are fully inserted before placing under a load?		
High-pressure hoses have a safety (chain, cable or strap) at each end of the hose section to prevent whipping in the event of a failure?		
Rotating parts of the drill string shall be free of sharp projections or hooks, which could entrap clothing or foreign objects?		
Wire ropes should not be allowed to bend around sharp edges without cushion material.		
The exclusion zone is centered over the borehole and the radius is equal or greater than the boom height?		

ITEMS TO CHECK	OK	ACTION NEEDED

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DRILLING SAFETY CHECKLIST

Project: **Supplemental Phase II RFI/ICMs**	Date:
Project No.: **0041-009-500**	Drilling Company:
Client: **RealCo., Inc.**	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
The work area around the borehole shall be kept clear of trip hazards and walking surfaces should be free of slippery material.		
Workers shall not proceed higher than the drilling deck without a fall restraining device and must attach the device in a manner to restrict fall to less than 6 feet.		
A fire extinguisher of appropriate size shall be immediately available to the drill c… drill crew shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines … energized and visibly grounded, drill rigs will be operated proximate t… under, by, or … fer lines only in accordance with the following: .333 © (3) (ii) 50 kV or less -minimum clearance is 1… For 50 kV or over - 10ft. Plus ½ in. For each add… **Benchmark Policy: Maintain 20 feet clearanc…**		
29 CFR 1910.333 © (3) (iii) While the rig is in t… wit… the do… ion, clearance from energized power lines will be maint… llow… Less than 50 kV - 4 feet 50 to 365 kV - 10 feet 365 to 720 kV - 16 feet		

Name: _____ (printed)

Signed: _____ Date: _____

SAMPLE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	A	B	C	D
Activity:	A	B	C	D
Activity:	A	B	C	D
Activity:	A	B	C	D
Activity:	A	B	C	D

New Equipment:

Other Safety Topic (s): (aggressive fauna)
tobacco products is prohibited in the Exclusion Zone (EZ)

SAMPLE

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

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FIELD OPERATING PROCEDURES

Field Quality Control Procedures

FOP 085.0

FIELD QUALITY CONTROL PROCEDURES

PURPOSE

In addition to traditional environmental samples (e.g., soil, groundwater, wipe, vapor etc.) described in each project work plan, site-specific field quality assurance/quality control (QA/QC) samples are typically collected and analyzed to support the required third-party data usability assessment effort of a project. Site-specific QA/QC samples generally include matrix spikes, matrix spike duplicates, blind duplicates (where appropriate), and trip blanks which accompany aqueous volatile organic compound (VOC) samples only.

The number of QA/QC field samples (blind duplicate, matrix spike/matrix spike duplicate, trip blank, field blank, or equipment blank) will be designated prior to field mobilization, but final QC sample locations will be contingent upon field conditions. This procedure outlines and discusses each QA/QC sample that may be required during a project.

PROCEDURE

A brief summary of each QA/QC sample identified above is presented below. Where appropriate, the procedure to be used to collect these samples is also presented.

- **Trip Blanks** – A sufficient number of trip blanks for VOC analysis must be prepared by the laboratory and delivered to the sampling team prior to a sampling event, typically two or three 40-ml VOA vials with organic free reagent water. One sealed blank will be carried into the field per day along with the sample containers for each day that water matrix volatile organic samples are collected. Trip blanks will be transported and handled in the same manner as the actual samples. The results of the trip blank analysis will be reviewed to evaluate if the potential for sample contamination during transportation and handling exists. The trip blanks will be analyzed for the same VOCs (and method) as the project groundwater samples.

- **Blind Duplicate** – One blind duplicate must be collected and analyzed per 20 samples collected per matrix (i.e., soil, groundwater, soil vapor, etc.). The location

of the sample collection point will not be disclosed to the analytical laboratory, therefore the field sample containers will be returned to the laboratory identified only as the "blind duplicate." The well or sample location will be recorded in the Project Field Book or handheld RuggedReader® Pocket PC and on the field data sheets, and the results will be compared to review analytical precision. Sample analysis will be identical to the original sample per the project work plan. The Blind Duplicate sample must be collected simultaneously from the same source under identical conditions as the original sample.

- **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** – A sufficient volume of sample will be collected at one sampling location per sampling event for MS/MSD analysis per matrix (i.e., soil and groundwater only). The laboratory will report the results of the MS/MSD analysis, which will be reviewed for sampling and analysis precision and accuracy. Sample analysis will be identical to the original sample per the project work plan. The MS/MSD sample must be collected simultaneously from the same source under identical conditions as the original sample.

- **Equipment (Rinsate) Blank** – In general, dedicated sampling equipment is used to minimize field decontamination time and avoid the need for equipment blanks; however there may be instances where the use of non-dedicated equipment cannot be avoided. An equipment blank will be collected for each day of sampling activity when non-dedicated sampling equipment is used. These equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment. Sample analysis for the equipment blank will consist of the most comprehensive parameter list used for risk assessment in which the non-dedicated equipment was used for environmental sample collection. During most projects, every effort to use dedicated sampling equipment should be made in order to minimize field decontamination time and avoid the need for equipment blanks. Equipment Blank sampling procedure is as follows:
    - Non-dedicated equipment are to be decontaminated in accordance with Benchmark's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures prior to use in the field. If organic-free

deionized water (generally provided by the laboratory) is not available for decontamination, equipment will be allowed to thoroughly air dry.
  - Once properly rinsed or allowed to air dry, analyte-free water (provided by the laboratory) is poured appropriately over or through the decontaminated sample collection device, collected in a sample container, and returned to the laboratory as a sample.

- **Field Blank** – A field blank is a sample of the unused final decontamination rinse water that is collected at the sampling site and returned to the laboratory as a sample. Sample analysis for the field blank will consist of the most comprehensive parameter list used during the investigation.

- **Split Sample** – A split sample is a sample that has been portioned into two or more containers from a single sample container or sample mixing container. Samples for VOC analysis should never be mixed prior to splitting.

- **Blank Wipe Samples** – There are two types of blank wipe samples, an equipment blank and a field blank that may be required per the project work plan, both are described below:
  - Equipment Blank – Required only if reusable templates are used for wipe sample collection. The decontaminated template is wiped with a hexane saturated swab. The swab is placed in the appropriate sample container and returned to the laboratory as a sample.
  - Field Blank – Clean disposable gloves are wiped with a hexane saturated swab. The swab is placed in the appropriate sample container and returned to the laboratory as a sample.

REFERENCES

Benchmark FOPs:

040 Non-disposable and Non-dedicated Sampling Equipment Decontamination

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FIELD OPERATING PROCEDURES

Treatment System Sample Collection Procedure

FOP 086.0

TREATMENT SYSTEM SAMPLE COLLECTION PROCEDURE

PURPOSE

This procedure describes the methods for collecting treatment system influent and effluent samples.

PROCEDURE

1. Decontaminate non-disposable and non-dedicated sampling equipment in accordance with the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Calibrate the pH field meter in accordance with the Benchmark Field Operating Procedure 008.0 Calibration and Maintenance of the Portable Field pH/Eh Meter.

3. Prepare sampling equipment for use while wearing appropriate protective gear (i.e., latex gloves, safety glasses).

4. Prior to collecting an influent or effluent sample, purge the line by opening the valve for 30 seconds. Collect the purge water in a container and run it through the treatment system following sample collection.

5. Collect the sample by placing a sample collection jar (vial) directly beneath the sampling port and opening the valve. Hold the vial at a slight angle and fill slowly so little to no aeration of the water can occur. Vials must be filled with zero headspace (no air bubbles) in the sample. To ensure this, after the vial has been filled, twist the cap on tightly, turn the vial upside down and lightly tap. If no air bubbles are visible, proceed with filling the next vial.

6. Pre-label all sample bottles in the field using a waterproof permanent marker in accordance with the Benchmark Sample Labeling, Storage and Shipment FOP. The following information, at a minimum, should be included on the label:

    - Project number;

- Sample identification code (as per project specifications);
- Date of sample collection (mm, dd, yy);
- Time of sample collection (military time only) (hh:mm);
- Specify "grab" or "composite" sample type;
- Sampler initials;
- Preservative(s) (if applicable); and
- Analytes for analysis (if practicable).

7. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required.

8. Collect a separate sample of approximately 200 mL into an appropriate container to measure the pH. Record the field measurement on the Sample Collection Log (sample form attached).

9. Record all pertinent field data in the Project Field Book and on the Sample Collection Log form.

10. Label, store, and ship the samples in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

11. Decontaminate all non-disposable and non-dedicated sampling equipment upon completion of the sampling event in accordance with the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

REQUIRED EQUIPMENT

- Personal protective equipment (PPE) (if applicable)
- Water quality meter
- Field forms
- Project field book

ATTACHMENTS

Sample Collection Log – Water (sample)

REFERENCES

Benchmark FOPs:

008 *Calibration and Maintenance of Portable Field pH/Eh Meter*
040 *Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046 *Sample Labeling, Storage and Shipment Procedures*

TREATMENT SYSTEM
SAMPLE COLLECTION PROCEDURE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

WATER SAMPLE COLLECTION LOG

PROJECT INFORMATION

Project Name:

Project No.:

Client:

Location:

SAMPLE DESCRIPTION

I.D.:

Matrix: ☐ SURFACE WATER ☐ STORM ☐ SEEP ☐ OTHER ☐ INFLUENT ☐ EFFLUENT

SAMPLE INFORMATION

Date Collected:

Time Collected:

Date Shipped to Lab:

Collected By:

Sample Type: ☐ POINT ☐ GRAB ☐ COMPOSITE

Sample Collection Method: ☐ DIRECT DIP ☐ SS / POLY. DIPPER ☐ PERISTALTIC PUMP ☐ POLY. DISP. BAILER ☐ ISCO SAMPLER ☐ OTHER

SAMPLING INFORMATION

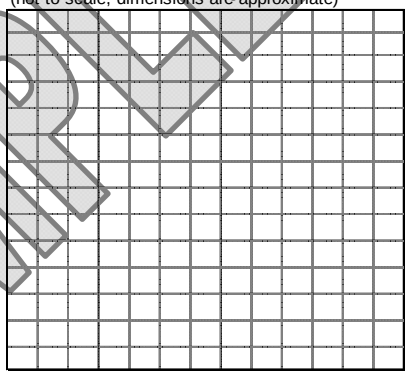
Weather:

Air Temperature:

Parameter	First	Last	Units
pH			units
Temp.			°C
Cond.			mS
Turbidity			NTU
Eh / ORP			mV
D.O.			ppm
Odor			olfactory
Appearance			visual

LOCATION SKETCH

(not to scale, dimensions are approximate)



EXACT LOCATION (if applicable)

Northing (ft)	Easting (ft)	Surface Elevation (fmsl)

SAMPLE DESCRIPTION (appearance, olfactory):

SAMPLE ANALYSIS (depth, laboratory analysis required):

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

SAMPLE

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

FIELD OPERATING PROCEDURES

SVE System Sample Collection Procedure

FOP 089.0

SVE SYSTEM SAMPLE COLLECTION PROCEDURE

PURPOSE

Soil vapor extraction (SVE), also known as "soil venting" or "vacuum extraction", is an *in-situ* remedial technology that reduces concentrations of volatile constituents in petroleum products adsorbed to the soils in the unsaturated (vadose) zone. In this technology, a vacuum is applied through vertical and/or horizontal SVE wells near the source of contamination in the soil, typically with a blower. Volatile constituents of the contaminant mass "evaporate" and the vapors are drawn through the extraction wells. This procedure describes the general methods for collecting extracted vapor samples from an SVE system using a Tedlar® bag or Summa Canister.

REQUIRED EQUIPMENT

- Personal protective equipment (PPE) (if applicable)
- New Teflon® or equivalent tubing
- Sample collection vessel (Tedlar® bag, Summa Canister, or equivalent)
- Vacuum Box (Required for sampling against negative pressure)
- Project field book

TEDLAR® BAG SAMPLING

Tedlar® bag sampling allows for the collection of a representative grab sample of a gaseous media for analysis.

1. Prepare sampling equipment for use while wearing appropriate protective gear (i.e., nitrile gloves, safety glasses).

2. Pre-label all sample container labels in the field using a waterproof permanent marker in accordance with the Benchmark Sample Labeling, Storage and Shipment FOP. The following information, at a minimum, should be included on the label:
    - Project number;
    - Sample identification code (as per project specifications);
    - Date of sample collection (mm, dd, yy);
    - Time of sample collection (military time only) (hh:mm);
    - Specify "grab" or "composite" sample type;
    - Sampler initials;
    - Preservative(s) (if applicable); and
    - Analytes for analysis (if practicable).

3. Collect air sample. Sample ports for air samples may be located in areas of the SVE system under positive or negative pressure and the sampling method will vary accordingly.

    Positive Pressure

    - A piece of new Teflon® tubing is fitted to the SVE system sampling port and purged by slowly opening the valve on the SVE system sampling port.
    - Attach the Teflon® tubing to the Tedlar® bag.
    - Open the plastic valve on the Tedlar® bag slowly and fill the bag no more than 2/3 full. If the bags will be shipped to an analytical laboratory via air transportation, the Tedlar® bag should be only half full. Unpressurized air planes could result in full bags bursting and loss of sample.
    - Close the Tedlar® bag valve, then sample port valve, and disconnect the bag.

    Negative Pressure

    - A piece of new Teflon® tubing is fitted to the SVE system sampling port and the Tedlar® bag.
    - Open the plastic valve on the Tedlar® bag.
    - Place the Tedlar® bag in an air tight vacuum box with the tubing protruding from the chamber.

- Connect a pump to the evacuation tube on the vacuum box.
- Open the valve on the sampling port.
- Turn on the pump and evacuate the chamber allowing the Tedlar® bag to expand and draw a sample into the bag through the protruding tube.
- Allow the Tedlar® bag to fill no more than 2/3 full, close the sampling port, turn off the pump, and open the vacuum box and close the plastic valve on the Tedlar® bag.

4. Record all pertinent sample collection information in the Project Field Book.
5. If collected for field screening, screen the sample and record the results.
6. If collected for laboratory analysis, return the sample to the provided box or cooler, and submit samples to the laboratory under chain-of-custody command.

SUMMA CANISTER

1. Prepare sampling equipment for use while wearing appropriate protective gear (i.e., latex gloves, safety glasses).
2. Canisters will be pre-cleaned and supplied by the laboratory that will be conducting the analysis.
3. The number of Summa canisters required as well as the flow rate of the constant differential low volume flow controllers will be supplied by the laboratory in accordance with the project work plan.
4. Label the canisters prior to sample collection.
5. Connect the Teflon® tubing to the sample port and purge by opening the valve on the sample port.
6. Record the initial canister vacuum with the laboratory-supplied pressure gauge.

7. Connect the tubing to the Summa canister.

8. Open the valve of the canister for the required collection period.

9. Following sample collection, close and cap each canister valve.

10. Record the canister vacuum following sample collection with the laboratory-supplied pressure gauge.

11. Record all pertinent field data in the Project Field Book.

12. Label, store, and ship the samples in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures

REFERENCES

Benchmark FOPs:
046 Sample Labeling, Storage and Shipment Procedures

TYPICAL AIR SAMPLE VESSELS

Typical Summa Canisters

Typical Tedlar Bags

TYPICAL VACUUM BOX

ATTACHMENT B

PROJECT FORMS

BENCHMARK
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DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

DAILY QUALITY CONTROL REPORT

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TIME	DESCRIPTION

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS: A.M.:	IMPORTANT TELEPHONE CALLS:
P.M.:	
PERSONNEL ON SITE:	
SIGNATURE	DATE:

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

DAILY LOG	DATE			
	NO.			
	SHEET		OF	

DAILY QUALITY CONTROL REPORT
(CONTINUED)

PROJECT NAME:	PROJECT NO.

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TIME	DESCRIPTION

SIGNATURE DATE:

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DAILY LOG	DATE			
	NO.			
	SHEET		OF	

DAILY QUALITY CONTROL REPORT
(CONTINUED)

PROJECT NAME:	PROJECT NO.

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TIME	DESCRIPTION

REFERENCED PROJECT FIELD FORMS:

☐ Aquifer Test Data Sheet	☐ Impacted Soil Excavation Log	☐ Soil Gas Survey Log
☐ Chain-of-Custody Form	☐ Impacted Soil Transportation Log	☐ Step-Drawdown Test Data Sheet
☐ Construction Sample Summary Log	☐ Monitoring Well Inspection Form	☐ Survey Elevation Log
☐ Corrective Measures Report	☐ Nuclear Densitometer Field Log	☐ Tailgate Safety Meeting Form
☐ Daily Drilling Report	☐ Photographic Log	☐ Test Pit Excavation Log
☐ Drilling Safety Checklist	☐ Pipe Leakage Testing Log	☐ Underground/Overhead Utility Checklist
☐ Equipment Calibration Log	☐ Post-Closure Field Inspection Report	☐ Variance Log
☐ Field Borehole Log	☐ Pressure Packer Testing Log	☐ Water Level Monitoring Record
☐ Field Borehole/Monitoring Well Installation Log	☐ Problem Identification Report	☐ Water Quality Field Collection Log
☐ Field Investigation Report	☐ Real-Time Air Monitoring Log	☐ Water Sample Collection Log
☐ Field Slug Test Log	☐ Record of Telecom Meeting	☐ Well Abandonment/Decomm. Log
☐ Groundwater Elevation Log	☐ Sample Summary Collection Log	☐ Well Completion Detail
☐ GW Well Development and Purge Log	☐ Sediment Sample Collection Log	☐
☐ Hot Work Permit	☐ Seep Sample Collection Log	☐
☐ IDW Container Log	☐ Seepage Meter Sample Collection Log	☐

SIGNATURE DATE:

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DAILY HEALTH AND SAFETY

Project Name: Date: Time:

Project Number: Client:

Work Activities:

HOSPITAL INFORMATION:

Name:

Address: *City:* *State:* *Zip:*

Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)

Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

VOLUME 4

HEALTH AND SAFETY CONTINGENCY PLAN

REMEDIAL ACTION WORK PLAN COMPENDIUM VOLUME 4

HEALTH AND SAFETY CONTINGENCY PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LeRoy, New York

Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to
Unicorn Management Consultants, LLC
For
Lehigh Valley Railroad Company
Cincinnati, Ohio

Health and Safety Contingency Plan
Lehigh Valley Railroad Derailment Superfund Site

Plan Reviewed by (initial):

Corporate Health and Safety Director: _____

Project Manager: _____

Designated Site Safety and Health Officer: _____

Acknowledgement:

I acknowledge that I have reviewed the information contained in this site-specific Health and Safety Contingency Plan, and understand the hazards associated with performance of the field activities described herein. I agree to comply with the requirements of this plan.

NAME (PRINT)	SIGNATURE	DATE

HEALTH AND SAFETY CONTINGENCY PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

ATTACHMENTS

1.0 INTRODUCTION

Benchmark Environmental Engineering & Science, PLLC, as sub-consultant to Unicorn Management Consultants, LLC (UMC), has prepared this Health and Safety Contingency Plan (HSCP) on behalf of the Lehigh Valley Railroad Company (LVRR). LVRR is the respondent to a March 21, 2014 Administrative Order for Remedial Action, Index Number CERCLA-02-2014-2010 (Ref. 1) for the Lehigh Valley Railroad Derailment Superfund Site (Site) located in LeRoy, New York (see Remedial Action Work Plan (RAWP) Figures 1 and 2). Benchmark Environmental Engineering & Science, PLLC in association with TurnKey Environmental Restoration, LLC (hereafter referred to collectively as "Benchmark") is the Supervising Contractor for the implementation of Operable Unit # 1 Remedial Actions. This document serves as Volume 4 of the RAWP Compendium.

1.1 Background

The Lehigh Valley Railroad Derailment Superfund Site is the location of a 1970 historical train derailment and chemical spill which occurred east of the Village of LeRoy, New York, along Gulf Road. On December 6, 1970, a portion of an eastbound 114-car freight train operated by the Lehigh Valley Railroad derailed at the Gulf Road crossing. Two tank cars containing trichloroethylene (TCE) ruptured and spilled their contents onto the ground. Approximately 30,000 gallons of TCE were spilled. A third car containing a crystalline form of cyanide was also reported to have partially spilled as well. Newspaper articles from this time period and rhetorical sources indicate that most of the cyanide was recovered shortly after the derailment. The TCE reportedly infiltrated directly into the ground and was not recovered. Nearby residents reported odors in homes and contamination of drinking water wells shortly after the release. In response to the complaints, LVRR constructed a series of ditches and berms at the site of the release and flooded the ditches with approximately one million gallons of water in an attempt to flush away the TCE.

The release and subsequent response actions resulted in contaminated surface soil and bedrock groundwater. As stated in a 1999 Superfund Record of Decision (ROD) (Ref. 2), the soil contamination and bedrock contamination appear to be physically separated from each other and, because techniques for dealing with soil contamination are different from

those required for the groundwater, the NYSDEC established two operable units for administration of the spill. Operable Unit #1 addressed groundwater and Operable Unit #2 addressed overburden soil.

In May 2000, the operable units were redefined by the USEPA as follows:

- Operable Unit #1 addresses a 10 acre "source area" immediately surrounding the bedrock and the contaminated groundwater present in the bedrock (about 3 ½ square miles); 1.5 acres (surface soils) and the contaminated overburden (soil, railroad ballasts, broken rock, fill, etc.)
- Operable Unit #2 addresses a four mile TCE groundwater plume

This report pertains to the contaminated overburden soil now included as a portion of Operable Unit #1 and referred to throughout this document as the "Spill Area". The Spill Area encompasses a portion of Gulf Road, the former Lehigh Valley main line railroad bed, and other adjoining lands.

1.2 Spill Area Remedial Approach

Site investigations indicate that TCE and to a lesser extent 1,2-dichloroethene (1,2-DCE; a breakdown product of TCE) remain at elevated concentration in a portion of the Spill Area soils above the bedrock (Ref. 3 & 4). The remedial design is detailed in a September 2013 Soil Remedial Design Report (Ref. 5). The remedial activities generally incorporate separate SVE systems on the north and south sides of Gulf Road, including subgrade horizontal extraction points connected to a series of above and below ground manifolds, vertical vacuum observation wells, and trailer-mounted SVE mechanical equipment with granular activated carbon (GAC) emissions controls.

1.3 Purpose and Scope

This Health and Safety Contingency Plan (HSCP) has been prepared in general accordance with the occupational Safety and Health Administration (OSHA) Guidance for Hazardous Waste Site Activities (June 1990), and the requirements contained in 29 CFR 1910.120, Subpart H and 29 CFR 1910.126, and the USEPA Standard Operating Safety Guidelines. This HSCP describes the specific health and safety practices and procedures to be employed by Benchmark employees during remedial action activities at the Lehigh Valley

Railroad Derailment Superfund Site located in Genesee County, Town of LeRoy, New York (hereafter, the "Site"). This HSCP presents information and procedures for Benchmark employees who will be involved with field activities, including the assignment of responsibilities, personnel protection requirements, work practices and emergency response procedures. It is not intended to cover the activities of other contractors or subcontractors (if any) on the Site; these firms will be required to develop and enforce their own HSCPs as discussed below. In order to ensure that proper coordination on such key issues as emergency notification and decontamination exists between Benchmark and other contractors or subcontractors (if any), Benchmark will review all HSCPs and coordinate procedures where appropriate.

This HSCP presents information on known Site health and safety hazards using available historical information for previously-investigated areas of the Site, and identifies the equipment, materials and procedures that will be used to eliminate or control these hazards. Environmental monitoring will be performed during the course of field activities to provide real-time data for on-going assessment of potential hazards. This HSCP will be updated as new investigation data becomes available.

All Benchmark personnel involved with the field activities associated with the Site will be required to comply with this HSCP and any field modifications as directed by the Site Safety and Health Officer.

2.0 ORGANIZATIONAL STRUCTURE

This chapter of the HSCP describes the lines of authority, responsibility and communication as they pertain to health and safety functions at the Site. The purpose of this chapter is to identify the personnel who will impact the development and implementation of the HSCP and to describe their roles and responsibilities. The organizational structure described in this chapter is consistent with the requirements of 29 CFR 1910.120(b)(2). This section will be reviewed by the Project Manager and updated as necessary to reflect the current organizational structure at this Site.

2.1 Roles and Responsibilities

The specific responsibilities and authority of management, safety and health, and other personnel on this Site are detailed in the following paragraphs.

2.1.1 Corporate Health and Safety Director *(Thomas H. Forbes, P.E.)*

The Corporate Health and Safety Director is responsible for developing and implementing the Health and Safety program and policies for Benchmark, and consulting with corporate management to ensure adequate resources are available to properly implement these programs and policies. The Corporate Health and Safety Director coordinates Benchmark's Health and Safety training and medical monitoring programs, and assists project management and field staff in developing site-specific health and safety plans.

2.1.2 Project Manager *(Thomas H. Forbes, P.E.)*

The Project Manager has the responsibility and authority to direct all work operations at the Site. The Project Manager coordinates safety and health functions with the Site Safety and Health Officer, and bears ultimate responsibility for proper implementation of this HSCP. He may delegate authority to expedite and facilitate any application of the program, including modifications to the overall project approach as necessary to circumvent unsafe work conditions. Specific duties of the Project Manager include:

- Preparing and coordinating the Site Work Plan.

- Providing SVE workers with work assignments and overseeing their performance.
- Coordinating health and safety efforts with the Site Safety and Health Officer (SSHO).
- Reviewing the emergency response coordination plan to assure its effectiveness.
- Serving as the primary liaison with Site contractors (if any) and the property owner.

2.1.3 Site Safety and Health Officer *(Rick L. Dubisz)*

SSHO reports to the Project Manager. The SSHO is on-site or readily accessible to the Site during all work operations and has the authority to halt work if unsafe conditions are detected. The specific responsibilities of the SSHO are:

- Managing the safety and health functions for Benchmark personnel on the Site.
- Serving as the point of contact for safety and health matters.
- Ensuring that Benchmark field personnel working on the Site have received proper training (per 29 CFR Part 1910.120(e)), that they have obtained medical clearance to wear respiratory protection (per 29 CFR Part 1910.134), and that they are properly trained in the selection, use and maintenance of personal protective equipment, including qualitative respirator fit testing.
- Performing or overseeing Site monitoring as required by the HSCP.
- Assisting in the preparation and review of the HSCP.
- Maintaining site-specific safety and health records as described in this HSCP.
- Coordinating with the Project Manager, Site Workers and Contractor's (if any) SSHO as necessary for safety and health efforts.

2.1.4 Site Workers

Site workers are responsible for: complying with this HSCP or a more stringent HSCP, if appropriate (i.e. Contractor and Subcontractor's HSCP); using proper PPE; reporting unsafe acts and conditions to the SSHO; and following the safety and health instructions of the Project Manager and SSHO.

2.1.5 Other Site Personnel

Other Site personnel who will have health and safety responsibilities in the work zone will include subcontractors and governmental agencies performing Site inspection work (viz. EPA and/or its designated oversight contractor) who will be responsible for developing, implementing and enforcing a Health and Safety Contingency Plan equally stringent or more stringent than Benchmark's HSCP. Benchmark assumes no responsibility for the health and safety of anyone outside its direct employ. During field activities involving subcontractors (if any), the subcontractor's HSCP shall cover all non-Benchmark Site personnel. The subcontractor(s) shall assign a SSHO who will coordinate with Benchmark's SSHO as necessary to ensure effective lines of communication and consistency between contingency plans.

3.0 HAZARD EVALUATION

The possibility exists that workers will be exposed to hazardous substances in soil, groundwater, surface water and/or sediment during field activities. The principal points of exposure would be through direct contact with impacted media and through the inhalation of contaminated particles or vapors during drilling or sample collection and handling activities. In addition, the use of large equipment and uneven terrain will also present conditions for potential physical injury to workers. Further, since work will be performed outdoors, the potential exists for heat/cold stress to impact workers, especially those wearing protective equipment and clothing. Adherence to the medical evaluations, worker training relative to chemical hazards, safe work practices, proper personal protection, environmental monitoring, establishment work zones and site control, appropriate decontamination procedures and contingency planning outlined herein will reduce the potential for chemical exposures and physical injuries.

3.1 Chemical Hazards

Previous field investigations at the Site have provided information concerning the types of hazardous substances that may be encountered during intrusive activities. Table 1 identifies known constituents of potential concern for the Site, and ranges of concentrations, by media, observed during previous investigations. Based on this work, the constituents of potential concern include specific chlorinated VOCs. Table 2 lists toxicity and exposure data for these constituents of potential concern. As additional Site data is obtained, Tables 1 and 2 will be updated accordingly. Brief descriptions of the toxicology of these materials and related health and safety guidance and criteria are provided below.

- **Trichloroethene (TCE)** was formally widely used in dry cleaning operations and metal degreasing. In pure form it is a clear, colorless liquid with a distinct odor and boiling point of 186 degrees Fahrenheit. TCE is more dense than water, causing it to sink rapidly through soil and fractured bedrock. It is toxic by inhalation and skin absorption. It is an irritant to the skin, eyes and mucous membranes. Symptoms of exposure may include headache, dizziness and nausea. Exposure may cause liver and kidney damage. TCE is a suspected human carcinogen

- **Cis 1,2-Dichloroethene (cis 1,2-DCE)** is used as an intermediate in the production of other chlorinated solvents and compounds, as well as low temperature extraction solvents for dyes, perfumes, and lacquers; commercial use of these compounds is not extensive. They are highly volatile by reaction with alkalis, potassium hydroxide, sodium, and sodium hydroxide. Direct exposure is mostly by inhalation resulting in heart and liver damage.

- **Cyanide** is a carbon-nitrogen chemical unit which combines with many organic and inorganic compounds. The most commonly used form, hydrogen cyanide, is mainly used to make nylon and other synthetic fibers and resides. Other cyanides are used as herbicides. Cyanides are generally not persistent when released to water or soil, and are not likely to accumulate in aquatic life. They rapidly evaporate and are broken down by microbes. They do not bind to soils and may leach to groundwater. Short term exposure may cause rapid breathing, tremors and other neurological effects. Long-term exposures may cause weight loss, thyroid effects, and nerve damage.[1]

With respect to the anticipated intrusive activities defined above, possible routes of exposure to the above-mentioned contaminants are presented in Table 3-3. The use of proper respiratory equipment, as outlined in Section 7.0, will minimize the potential for exposure to airborne contamination. Further, exposure to contaminants through dermal and other routes will also be minimized through the use of protective clothing (Section 7.0), safe work practices (Section 6.0), and proper decontamination procedures (Section 12.0).

3.2 Physical Hazards

Remedial activities at the Site may present the following physical hazards:

- The potential for physical injury during heavy equipment use, such as drill rigs, back hoes, bull dozers or excavators.

- The potential for heat/cold stress to employees during the summer/winter months (see Section 10.0).

- The potential for slip and fall injuries due to rough, uneven terrain.

[1] http://www.epa.gov/safewater/pdfs/factsheets/ioc/cyanide.pdf

These hazards represent only some of the possible means of injury which may be present during remedial and sampling activities at the Site. Since it is impossible to list all potential sources of injury, it shall be the responsibility of each individual to exercise proper care and caution during all phases of the work.

4.0 TRAINING

4.1 Site Workers

All personnel performing remedial activities at the Site (such as, but not limited to, equipment operators and general laborers) and who may be exposed to hazardous substances, health hazards, or safety hazards and their supervisors/managers responsible for the Site shall receive training in accordance with 29 CFR 1910.120(e) before they are permitted to engage in operations in the exclusion zone or contaminant reduction zone. This training includes an initial 40-hour Hazardous Waste Site Worker Protection Course, an 8-hour Annual Refresher Course subsequent to the initial 40-hour training, and 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Additional site-specific training shall also be provided by the SSHO prior to the start of field activities. A description of topics to be covered by this training is provided below.

4.1.1 Initial and Refresher Training

Initial and refresher training is conducted by a qualified instructor as specified under OSHA 29 CFR 1910.120(e)(5), and is specifically designed to meet the requirements of OSHA 29 CFR 1910.120(e)(3) and 1910.120(e)(8). The training covers, as a minimum, the following topics:

- OSHA HAZWOPER regulations.
- Site safety and hazard recognition, including chemical and physical hazards.
- Medical monitoring requirements.
- Air monitoring, permissible exposure limits, and respiratory protection level classifications.
- Appropriate use of personal protective equipment (PPE), including chemical compatibility and respiratory equipment selection and use.
- Work practices to minimize risk.
- Work zones and Site control.

- Safe use of engineering controls and equipment.
- Decontamination procedures.
- Emergency response and escape.
- Confined space entry procedures.
- Heat and cold stress monitoring.
- Elements of a Health and Safety Contingency Plan.
- Spill containment.

Initial training also incorporates workshops for PPE and respiratory equipment use (Levels A, B and C), and respirator fit testing. Records and certification received from the course instructor documenting each employee's successful completion of the training identified above are maintained on file at Benchmark's Buffalo, NY office. Contractors and Subcontractors (if any) are required to provide similar documentation of training for all their personnel who will be involved in on-site work activities.

Any employee who has not been certified as having received health and safety training in conformance with 29 CFR 1910.120(e) is prohibited from working in the exclusion and contamination reduction zones, or to engage in any on-site work activities that may involve exposure to hazardous substances or wastes.

4.1.2 Site Training

Site workers are given a copy of the HSCP and provided a site-specific briefing prior to the commencement of work to ensure that employees are familiar with the HSCP and the information and requirements it contains. The site briefing shall be provided by the SSHO prior to initiating field activities and shall include:

- Names of personnel and alternates responsible for Site safety and health.
- Safety, health and other hazards present on the Site.

- The Site lay-out including work zones and places of refuge.
- The emergency communications system and emergency evacuation procedures.
- Use of PPE.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on the Site.
- Medical surveillance, including recognition of symptoms and signs of over-exposure (see Section 5).
- Decontamination procedures (see Section 12).
- The Emergency Response Plan (see Appendix A).
- Confined space entry procedures, if required (see Section 13).
- The spill containment program (see Section 9).
- Site control (see Section 11).

Supplemental health and safety briefings will also be conducted by the SSHO on an as-needed basis during the course of the work. Supplemental briefings are provided as necessary to notify employees of any changes to this HSCP as a result of information gathered during on-going Site characterization and analysis. Conditions for which the SSHO may schedule additional briefings include, but are not limited to: a change in Site conditions (viz., based on monitoring results); changes in the work schedule/plan; newly discovered hazards; and safety incidents occurring during Site work.

4.2 Supervisor Training

On-site safety and health personnel who are directly responsible for or who supervise the safety and health of workers engaged in hazardous waste operations (viz., SSHO) shall receive, in addition to the appropriate level of worker training described above, eight (8)

additional hours of specialized supervisory training, in compliance with 29 CFR 1910.120(e)(4).

4.3 Emergency Response Training

Emergency response training is addressed in Appendix A of this HSCP, Emergency Response Plan.

4.4 Site Visitors

Benchmark's SSHO will provide a site-specific briefing to all Site visitors and other non-Benchmark personnel who enter the Site beyond the Site entry point. The site-specific briefing will provide information about Site hazards, the Site lay-out including work zones and places of refuge, the emergency communications system and emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

Site visitors will not be permitted to enter the exclusion zone or contaminant reduction zones unless they have received the level of training required for Site workers as described in Section 4.1.

5.0 MEDICAL MONITORING

Medical monitoring examinations are provided to Benchmark employees as stipulated under 29 CFR Part 1910.120(f). These exams include initial employment and termination physicals for all Benchmark employees involved in hazardous waste Site field operations. Annual exams are provided for those employees who are engaged in hazardous waste site field operations for more than 30 days per year, or who meet other specific criteria listed in 29 CFR 1910.120(f). Post-exposure examinations are also provided for employees who may have been injured, received a health impairment, or developed signs or symptoms of over-exposure to hazardous substances or were accidentally exposed to substances at concentrations above the permissible exposure limits without necessary personal protective equipment. Such exams are performed as soon as possible following development of symptoms or the known exposure event.

Medical evaluations are performed by an occupational health care provider under contract with Benchmark, identified as Health Works WNY, Seneca Square Plaza, 1900 Ridge Road, West Seneca, New York 14224. The facility can be reached at (716) 823-5050 to schedule routine appointments or post-exposure examinations.

Medical evaluations are conducted according to the Benchmark-TurnKey Medical Monitoring Program and include an evaluation of the workers' ability to use respiratory protective equipment. The examinations include:

- Occupational/medical history review.
- Physical exam, including vital sign measurement.
- Spirometry testing.
- Eyesight testing.
- Audio testing (minimum baseline and exit, annual for employees routinely exposed to greater than 85db).
- EKG (for employees >40 years age or as medical conditions dictate).
- Chest X-ray (baseline and exit, and every 5 years).

- Blood biochemistry (including blood count, white cell differential count, serum multi-plastic screening).

- Medical certification of physical requirements (viz., sight, musculoskeletal, cardiovascular) for safe job performance and to wear respiratory protection equipment.

The purpose of the medical evaluation is to determine an employee's fitness for duty on hazardous waste sites; and to establish baseline medical data.

In conformance with OSHA regulations, Benchmark will maintain and preserve medical records for a period of 30 years following termination of employment. Employees are provided a copy of the physician's post-exam report, and have access to their medical records and analyses.

6.0 SAFE WORK PRACTICES

All Benchmark employees shall conform to the following safe work practices during all on-site work activities conducted within the exclusion and contamination reduction zones:

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth contact is strictly prohibited.
- The hands and face must be thoroughly washed upon leaving the work area and prior to engaging in any activity indicated above.
- Respiratory protective equipment and clothing must be worn by all personnel entering the Site as required by the HSCP or as modified by the Site Safety Officer. Excessive facial hair (i.e., beards, long mustaches or sideburns) that interferes with the satisfactory respirator-to-face seal is prohibited.
- Contact with surfaces/materials either suspected or known to be contaminated will be avoided to minimize the potential for transfer to personnel, cross contamination and need for decontamination.
- Due to possible contraindications, use of prescribed drugs should be reviewed with the Benchmark occupational physician.
- Alcoholic beverage and illegal drug intake are strictly forbidden during the work day.
- All personnel shall be familiar with standard operating safety procedures and additional instructions contained in this Health and Safety Contingency Plan.
- On-site personnel shall use the "buddy" system. No one may work alone (i.e., out of earshot or visual contact with other workers) in the exclusion zone.
- Personnel and equipment in the contaminated area shall be minimized, consistent with effective Site operations.
- All employees have the obligation to immediately report and if possible, correct unsafe work conditions.
- Use of contact lenses on-site will not be permitted. Spectacle kits for insertion

into full-face respirators will be provided for Benchmark employees, as requested and required.

The recommended specific safety practices for working around equipment (e.g., backhoes, bulldozers, excavators, etc.) are as follows:

- Any subcontractors are responsible for their equipment and safe operation of the Site; however, Benchmark personnel are also responsible for their own safety.
- Subsurface work will not be initiated without first clearing underground utility services.
- Heavy equipment should not be operated within 20 feet of overhead wires. This distance may be increased if windy conditions are anticipated or if lines carry high voltage. The Site should also be sufficiently clear to ensure the project staff can move around the heavy machinery safely.
- Care should be taken to avoid overhead wires when moving heavy-equipment from location to location.
- Hard hats, safety boots and safety glasses should be worn at all times in the vicinity of heavy equipment. Hearing protection is also recommended.
- The work Site should be kept neat. This will prevent personnel from tripping and will allow for fast emergency exit from the Site.
- Proper lighting must be provided when working at night.
- Activities should be discontinued during an electrical storm or severe weather conditions.
- The presence of combustible gases should be checked before igniting any open flame.
- Personnel shall stand upwind of any investigation activity when not immediately involved in sampling/logging/observing activities.
- Personnel will not approach the edge of an unsecured trench/excavation closer than 2 feet.

7.0 PERSONAL PROTECTIVE EQUIPMENT

7.1 Equipment Selection

Personal protective equipment (PPE) will be donned when work activities may result in exposure to physical or chemical hazards beyond acceptable limits, and when such exposure can be mitigated through appropriate PPE. The selection of PPE will be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the Site, the task-specific conditions and duration, and the hazards and potential hazards identified at the Site.

Equipment designed to protect the body against contact with known or suspect chemical hazards are grouped into four categories according to the degree of protection afforded. These categories, designated A through D consistent with United States Environmental Protection Agency (USEPA) Level of Protection designation, are:

- **Level A:** Should be selected when the highest level of respiratory, skin and eye protection is needed.

- **Level B:** Should be selected when the highest level of respiratory protection is needed, but a lesser level of skin protection is required. Level B (or Level A) is also necessary for oxygen-deficient atmospheres.

- **Level C:** Should be selected when the types of airborne substances are known, the concentrations have been measured and the criteria for using air-purifying respirators are met. In atmospheres where no airborne contaminants are present, Level C provides dermal protection only.

- **Level D:** Should not be worn on any site with elevated respiratory or skin hazards. This is generally a work uniform providing minimal protection.

OSHA requires the use of certain PPE under conditions where an immediate danger to life and health (IDLH) may be present. Specifically, OSHA 29 CFR 1910.120(g)(3)(iii) requires use of a positive pressure self-contained breathing apparatus, or positive pressure air-line respirator equipped with an escape air supply when chemical exposure levels present a substantial possibility of immediate serious injury, illness or death, or impair the ability to escape. Similarly, OSHA 29 CFR 1910.120(g)(3)(iv) requires donning totally-encapsulating

chemical protective suits (with a protection level equivalent to Level A protection) in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate serious illness, injury or death, or impair the ability to escape.

In situations where the types of chemicals, concentrations, and possibilities of contact are unknown, the appropriate level of protection must be selected based on professional experience and judgment until the hazards can be further characterized. The individual components of clothing and equipment must be assembled into a full protective ensemble to protect the worker from site-specific hazards, while at the same time minimizing hazards and drawbacks of the personal protective gear itself. Ensemble components are detailed below for levels A/B, C, and D protection.

7.2 Protection Ensembles

7.2.1 Level A/B Protection Ensemble

Level A/B ensembles include similar respiratory protection, however Level A provides a higher degree of dermal protection than Level B. Use of Level A over Level B is determined by: comparing the concentrations of identified substances in the air with skin toxicity data, and assessing the effect of the substance (by its measured air concentrations or splash potential) on the small area of the head and neck unprotected by Level B clothing.

The recommended PPE for level A/B is:

- Pressure-demand, full-face piece self-contained breathing apparatus (MSHA/-NIOSH approved) or pressure-demand supplied-air respirator with escape self-contained breathing apparatus (SCBA).
- Chemical-resistant clothing. For Level A, clothing consists of totally-encapsulating chemical resistant suit. Level B incorporates hooded one-or two-piece chemical splash suit.
- Inner and outer chemical resistant gloves.
- Chemical-resistant safety boots/shoes.
- Hardhat.

7.2.2 Level C Protection Ensemble

Level C protection is distinguished from Level B by the equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing an air-purifying device. The device (when required) must be an air purifying respirator (MSHA/NIOSH approved) equipped with filter cartridges. Cartridges must be able to remove the substances encountered. Respiratory protection will be used only with proper fitting, training and the approval of a qualified individual. In addition, an air-purifying respirator can be used only if: oxygen content of the atmosphere is at least 19.5% in volume; substances are identified and concentrations measured; substances have adequate warning properties; the individual passes a qualitative fit-test for the mask; and an appropriate cartridge/canister is used, and its service limit concentration is not exceeded.

Recommended PPE for Level C conditions includes:

- Full-face piece, air-purifying respirator equipped with MSHA and NIOSH approved organic vapor/acid gas/dust/mist combination cartridges or as designated by the SSHO.
- Chemical-resistant clothing (hooded, one or two-piece chemical splash suit or disposable chemical-resistant one-piece suit).
- Inner and outer chemical-resistant gloves.
- Chemical-resistant safety boots/shoes.
- Hardhat.

An air monitoring program is part of all response operations when atmospheric contamination is known or suspected. It is particularly important that the air be monitored thoroughly when personnel are wearing air-purifying respirators. Continual surveillance using direct-reading instruments is needed to detect any changes in air quality necessitating a higher level of respiratory protection.

7.2.3 Level D Protection Ensemble

As indicated above, Level D protection is primarily a work uniform. It can be worn in areas where only boots can be contaminated, where there are no inhalable toxic substances and where the atmospheric contains at least 19.5% oxygen.

Recommended PPE for Level D includes:

- Coveralls.
- Safety boots/shoes.
- Safety glasses or chemical splash goggles.
- Hardhat.
- Optional gloves; escape mask; face shield.

7.2.4 Recommended Level of Protection for Site Tasks

Based upon current information regarding both the contaminants suspected to be present at the Site and the various tasks that are included in the remedial activities, the minimum required Levels of Protection for these tasks shall be as identified in Table 4.

8.0 EXPOSURE MONITORING

8.1 General

Based on the results of historic sample analysis and the nature of the proposed work activities at the Site, the possibility exists that particulates may be released to the air during intrusive sampling activities. Ambient breathing zone concentrations may at times, exceed the permissible exposure limits (PEL) established by OSHA for the individual compounds (see Table 2), in which case respiratory protection will be required. Respiratory and dermal protection may be modified (upgraded or downgraded) by the SSHO based upon real-time field monitoring data.

8.1.1 Work Area Monitoring

Site personnel will conduct routine, real-time air monitoring during all intrusive construction phases such as excavation, backfilling, drilling, etc. The work area will be monitored at regular intervals using a photo-ionization detector (PID), combustible gas meter and a particulate meter. Observed values will be recorded and maintained as part of the permanent field record.

Additional air monitoring measurements may be made by Benchmark personnel to verify field conditions during subcontractor (if any) oversight activities. Monitoring instruments will be protected from surface contamination during use. Additional monitoring instruments may be added if the situations or conditions change. Monitoring instruments will be calibrated in accordance with manufacturer's instructions before use.

8.1.2 Community Air Monitoring

In addition to on-site monitoring within the work zone(s), monitoring at the down-wind portion of the Site will be conducted. This will provide a real-time method for determination of vapor and/or particulate releases to the surrounding community as a result of ground intrusive work.

Ground intrusive activities are defined by NYSDOH Generic Community Air Monitoring Plan (Appendix C). Ground intrusive activities include soil/waste excavation and

handling, test pitting or trenching, and the installation of soil borings or monitoring wells. Non-intrusive activities include the collection of soil and sediment samples or the collection of groundwater samples from existing wells. Continuous monitoring is required for ground intrusive activities and periodic monitoring is required for non-intrusive activities. Periodic monitoring consists of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring while bailing a well, and taking a reading prior to leaving a sampling location. This may be upgraded to continuous if the sampling location is in close proximity to individuals not involved in the Site activity (i.e., on a curb of a busy street). The action levels below will be used during periodic monitoring.

8.2 Monitoring Action Levels and Responses

8.2.1 Work Area Monitoring

The PID or other appropriate instrument(s) will be used by Benchmark to monitor organic vapor concentrations as specified in this plan. In addition, fugitive dust/particulate concentrations will be monitored during major soil intrusion (viz., well/boring installation) using a real-time particulate monitor as specified in this plan. Readings obtained in the breathing zone may be interpreted (with regard to other Site conditions) as follows for on-site Benchmark personnel:

- Total atmospheric concentrations of unidentified vapors or gases ranging from non-detect to background on the PID) - Continue operations under Level D (see Appendix C).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings above background to 5 ppm on the PID (vapors not suspected of containing high levels of chemicals toxic to the skin) - Continue operations under Level C (see Appendix C).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings of 5 to 50 ppm above background on the PID - Continue operations under Level B (see Appendix C), re-evaluate and alter (if possible) methods to achieve lower vapor concentrations.

- Total atmospheric concentrations of unidentified vapors or gases above 50 ppm on the PID - Discontinue operations and exit the work zone immediately.

The particulate monitor will be used to monitor respirable dust (PM-10) concentrations in the work zone during significant soil intrusion activities. Action levels based on the instrument readings shall be as follows:

- Less than 150 mg/m^3 - Continue field operations.
- Greater than 150 mg/m^3 - Don dust/particulate mask or equivalent. Initiate engineering controls to reduce respirable dust concentration (viz., wetting of excavated soils or tools) at discretion of Site Health and Safety Officer and as warranted based on upwind concentrations.

The explosimeter may be used to monitor levels of both combustible gases and oxygen during intrusive activities. Action levels based on the instrument readings shall be as follows:

- Less than 10% LEL - Continue engineering operations with caution.
- 10-25% LEL - Continuous monitoring with extreme caution, determine source/cause of elevated reading.
- Greater than 25% LEL - Explosion hazard, evaluate source and leave the Work Zone.
- 19.5% - 21% oxygen - Proceed with extreme caution; attempt to determine potential source of oxygen displacement.
- Less than 19.5% oxygen - Leave work zone immediately.
- 21-25% oxygen - Continue engineering operations with caution.
- Greater than 25% oxygen - Fire hazard potential, leave Work Zone immediately.

Readings with the monitoring equipment will be recorded and documented in the Health and Safety Logbook. All instruments will be calibrated before use and the procedure will be documented in the Health and Safety Logbook.

8.2.2 Community Air Monitoring Action Levels

In addition to the action levels described above, the following criteria shall also be adhered to by Benchmark personnel for the protection of the nearby community.

Organic Vapor Perimeter Monitoring

The following criteria shall also be adhered to for the protection of downwind receptors consistent with NYSDOH requirements (Appendix C):

- **ORGANIC VAPOR PERIMETER MONITORING:**
  - If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
  - If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
  - If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.
  - All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.
- **Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures**

- When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure (s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored Response levels and actions should be pre-determined, as necessary, for each site.

Additionally, if following the cessation of work and efforts to abate the emission source are unsuccessful, and if sustained organic vapor levels exceed 25 ppm above

background within the 20-foot zone for more than 30 minutes, then the **Major Vapor Emission Response Plan** (see below) will automatically be placed into effect.

- **MAJOR VAPOR EMISSION RESPONSE PLAN:**

  Upon activation, the following activities will be undertaken:

  1. All Emergency Response Contacts as listed in this Health and Safety Plan and the Emergency Response Plan (Appendix A) will be advised.

  2. The local police authorities will immediately be contacted by the Site Health and Safety Officer and advised of the situation.

  3. The Site Safety and Health Officer will determine if site workers can safely undertake source abatement measures. Abatement measures may include covering the source area with clean fill or plastic sheeting, or consolidating contaminated materials to minimize surface area. The Site Safety and Health Officer will adjust worker personal protective equipment as necessary to protect workers from over-exposure to organic vapors.

  The following personnel are to be notified in the listed sequence in the event that a Major Vapor Emission Plan is activated:

Responsible Person	Contact	Phone Number
SSHO	Police Genesee County Sheriff Dispatch Village of LeRoy Police New York State Police Zone 1	911 (585) 343-5000 (585) 768-2527 (585) 768-8070
SSHO	Fire LeRoy Fire Department	911 (585) 768-2527
SSHO	Ambulance LeRoy Ambulance and EMS	911 (585) 768-8612
SSHO	State Emergency Response Hotline	(800) 457-7362

  Additional emergency numbers are listed in the Emergency Response Plan included as Appendix A.

- **EXPLOSIVE VAPORS:**
  - Sustained atmospheric concentrations of greater than 10% LEL in the work area - Initiate combustible gas monitoring at the downwind portion of the Site perimeter.
  - Sustained atmospheric concentrations of greater than 10% LEL at the downwind Site perimeter – Halt work and contact local Fire Department.

Ambient Perimeter VOC Air Sampling

During intrusive activities, daily air sampling will be conducted at the downwind perimeter. The air samples will be collected utilizing a laboratory provided vacuum-sealed Summa Canister® equipped with an 8-hr flow controlling regulator. A Summa Canister® is a stainless steel, vacuum-sealed sample chamber with a volume of 6-liters. This collection equipment is intended to represent time-average VOC concentrations, in this case collected over an 8-hour typical work day time period.

The following procedure will be followed to collect the ambient air sample:

1. Prior to sample collection, the pressure in the Summa Canister® should be checked with a laboratory-supplied pressure gauge to assure that a minimum pressure of 28 inches of mercury is present.
2. Opening the valve on the canister will collect a 6-liter volume ambient air sample through the valve or tubing (if required) into an evacuated Summa Canister®. The canister will fill within 8-hour time period regulated by the sample port on the canister and retrieve a whole air sample from the breathing zone air space.
3. Record sample collection start time, sample station identification and Summa Canister® serial number in the field notebook.
4. After the specified sample collection time, close the canister valve and ship in a laboratory-supplied shipping box to the lab under Chain-of-Custody command for laboratory analysis of the Target Compound List (TCL) VOCs in accordance with USEPA Method TO-15.
5. Record ending time of sample collection, duration of collection, location identification at which the sample was collected, field staff present, barometric

pressure and weather conditions (i.e., ambient air temperature, wind speed, precipitation etc.) in the Field Log Book.

All analytical results and field readings will be available for United States Environmental Protection Agency (EPA), New York State Department of Environmental Conservation (DEC) and Department of Health (DOH) personnel to review once completed.

Airborne Particulate Community Air Monitoring

- Respirable (PM-10) particulate monitoring will be performed on a continuous basis at the downwind perimeter of the exclusion zone. The monitoring will be performed using real-time monitoring equipment capable of measuring PM-10 and integrating over a period of 15-minutes for comparison to the airborne particulate action levels. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities. All readings will be recorded and will be available for USEPA, NYSDEC and NYSDOH review. Background upwind monitoring may be initiated to provide baseline levels for evaluation if necessary.

Readings will be interpreted as follows:

- If the downwind PM-10 particulate level is greater than 100 micrograms per cubic meter (ug/m^3) reading for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression provided that the downwind PM-10 particulate levels do not exceed 150 ug/m^3, and that visible dust is not migrating from the work area.

- If, after implementation of dust suppression techniques downwind PM-10 levels are greater than 150 ug/m^3, work activities must be stopped and dust suppression controls re-evaluated. Work can resume provided that supplemental dust suppression measures and/or other controls are successful in reducing the downwind PM-10 particulate concentration to less than 150 ug/m^3 and in preventing visible dust migration.

9.0 SPILL RELEASE/RESPONSE

This chapter of the HSCP describes the potential for and procedures related to spills or releases of known or suspected contaminants on the Site. The purpose of this Section of the HSCP is to plan appropriate response, control, counter-measures and reporting, consistent with OSHA requirements in 29 CFR 1910.120(b)(4)(ii)(J) and (j)(1)(viii). The spill containment program addresses the following elements:

- Petroleum and/or potential hazardous material spills and available controls.
- Initial notification and evaluation.
- Spill response.
- Post-spill evaluation.

9.1 Potential Spills and Available Controls

An evaluation was conducted to determine the potential for hazardous material and oil/petroleum spills at this Site. For the purpose of this evaluation, hazardous materials posing a significant spill potential are considered to be:

- CERCLA Hazardous Substances as identified in 40 CFR Part 302, where such materials pose the potential for release in excess of their corresponding Reportable Quantity (RQ).
- Extremely Hazardous Substances as identified in 40 CFR Part 355, Appendix A, where such materials pose the potential for release in excess of their corresponding Reportable Quantity (RQ).
- Hazardous Chemicals as defined under Section 311(e) of the Emergency Planning and Community Right-To-Know Act of 1986, where such chemicals are present or will be stored in excess of 10,000 lbs.
- Toxic Chemicals as defined in 40 CFR Part 372, where such chemicals are present or will be stored in excess of 10,000 lbs.
- Chemicals regulated under 6NYCRR Part 597, where such materials pose the

potential for release in excess of their corresponding Reportable Quantity (RQ).

Oil/petroleum products are considered to pose a significant spill potential whenever the following situations occur:

- the potential for a "harmful quantity" of oil (including petroleum and non-petroleum-based fuels and lubricants) to reach navigable waters of the U.S. exists (40 CFR Part 112.4). Harmful quantities are considered by USEPA to be volumes of 1,000 gallons or more, or lesser quantities that either form a visible sheen on the water or violate applicable water quality standards.

- the potential for any amount of petroleum to reach any waters of NY State, including groundwater, exists. Petroleum, as defined by NY State in 6NYCRR Part 612, is a petroleum-based heat source, energy source, or engine lubricant/maintenance fluid.

- the potential for any release, to soil or water, of petroleum from a bulk storage facility regulated under 6NYCRR Part 612. A regulated petroleum storage facility is defined by NY State as a Site having stationary tank(s) and intra-facility piping, fixtures and related equipment with an aggregate storage volume of 1100 gallons or greater.

The evaluation indicates that, based on Site history, planned activities, and decommissioning records, a material spill is not likely to occur during remedial efforts. However, the procedures identified below will be followed in the event of an unanticipated release.

9.2 Initial Spill Notification and Evaluation

Any worker who discovers a hazardous substance or oil/petroleum spill will immediately notify the Project Manager and SSHO. The worker will, to the best of his/her ability, report the material involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, if any, and any associated injuries. The Emergency Response Plan presented in Appendix A of this HSCP will immediately be implemented if an emergency release has occurred.

Following initial report of a spill, the Project Manager will make an evaluation as to

whether the release exceeds RQ levels. If an RQ level is exceeded, the Project Manager will notify the Site owner who will in turn notify the National Response Center at 800-424-8802 and the NYSDEC at 1-800-457-7362 within 2 hours of spill discovery. Upon the occurrence of any event requiring notification to the National Response Center, the Chief of the Removal Action Branch of the Emergency and Remedial Response Division of EPA Region 2 shall be orally notified (762) 321-6658, of the incident or site condition. A written report will be submitted to the EPA within seven (7) days after the onset of such an event setting forth the events that occurred and the measures taken, if any, to mitigate any release or endangerment caused or threatened by the release and to prevent the reoccurrence of such a release. The Project Manager will also determine what additional agencies are to be contacted regarding the release, and will follow-up with written reports as required by the applicable regulations which may include reporting requirements of CERCLA Section 103, 42 U.S.C. § 9603 or Section 304 of the Emergency Planning and Community Right-To-Know Act of 1986, 42 U.S.C. § 11004.

9.3 Spill Response

For all spill situations, the following general response guidelines will apply:

- Only those personnel involved in overseeing or performing containment operations will be allowed within the spill area. If necessary, the area will be roped, ribboned or otherwise blocked off to prevent unauthorized access.
- Appropriate PPE, as specified by the SSHO, will be donned before entering the spill area.
- Ignition points will be extinguished/removed if fire or explosion hazards exist.
- Surrounding reactive materials will be removed.
- Drains or drainage in the spill area will be blocked to prevent inflow of spilled materials or applied materials.

For minor spills, Benchmark will maintain a Spill Control and Containment Kit in the Field Office or other readily accessible storage location. The kit will consist of, at a

minimum, a 50 lb. bag of "speedy dry" granular absorbent material, absorbent pads, shovels, empty 5-gallon pails and an empty open-top 55-gallon drum. Spilled materials will be absorbed, and shoveled into a 55-gallon drum for proper disposal (USEPA approval will be secured for on-site treatment of the impacted soils/absorbent materials, if applicable). Impacted soils will be hand-excavated to the point that no visible signs of contamination remains, and will be drummed with the absorbent.

In the event of a major release or a release that threatens surface water, a spill response contractor will be called to the Site. The response contractor may use heavy equipment (viz., excavator, backhoe, etc.) to berm the soils surrounding the spill site or create diversion trenching to mitigate overland migration or release to navigable waters. Where feasible, pumps will be used to transfer free liquid to storage containers. Spill control/cleanup contractors in the Western New York area that may be contacted for assistance (in order of preference) include:

- New York Environmental Technologies, Inc.: (585) 436-5660
- Environmental Products and Services of Vermont, Inc.: (315) 451-6666
- Green Environment Specialists, Inc.: (716) 298-5297

9.4 Post-Spill Evaluation

If a reportable quantity of hazardous material or oil/petroleum is spilled as determined by the Project Manager, a written report will be prepared as indicated in Section 9.2. The report will identify the root cause of the spill, type and amount of material released, date/time of release, response actions, agencies notified and/or involved in cleanup, and procedures to be implemented to avoid repeat incidents. In addition, all re-useable spill cleanup and containment materials will be decontaminated, and spill kit supplies/disposable items will be replenished.

10.0 HEAT/COLD STRESS MONITORING

Since some of the work activities at the Site may be scheduled for both summer and winter months, measures will be taken to minimize heat/cold stress to Benchmark employees. The Site Safety and Health Officer and/or his or her designee will be responsible for monitoring Benchmark field personnel for symptoms of heat/cold stress.

10.1 Heat Stress Monitoring

Personal protective equipment may place an employee at risk of developing heat stress, a common and potentially serious illnesses often encountered at construction, landfill, waste disposal, industrial or other unsheltered sites. The potential for heat stress is dependent on a number of factors, including environmental conditions, clothing, workload, physical conditioning and age. Personal protective equipment may severely reduce the body's normal ability to maintain temperature equilibrium (via evaporation and convection), and require increased energy expenditure due to its bulk and weight.

Proper training and preventive measures will mitigate the potential for serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illness. To avoid heat stress, the following steps should be taken:

- Adjust work schedules.
- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat (i.e., eight fluid ounces

must be ingested for approximately every 1 lb of weight lost). The normal thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost perspiration. When heavy sweating occurs, workers should be encouraged to drink more.

- Train workers to recognize the symptoms of heat related illness.

Heat-Related Illness - Symptoms:

- Heat rash may result from continuous exposure to heat or humid air.

- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: muscle spasms; pain in the hands, feet and abdomen.

- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: pale, cool, moist skin; heavy sweating; dizziness; nausea; fainting.

- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: red, hot, usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

The monitoring of personnel wearing protective clothing should commence when the ambient temperature is 70 degrees Fahrenheit or above. For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism.

- Heart rate may be measured by the radial pulse for 30 seconds as early as possible in the resting period. The rate at the beginning of the rest period should not exceed 100 beats per minute. If the rate is higher, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest periods stay the same, If the pulse rate is 100 beats per minute at the beginning of the nest rest period, the following work cycle should be further shortened by 33%.

- Body temperature may be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99.6 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period remains the same. However, if the oral temperature exceeds 99.6 degrees Fahrenheit at the beginning of the next period, the work cycle may be further shortened by 33%. Oral temperature should be measured at the end of the rest period to make sure that it has dropped below 99.6 degrees Fahrenheit. No Benchmark employee will be permitted to continue wearing semi-permeable or impermeable garments when his/her oral temperature exceeds 100.6 degrees Fahrenheit.

10.2 Cold Stress Monitoring

Exposure to cold conditions may result in frostbite or hypothermia, each of which progresses in stages as shown below.

- **Frostbite** occurs when body tissue (usually on the extremities) begins to freeze. The three states of frostbite are:

  1) **Frostnip** - This is the first stage of the freezing process. It is characterized by a whitened area of skin, along with a slight burning or painful sensation. Treatment consists of removing the victim from the cold conditions, removal of boots and gloves, soaking the injured part in warm water (102 to 108 degrees Fahrenheit) and drinking a warm beverage. Do not rub skin to generate friction/ heat.

  2) **Superficial Frostbite** - This is the second stage of the freezing process. It is characterized by a whitish gray area of tissue which will be firm to the touch but will yield little pain. The treatment is identical for Frostnip.

  3) **Deep Frostbite** - In this final stage of the freezing process the affected tissue will be cold, numb and hard and will yield little to no pain. Treatment is identical to that for Frostnip.

- **Hypothermia** is a serious cold stress condition occurring when the body loses heat at a rate faster than it is produced. If untreated, hypothermia may be fatal. The stages of hypothermia may not be clearly defined or visible at first, but generally include:

1) Shivering

2) Apathy (i.e., a change to an indifferent or uncaring mood)

3) Unconsciousness

4) Bodily freezing

Employees exhibiting signs of hypothermia should be treated by medical professionals. Steps that can be taken while awaiting help include:

1) Remove the victim from the cold environment and remove wet or frozen clothing. (Do this carefully as frostbite may have started.)

2) Perform active re-warming with hot liquids for drinking (Note: do not give the victim any liquid containing alcohol or caffeine) and a warm water bath (102 to 108 degrees Fahrenheit).

3) Perform passive re-warming with a blanket or jacket wrapped around the victim.

In any potential cold stress situation, it is the responsibility of the Site Health and Safety Officer to encourage the following:

- Education of workers to recognize the symptoms of frostbite and hypothermia.
- Workers should dress warmly, with more layers of thin clothing as opposed to one thick layer.
- Personnel should remain active and keep moving.
- Personnel should be allowed to take shelter in a heated area, as necessary.
- Personnel should drink warm liquids (no caffeine or alcohol if hypothermia has set in).
- For monitoring the body's recuperation from excess cold, oral temperature recordings should occur:
    - At the Site Safety Technicians discretion when suspicion is based on

changes in a worker's performance or mental status.

- At a workers request.

- As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind chill less than 20 degrees Fahrenheit or wind chill less than 30 degrees Fahrenheit with precipitation).

- As a screening measure whenever anyone worker on Site develops hypothermia.

Any person developing moderate hypothermia (a core body temperature of 92 degrees Fahrenheit) will not be allowed to return to work for 48 hours without the recommendation of a qualified medical doctor.

11.0 WORK ZONES AND SITE CONTROL

Work zones around the areas designated for intrusive activities will be established by Benchmark on a daily basis and communicated to all employees and other Site users by the SSHO. It shall be the Site Safety and Health Officer's responsibility to ensure that all Site workers are aware of the work zone boundaries and to enforce proper procedures in each area. The zones will include:

- Exclusion Zone ("Hot Zone") - The area where contaminated materials may be exposed, excavated or handled and all areas where contaminated equipment or personnel may travel. The zone will be delineated by flagging tape. All personnel entering the Exclusion Zone must wear the prescribed level of personal protective equipment identified in Section 7.

- Contaminant Reduction Zone - The zone where decontamination of personnel and equipment takes place. Any potentially contaminated clothing, equipment and samples must remain in the Contaminant Reduction Zone until decontaminated.

- Support Zone - The part of the Site that is considered non-contaminated or "clean." Support equipment will be located in this zone, and personnel may wear normal work clothes within this zone.

In the absence of other task-specific work zone boundaries established by the SSHO, the following boundaries will apply to all intrusive activities involving disruption or handling of Site soils, sediment or groundwater:

- Exclusion Zone: 50 foot radius from the outer limit of the sampling activity.

- Contaminant Reduction Zone: 100 foot radius from the outer limit of the sampling activity.

- Support Zone: Areas outside the Contaminant Reduction Zone.

Access of non-essential personnel to the Exclusion and Contaminant Reduction Zones will be strictly controlled by Benchmark. Only personnel wearing the prescribed level

of protection who are essential to the completion of the task will be allowed access to these areas. Entrance of all personnel must be approved by the SSHO.

Benchmark will maintain a Health and Safety Logbook containing the names of workers and their level of protection. The zone boundaries may be changed by the SSHO as environmental conditions warrant, and to respond to the necessary changes in work locations on-site.

12.0 DECONTAMINATION

12.1 Decontamination for Benchmark Employees

The degree of decontamination required is a function of a particular task and the environment within which it occurs. The following decontamination procedure will remain flexible, thereby allowing the decontamination crew to respond appropriately to the changing environmental conditions which may arise at the Site. All Benchmark personnel on-site shall follow the procedure below.

Station 1 - Equipment Drop: Deposit visibly contaminated (if any) re-useable equipment used in the contamination reduction and exclusion zones (tools, containers, monitoring instruments, radios, clipboards, etc.) on plastic sheeting.

Station 2 - Boots and Gloves Wash and Rinse: Scrub outer boots and outer gloves. Deposit tape and gloves in waste disposal container.

Station 3 - Tape, Outer Boot and Glove Removal: Remove tape, outer boots and gloves. Deposit tape and gloves in waste disposal container.

Station 4 - Canister or Mask Change: If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot cover donned, and worker returns to duty.

Station 5 - Outer Garment/Face Piece Removal: Protective suit removed and deposited in separate container provided by Benchmark. Face piece or goggles are removed if used. Avoid touching face with fingers. Face piece and/or goggles deposited on plastic sheet. Hard hat removed and placed on plastic sheet.

Station 6 - Inner Glove Removal: Inner gloves are the last personal protective equipment to be removed. Avoid touching the outside of the gloves with bare fingers. Dispose of these gloves in waste disposal container.

Following PPE removal, personnel shall wash hands, face and forearms with absorbent wipes. If field activities proceed for durations of 6 consecutive months or longer, shower facilities will be provided for worker use in accordance with OSHA 29 CFR 1910.120(n).

12.2 Decontamination for Medical Emergencies

In the event of a minor, non-life threatening injury, personnel should follow the decontamination procedures as defined, and then administer first-aid.

In the event of a major injury or other serious medical concern (e.g., heat stroke), immediate first-aid is to be administered and the victim transported to the hospital in lieu of further decontamination efforts unless exposure to a Site contaminant would be considered "Immediately Dangerous to Life or Health."

12.3 Decontamination of Field Equipment

Decontamination of heavy equipment will be conducted within the self-contained decontamination stations as detailed within the Remedial Action Management Plan included as Volume I of the Remedial Action Work Plan. As a minimum, this will include manually removing heavy soil clods, followed by high pressure water and detergent or steam cleaning.

Decontamination of all tools used for sample collection purposes will be conducted by Benchmark personnel. It is expected that all tools will be constructed of nonporous, nonabsorbent materials (i.e., metal) which will aid in the decontamination effort. Any tool or part of a tool made of porous, absorbent material (i.e., wood) will be placed into suitable containers and prepared for disposal. Decontamination of bailers, split-spoons, spatula knives, and other tools used for environmental sampling and examination shall be as described in the Field Operating Procedure for Drilling and Excavation Equipment Decontamination included in the Remedial Design Report for the site.

13.0 CONFINED SPACE ENTRY

OSHA 29 CFR 1910.146 identifies a confined space as a space which is large enough and so configured that an employee can physically enter and do assigned work, has limited or restricted means for entry and exit, and is not intended for continuous employee occupancy. Confined spaces include, but are not limited to, trenches, storage tanks, process vessels, pits, sewers, tunnels, underground utility vaults, pipelines, sumps, wells, and excavations.

Confined space entry by Benchmark employees is not anticipated to be necessary to complete the remedial activities. In the event that the scope of work changes or confined space entry appears necessary, the Project Manager will be consulted to determine if feasible engineering alternatives to confined space entry can be implemented. If confined space entry by Benchmark employees cannot be avoided through reasonable engineering measures, task-specific confined space entry procedures will be developed and a confined-space entry permit will be issued through Benchmark's corporate Health and Safety Director. Benchmark employees shall not enter a confined space without these procedures and permits in place.

14.0 FIRE PREVENTION AND PROTECTION

14.1 General Approach

Recommended practices and standards of the National Fire Protection Association (NFPA) and other applicable regulations will be followed in the development and application of Project Fire Protection Programs. When required by regulatory authorities, the project management will prepare and submit a Fire Protection Plan for the approval of the contracting officers, authorized representative or other designated official. Essential considerations for the Fire Protection Plan will include:

- Proper Site preparation and safe storage of combustible and flammable materials.
- Availability of coordination with private and public fire authorities.
- Adequate job-site fire protection and inspections for fire prevention.
- Adequate indoctrination and training of employees.

14.2 Equipment and Requirements

Fire extinguishers will be provided by Benchmark and are required on all heavy equipment brought on-site. Fire extinguishers will be inspected, serviced, and maintained in accordance with the manufacturer's instructions. As a minimum, all extinguishers shall be checked monthly and weighed semi-annually, and recharged if necessary. Recharge or replacement shall be mandatory immediately after each use.

14.3 Flammable and Combustible Substances

All storage, handling or use of flammable and combustible substances will be under the supervision of qualified persons. All tanks, containers and pumping equipment, whether portable or stationary, which are used for the storage and handling of flammable and combustible liquids, will meet the recommendations of the National Fire Protection Association.

14.4 Hot Work

If the scope of work necessitates welding or blow torch operation, the hot work permit presented in Appendix B will be completed by the SSHO and reviewed/issued by the Project Manager.

15.0 EMERGENCY INFORMATION

In accordance with OSHA 29 CFR Part 1910, an Emergency Response Plan is attached to this HSCP as Appendix A.

16.0 REFERENCES

1. Administrative Order for Remedial Action, Lehigh Valley Railroad (LVRR) Derailment Superfund Site, LeRoy, NY. CERCLA 02-2014-2010. United States Environmental Protection Agency, Region 2, March 2014.

2. New York State Department of Environmental Conservation (NYSDEC) Record of Decision (ROD) & Supplemental Memorandum (EPA), LVRR Derailment Superfund Site, LeRoy, NY. March 1997 & May 2002.

3. Spill Site Soil Investigation Report (RI/FS), LVRR Derailment Superfund Site, LeRoy, NY. Rust Environmental & Infrastructure of New York, October 1996.

4. Pre-Remedial Design Soil Data Summary & Addendum, LVRR Derailment Superfund Site, LeRoy, NY. Unicorn Management Consultants, LLC (UMC), December 2010 & January 2011.

5. Soil Remedial Design Report, LVRR Derailment Superfund Site, LeRoy, NY. Benchmark Environmental Engineering & Science, PLLC on behalf of UMC, September 2013.

TABLES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TABLE 1

CONSTITUENTS OF CONCERN & OBSERVED CONCENTRATIONS BY MEDIA

Health & Safety Contingency Plan
Lehigh Valley Railroad Derailment Superfund Site
LeRoy, New York

Parameter	Soil (mg/kg)
cis-1,2-Dichloroethene (cis 1,2-DCE)	ND - 3.4[1]
Trichloroethene (TCE)	ND - 400[1]
Cyanide	ND-25.3[2]

Notes:

[1] Maximum concentrations detected during the 2010 RI; Concentrations from SB-F6 (2-4').

[2] Maximum concentrations detected during the 1996 SI Report. Subsequent investigations have not identified detectable concentrations of cyanide.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TABLE 2

TOXICITY AND EXPOSURE DATA FOR CONSTITUENTS OF CONCERN

Health & Safety Contingency Plan
Lehigh Valley Railroad Delrailment Superfund Site
LeRoy, New York

Constituents of Concern	Inhalation Hazard		IDLH
	PEL	TLV	
Volatile Organic Compounds (ppm):			
cis-1,2-Dichloroethene (cis 1,2-DCE)	200 ppm	200 ppm	1,000 ppm
Trichloroethene (TCE)	100 ppm	50 ppm	1,000 ppm, Ca
Cyanide	4.7 ppm	4.7 ppm	21.8 ppm

Notes:

PEL - Permissible Exposure Limit, established by OSHA, equals the maximium exposure concentration allowable for 8 hours per day @ 40 hours per week.

TLV - Threshold Limit Value, established by ACGIH, equals the maximum exposure concentration allowable for 8 hours per day @ 40 hours per week.

C - Ceiling Level equals the maximum exposure concentration allowable during the work day.

IDLH - Immediately Dangerous to Life or Health

Ca - NIOSH considers constituent to be a potential occupational carcinogen.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TABLE 3

POTENTIAL ROUTES OF EXPOSURE TO CONSTITUENTS OF CONCERN

Health & Safety Contingency Plan
Lehigh Valley Railroad Derailment Superfund Site
LeRoy, New York

Activity	Direct Contact with Subsurface Soils	Direct Contact with Groundwater [1]	Inhalation of Vapors or Dust
SVE System Installation (site grading, trenching, extraction piping installation)	X		X
OM&M of SVE System			X

Notes

1. Groundwater was found to be at the soil-bedrock interface and at depths greater than 6 feet below ground surface (fbgs) during RI activities. Contact with groundwater is not expected during remedial action.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TABLE 4

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)1 LEVELS

Health & Safety Contingency Plan
Lehigh Valley Railroad Derailment Superfund Site
LeRoy, New York

Activity	Respiratory Protection[2]	Clothing	Gloves	Boots	Other Required PPE/Modifications[3]
OM&M of SVE System	Level D	Work Uniform or Tyvek	L	L outer, steel-toed safety boot inner	Hardhat, Safety glasses w/ side shields
SVE System Installation (site grading, trenching, extraction piping installation)	Level D; upgrade to Level C if necessary	Work Uniform or Tyvek	L	L outer, steel-toed safety boot inner	Hardhat, Safety glasses w/ side shields

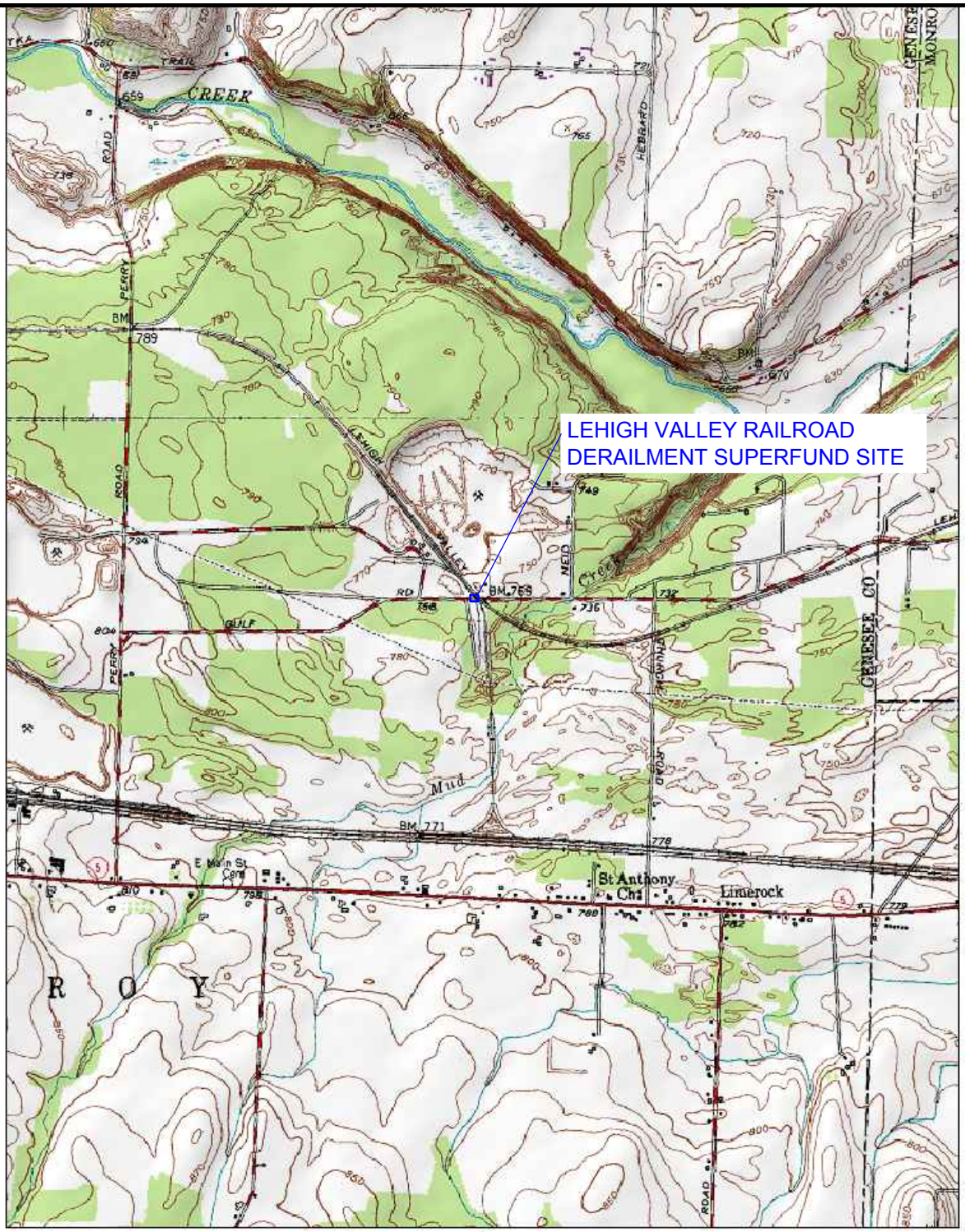
Notes:

1. T = Tyvek; L= Latex; N = Nitrile; S = Saranex
2. Respiratory equipment shall conform to guidelines presented in Section 8. The Level C requirement is an air-purifying respirator equipped with organic compound/acid gas/dust cartridge.
3. Dust masks shall be donned as directed by the site health and safety officer or site safety technician whenever potentially contaminated airborne particulates (i.e., dust) are present in significant amounts in the breathing zone. Goggles may be substituted with safety glasses w/side-shields whenever contact with contaminated liquids is not anticipated.

FIGURES

F:\CAD\Benchmark\Unicorn\LVRR Site\HSCP\Figure 1; Regional Vacinity Map.dwg

FIGURE 1



BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

PROJECT NO.: 0276-014-001

DATE: MAY 2014

DRAFTED BY: BLR

REGIONAL VICINITY MAP

HEALTH AND SAFETY CONTINGENCY PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR

LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

F:\CAD\Benchmark\Unicorn\LVRR Site\HSCP\Figure 2; Site Plan (Aerial).dwg

DATE: MAY 2014
DRAFTED BY: BLR

SITE PLAN AERIAL

HEALTH AND SAFETY CONTINGENCY PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR

LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE 2

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-014-001

ATTACHMENT A

EMERGENCY RESPONSE PLAN

EMERGENCY RESPONSE PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

Le Roy, New York

Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to
Unicorn Management Consultants, LLC
For
Lehigh Valley Railroad Company
Cincinnati, Ohio

HEALTH AND SAFETY CONTINGENCY PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

APPENDIX A: EMERGENCY RESPONSE PLAN

TABLE OF CONTENTS

LIST OF FIGURES

1.0 GENERAL

This appendix of the HSCP describes potential emergencies that may occur at the Site; procedures for responding to those emergencies; roles and responsibilities during emergency response; and training all workers must receive in order to follow emergency procedures. This ERP also describes the provisions this Site has made to coordinate its emergency response planning with other contractors (if any) on-site and with off-site emergency response organizations.

This ERP is consistent with the requirements of 29 CFR 1910.120(l) and provides the following site-specific information:

- Pre-emergency planning.
- Personnel roles, lines of authority, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Evacuation routes and procedures.
- Decontamination procedures.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedures.
- Critique of response and follow-up.
- Emergency personal protective equipment (PPE) and equipment.

2.0 PRE-EMERGENCY PLANNING

This Site has been evaluated for potential emergency occurrences, based on site hazards, the required work tasks, the site topography, and prevailing weather conditions. The results of that evaluation indicate the potential for the following site emergencies to occur at the locations indicated.

Type of Emergency:

1. Medical, due to physical injury

Source of Emergency:

1. Slip/trip/fall

Location of Source:

1. Non-specific

3.0 ON-SITE EMERGENCY RESPONSE EQUIPMENT

Emergency procedures may require specialized equipment to facilitate worker rescue, contamination control and reduction, or post-emergency clean up. Emergency response equipment available on the Site is listed below. The equipment inventory and storage locations are based on the potential emergencies described above. This equipment inventory is designed to meet on-site emergency response needs and any specialized equipment needs that off-site responders might require because of the hazards at this Site but not ordinarily stocked.

Any additional personal protective equipment (PPE) required and stocked for emergency response is also listed in below. During an emergency, the Emergency Response Coordinator (ERC) is responsible for specifying the level of PPE required for emergency response. At a minimum, PPE used by emergency responders will comply with Section 7.0, Personal Protective Equipment, of this HASP. Emergency response equipment is inspected at regular intervals and maintained in good working order. The equipment inventory is replenished as necessary to maintain response capabilities.

Emergency Equipment	Quantity	Location
First Aid Kit	1	Site Vehicle
Chemical Fire Extinguisher	2 (minimum)	All heavy equipment and Site Vehicle

Emergency PPE	Quantity	Location
Full-face respirator	1 for each worker	Site Vehicle
Chemical-resistant suits	4 (minimum)	Site Vehicle

4.0 EMERGENCY PLANNING MAPS

An area-specific map of the Site will be developed on a daily basis during performance of field activities. The map will be marked to identify critical on-site emergency planning information, including: emergency evacuation routes, a place of refuge, an assembly point, and the locations of key site emergency equipment. Site zone boundaries will be shown to alert responders to known areas of contamination. There are no major topographical features, however the direction of prevailing winds/weather conditions that could affect emergency response planning are also marked on the map. The map will be posted at site-designated place of refuge and inside the Benchmark personnel field vehicle.

5.0 EMERGENCY CONTACTS

The following identifies the emergency contacts for this ERP.

Emergency Telephone Numbers:

Project Manager: ***Thomas H. Forbes, P.E.***
Work: (716) 856-0599
Mobile: (716) 864-1730

Corporate Health and Safety Director: ***Thomas H. Forbes, P.E.***
Work: (716) 856-0599
Mobile: (716) 864-1730

Site Safety and Health Officer (SSHO): ***Richard L. Dubisz***
Work: (716) 856-0599
Mobile: (716) 998-4334

Alternate SSHO: ***John T. Deth***
Work: (716) 856-0599
Mobile: (716) 863-0333

HOSPITAL (ER):	(585) 343-6030
FIRE:	911 (Emergency)/(585) 768-2527 (Non-Emergency)
AMBULANCE:	911 (Emergency)/(585) 768-8612 (Non-Emergency)
POLICE:	911 (Emergency)/(585) 343-5000 (Genesee County Sheriff Dispatch)
STATE EMERGENCY RESPONSE HOTLINE:	(800) 457-7362
CHIEF OF THE REMOVAL BRANCH OF THE EMERGENY AND REMEDIAL RESPONSE DIVISION, EPA REGION 2	(732) 321-6658
NATIONAL RESPONSE HOTLINE:	(800) 424-8802
NYSDOH:	(518) 402-7860
NYSDEC:	(716) 851-7220
NYSDEC 24-HOUR SPILL HOTLINE:	(800) 457-7252

The Site location is:
8300 Gulf Road
LeRoy, New York
(Site is approximately 2.5 miles northeast of the Village of LeRoy, NY)

Site Phone Number: (Insert Cell Phone or Field Trailer): _____

6.0 EMERGENCY ALERTING & EVACUATION

Internal emergency communication systems are used to alert workers to danger, convey safety information, and maintain site control. Any effective system can be employed. Two-way radio headsets or field telephones are often used when work teams are far from the command post. Hand signals and air-horn blasts are also commonly used. Every system must have a backup. It shall be the responsibility of each contractor's Site Health and Safety Officer (if any) to ensure all personnel entering the site understand an adequate method of internal communication. Unless all personnel are otherwise informed, the following signals shall be used.

1) Emergency signals by portable air horn, siren, or whistle: two short blasts, personal injury; continuous blast, emergency requiring site excavation.

2) Visual signals: hand gripping throat, out of air/cannot breathe; hands on top of head, need assistance; thumbs up, affirmative/ everything is OK; thumbs down, no/negative; grip partner's wrist or waist, leave area immediately.

If evacuation notice is given, site workers leave the worksite with their respective buddies, if possible, by way of the nearest exit. Emergency decontamination procedures detailed in Section 12.0 of the HASP are followed to the extent practical without compromising the safety and health of site personnel. The evacuation routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by rehearsals and inputs from emergency response organizations. Wind direction indicators are located so that workers can determine a safe up wind or cross wind evacuation route and assembly area if not informed by the emergency response coordinator at the time the evacuation alarm sounds. Since work conditions and work zones within the site may be changing on daily basis, it shall be the responsibility of the construction Site Health and Safety Officer to review evacuation routes and procedures as necessary and to inform all Benchmark-TurnKey workers of any changes.

Personnel exiting the site will gather at a designated assembly point. To determine that everyone has successfully exited the site, personnel will be accounted for at the assembly

site. If any worker cannot be accounted for, notification is given to the SSHO so that appropriate action can be initiated. Contractors and subcontractors (if any) on this site have coordinated their emergency response plans to ensure that these plans are compatible and that source(s) of potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

7.0 EXTREME WEATHER CONDITIONS

In the event of adverse weather conditions, the Site Safety and Health Officer in conjunction with the Contractor's SSHO (if any) will determine if engineering operations can continue without sacrificing the health and safety of site personnel. Items to be considered prior to determining if work should continue include but are not limited to:

- Potential for heat/cold stress.
- Weather-related construction hazards (e.g., flooding or wet conditions producing undermining of structures or sheeting, high wind threats, etc).
- Limited visibility.
- Potential for electrical storms.
- Limited site access/egress (e.g., due to heavy snow)

8.0 EMERGENCY MEDICAL TREATMENT & FIRST AID

Personnel Exposure:

The following general guidelines will be employed in instances where health impacts threaten to occur acute exposure is realized:

- Skin Contact: Use copious amounts of soap and water. Wash/rinse affected area for at least 15 minutes. Decontaminate and provide medical attention. Eyewash stations will be provided on site. If necessary, transport to Buffalo General Hospital.
- Inhalation: Move to fresh air and, if necessary, transport to Hospital.
- Ingestion: Decontaminate and transport to Hospital.

Personal Injury:

Minor first-aid will be applied on-site as deemed necessary. In the event of a life threatening injury, the individual should be transported to Hospital via ambulance. The Site Health and Safety Officer will supply available chemical specific information to appropriate medical personnel as requested.

First aid kits will conform to Red Cross and other applicable good health standards, and shall consist of a weatherproof container with individually sealed packages for each type of item. First aid kits will be fully equipped before being sent out on each job and will be checked weekly by the SSHO to ensure that the expended items are replaced.

Directions to United Memorial Medical Center (see Figure 1):

The following directions describe the best route from the Site to United Memorial Medical Center:

- From the Site head west on Gulf Road (1 mile)
- Turn left onto Circular Hill Road (0.7 miles)
- Turn right onto East Main Road and head west through LeRoy and towards Batavia (approximately 11.5 miles).
- In Batavia, turn right onto Summit Street and head north (0.6 miles).
- Turn right onto North Street (100 feet)
- United Memorial Medical Center on Left. Follow signs to the ER.

9.0 EMERGENCY RESPONSE CRITIQUE & RECORD KEEPING

Following an emergency, the SSHO and Project Manager shall review the effectiveness of this Emergency Response Plan (ERP) in addressing notification, control and evacuation requirements. Updates and modifications to this ERP shall be made accordingly. It shall be the responsibility of each contractor (if any) to establish and assure adequate records of the following:

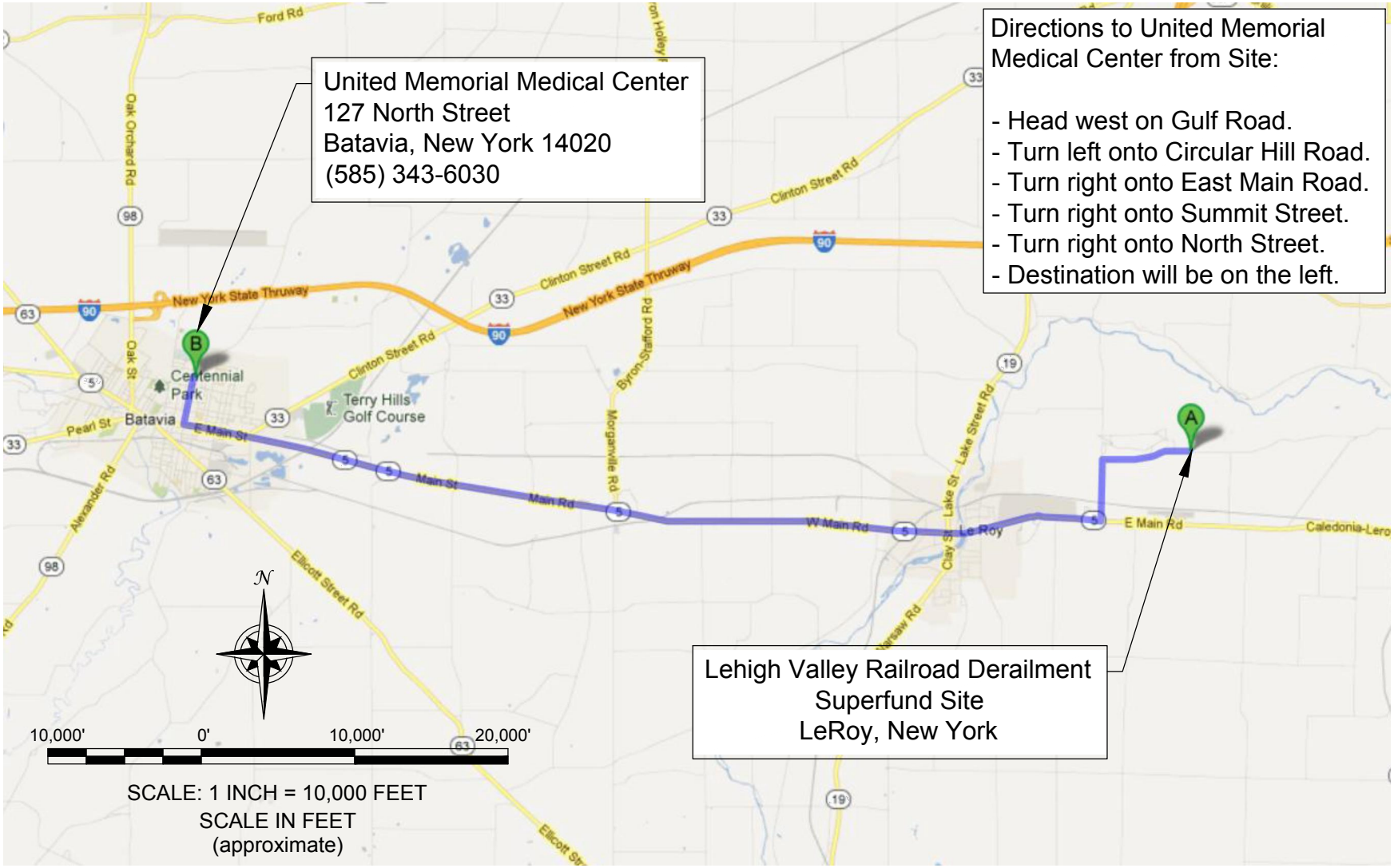
- Occupational injuries and illnesses.
- Accident investigations.
- Reports to insurance carrier or State compensation agencies.
- Reports required by the client.
- Records and reports required by local, state, federal and/or international agencies.
- Property or equipment damage.
- Third party injury or damage claims.
- Environmental testing logs.
- Explosive and hazardous substances inventories and records.
- Records of inspections and citations.
- Safety training.

10.0 EMERGENCY RESPONSE TRAINING

All persons who enter the worksite, including visitors, shall receive a site-specific briefing about anticipated emergency situations and the emergency procedures by the SSHO. Where this site relies on off-site organizations for emergency response, the training of personnel in those off-site organizations has been evaluated and is deemed adequate for response to this site.

FIGURE

F:\CAD\Benchmark\Unicorn\LVRR Site\HSCP\Figure A-1; Hospital Route Map.dwg



BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

PROJECT NO.: 0276-014-001

DATE: MAY 2014

DRAFTED BY: BLR

HOSPITAL ROUTE MAP

EMERGENCY RESPONSE PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LEROY, NEW YORK

PREPARED FOR

UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE A-1

ATTACHMENT B

HOT WORK PERMIT FORM

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

HOT WORK PERMIT

PART 1 - INFORMATION

Issue Date:

Date Work to be Performed: Start: Finish (permit terminated):

Performed By:

Work Area:

Object to be Worked On:

PART 2 - APPROVAL

(for 1, 2 or 3: mark Yes, No or NA)*

Will working be on or in: Finish (permit terminated):

1. Metal partition, wall, ceiling covered by combustible material?	yes	no
2. Pipes, in contact with combustible material?	yes	no
3. Explosive area?	yes	no

* = If any of these conditions exist (marked "yes"), a permit will not be issued without being reviewed and approved by Michael M. Yount (Corporate Health and Safety Director). Required Signature below.

PART 3 - REQUIRED CONDITIONS**

(Check all conditions that must be met)

	PROTECTIVE ACTION		PROTECTIVE EQUIPMENT
	Specific Risk Assessment Required		Goggles/visor/welding screen
	Fire or spark barrier		Apron/fireproof clothing
	Cover hot surfaces		Welding gloves/gauntlets/other:
	Move movable fire hazards, specifically		Wellintons/Knee pads
	Erect screen on barrier		Ear protection: Ear muffs/Ear plugs
	Restrict Access		B.A.: SCBA/Long Breather
	Wet the ground		Respirator: Type:
	Ensure adequate ventilation		Cartridge:
	Provide adequate supports		Local Exhaust Ventilation
	Cover exposed drain/floor or wall cracks		Extinguisher/Fire blanket
	Fire watch (must remain on duty during duration of permit)		Personal flammable gas monitor
	Issue additional permit(s):		

Other precautions:

** Permit will not be issued until these conditions are met.

SIGNATURES

Orginating Employee:	Date:
Project Manager:	Date:
Part 2 Approval:	Date:

ATTACHMENT C

NYSDOH GENERIC COMMUNITY AIR MONITORING PLAN

Appendix C1
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

Appendix C2
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

VOLUME 5

PERFORMANCE SAMPLING, MONITORING AND REPORTING PLAN

REMEDIAL ACTION WORK PLAN COMPENDIUM VOLUME 5

PERFORMANCE SAMPLING, MONITORING AND REPORTING PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LeRoy, New York

Index No. CERCLA-02-2014-2010

June 2014 0276-014-001

Prepared Under Contract to

Unicorn Management Consultants, LLC

For

Lehigh Valley Railroad Company

Cincinnati, Ohio

PERFORMANCE SAMPLING, MONITORING AND REPORTING PLAN
Lehigh Valley Railroad Derailment Superfund Site

Table of Contents

1.0 INTRODUCTION

Benchmark Environmental Engineering & Science, PLLC, as sub-consultant to Unicorn Management Consultants, LLC (UMC), has prepared this Performance Sampling, Monitoring, and Reporting Plan (PSMRP) on behalf of the Lehigh Valley Railroad Company (LVRR). LVRR is the respondent to a March 21, 2014 Administrative Order for Remedial Action, Index Number CERCLA-02-2014-2010 (Ref. 1) for the Lehigh Valley Railroad Derailment Superfund Site (Site) located in LeRoy, New York (see Remedial Action Work Plan (RAWP) Figures 1 and 2). This document serves as Volume 5 of the RAWP Compendium. Figures and appendices are provided in a single location within the Compendium and are referenced throughout all volumes.

1.1 Background

The Lehigh Valley Railroad Derailment Superfund Site is the location of a 1970 historical train derailment and chemical spill which occurred east of the Village of LeRoy, New York, along Gulf Road. On December 6, 1970, a portion of an eastbound 114-car freight train operated by the Lehigh Valley Railroad derailed at the Gulf Road crossing. Two tank cars containing trichloroethylene (TCE) ruptured and spilled their contents onto the ground. Approximately 30,000 gallons of TCE were spilled. A third car containing a crystalline form of cyanide was also reported to have partially spilled as well. Newspaper articles from this time period and rhetorical sources indicate that most of the cyanide was recovered shortly after the derailment. The TCE reportedly infiltrated directly into the ground and was not recovered. Nearby residents reported odors in homes and contamination of drinking water wells shortly after the release. In response to the complaints, LVRR constructed a series of ditches and berms at the site of the release and flooded the ditches with approximately one million gallons of water in an attempt to flush away the TCE.

The release and subsequent response actions resulted in contaminated surface soil and bedrock groundwater. As stated in a 1999 Superfund Record of Decision (ROD) (Ref. 2), the soil contamination and bedrock contamination appear to be physically separated from each other and, because techniques for dealing with soil contamination are different from those required for the groundwater, the NYSDEC established two operable units for

administration of the spill. Operable Unit #1 addressed groundwater and Operable Unit #2 addressed overburden soil.

In May 2000, the operable units were redefined by the USEPA as follows:

- Operable Unit #1 addresses a 10 acre "source area" immediately surrounding the bedrock and the contaminated groundwater present in the bedrock (about 3 ½ square miles); 1.5 acres (surface soils) and the contaminated overburden (soil, railroad ballasts, broken rock, fill, etc.)
- Operable Unit #2 addresses a four mile TCE groundwater plume

This report pertains to the contaminated overburden soil now included as a portion of Operable Unit #1 and referred to throughout this document as the "Spill Area." The Spill Area encompasses a portion of Gulf Road, the former Lehigh Valley main line railroad bed, and other adjoining lands.

1.2 Spill Area Remedial Approach

Site investigations indicate that TCE and to a lesser extent 1,2-dichloroethene (1,2-DCE; a breakdown product of TCE) remain at elevated concentration in a portion of the Spill Area soils above the bedrock (Ref. 3 & 4). The remedial design is detailed in a September 2013 Soil Remedial Design Report (Ref. 5). The remedial activities generally incorporate separate soil vapor extraction (SVE) systems on the north and south sides of Gulf Road (referred to herein as the North System and South System, respectively), including subgrade horizontal extraction points connected to a series of above and below ground manifolds, vertical vacuum observation wells, and trailer-mounted SVE mechanical equipment with granular activated carbon (GAC) emissions controls.

1.3 Purpose and Scope

This Performance Sampling, Monitoring and Reporting Plan (PSMRP) has been prepared in general accordance with the Statement of Work included as Appendix B of the Administrative Order (Ref. 1). This Plan establishes the post-remedial process for determining whether the performance standards for soil have been achieved at the Lehigh Valley Railroad Derailment Superfund Site located in Genesee County, Town of LeRoy, New York (hereafter, the "Site"). The following sections detail the performance based actions involved in the determination process and outline the objectives required for progression through those actions.

2.0 PERFORMANCE BASED ACTIONS

The process to determine whether the performance standards for soil have been achieved at the Site will involve the sequential actions listed below. Details concerning the specific performance objectives and sampling procedures that will be employed are presented in Sections 3.0 and 4.0, respectively:

- North and/or South SVE System deactivation:
  Soil vapor performance objectives will be used to identify when to temporarily deactivate one or both SVE systems and assess soil quality.

- Initial post-remedial investigation:
  The initial post-remedial investigation as outlined in the Soil Remedial Design Report includes up to six soil borings in the vicinity of each system to assess the remedial progress at the Site. These initial investigation(s) will be performed once specific performance objectives have been met.

- Full scale Spill Area investigation:
  The initial post-remedial investigation will be expanded to a full scale investigation of the Spill Area to include a total of up to 35 soil borings (including the initial investigation locations).

- North and/or South System decommissioning:
  Lastly, performance objectives will be used to determine when one or both systems are permanently decommissioned and RAs are complete.

3.0 PERFORMANCE OBJECTIVES

The following performance objectives will be used during the full scale RA implementation to track remedial progress and determine the timeframe for the remedial milestones outlined in Section 2.0, above.

3.1 Soil Vapor Monitoring Objectives

3.1.1 PID Testing Objectives

The post-remedial evaluation will include trending of SVE system monitoring data for remedial progress assessments. The untreated extracted vapor for both the North and South Systems will be monitored via field photoionization detector (PID) for volatile organic compound (VOC) concentrations every other week during system operation. The field data will be used to trend system contaminant mass recovery rates over time. Significant reductions in the contaminant mass recovery rates and/or asymptotic recovery trends will be cited as indicators for the temporary deactivation of one or both SVE systems and the completion of the limited subsurface investigation.

3.1.2 Extracted Vapor Analytical Objectives

In addition to monitoring indicators, the deactivation of one or both systems and the initiation of the soil sampling program will be determined based on TCE and 1,2-DCE concentrations in extracted vapor sample analytical results. Extracted vapor samples from the SVE system effluents (pre-treatment) will be collected immediately following the balancing and optimization period for the south SVE system and each pulsed area of the north SVE system. Following the initial sampling, sample collection will be repeated at approximately 6 month intervals or whenever a significant change in system operation occurs. Each set of analytical results for TCE and 1,2-DCE concentrations will be compared with historical extracted vapor concentrations. Deactivation objectives will take into consideration significant reductions in the contaminant mass in the samples between startup and deactivation, the total mass of contaminants removed by the SVE systems, and trends noted in the system recoveries (i.e., asymptotic reduction in concentration).

3.2 Soil Analytical Objectives

The quantitative analytical objectives of the RA in the Spill Area were established in the ROD with Remedial Action Objectives (RAOs) for Spill Area soil concentrations of TCE and 1,2-DCE. The maximum concentrations for achievement of the RAOs are 7,000 µg/kg for TCE and 3,000 µg/kg for 1,2-DCE. The RAOs will serve as the performance objectives for the initial subsurface investigation(s). Achievement of the RAOs during the initial subsurface investigation will initiate the full scale Spill Area investigation. Likewise, the full scale investigation soil quality will be compared with the RAOs to determine when one or both systems should be permanently decommissioned and RAs are complete.

4.0 SAMPLE COLLECTION

A brief summary of the sample collection methods associated with the performance objectives detailed in Section 3.0 is provided below. A more detailed description of sampling methods and quality control are detailed in the Soil Remedial Design Report and the Quality Assurance Project Plan (QAPP) included as Volume 3 of the RAWP.

4.1 Extracted Soil Vapor Samples

4.1.1 Field PID Samples

Field PID samples will be collected from several points in the SVE process including from the extraction point headers and vacuum monitoring points located across the Spill Area; from the SVE system effluent pre-treatment, mid-treatment (between the two carbon treatment units plumbed in series), and post-treatment (after both carbon treatment units); and from ambient air during intrusive construction activities. The field PID samples collected at the SVE system effluent pre-treatment are those that will be used to trend contaminant mass recovery rates over time. These samples will be collected in accordance with Benchmark Field Operating Procedure (FOP) #089.0, SVE System Sample Collection Procedure (see the Quality Assurance Project Plan (QAPP) included as Volume 3 of the RAWP), with a Tedlar bag from a positive pressure sampling point after the SVE system blower for field screening with a PID. Pre-treatment effluent samples will be collected immediately after each system start-up, following the completion of the initial start-up period and achievement of steady-state conditions, and during site visits performed every other week throughout the remedial period.

4.1.2 Samples for Laboratory Analysis

Extracted vapor samples will be collected from each SVE system from a sample port located at the system blower effluent (prior to vapor-phase carbon treatment) initially at system start-up and semi-annually thereafter, or in response to significant changes in system operation of system effluent PID readings. The vapor samples will be collected in pre-cleaned, batch certified, 6-liter passivated canisters and submitted to ALS Environmental under Chain of Custody (COC) protocol for analysis for VOCs by EPA Method TO-15. The analytical results will be provided with NYSDEC Analytical Services Protocol (ASP)

Category B deliverables for an independent third party data validation as detailed in the QAPP.

4.2 Soil Samples

The proposed post remedial sampling locations are depicted on the RAWP Figure 10. The initial investigation will be performed at a maximum of six of these locations per system. Soil borings will be advanced with a direct push drill rig (or equivalent) to the top of bedrock. An allocation of each soil sample will be field screened in approximate two-foot depth intervals for the presence of VOCs using a field PID. A separate, undisturbed allocation of each sample will be placed in pre-cleaned laboratory provided sample bottles and cooled to 4ºC±2ºC in the field.

Upon reaching the completion of each soil boring, PID, visual, and olfactory results will be reviewed. The sample interval identified as the most impacted (i.e., greatest PID scan result and/or evidence of visual/olfactory impact) will be selected for chemical analysis. If differentiable impacts are noted within a particular soil boring, additional samples may be collected from more than one depth interval to characterize the impacts in that soil boring location. In the event that either the impacts are ubiquitous from grade to final depth or no impacts were identified, the soil samples for laboratory analysis will be collected from the interval of the depth of highest impacts from samples collected during the UMC 2010 Pre-RD investigation (Ref. 4). Soil samples will be collected using an EnCore® sampler or equivalent. Immediately after collection, soil samples will be placed in a cooler on ice and delivered to ALS Environmental under COC protocol within 48 hours of collection for analysis for Target Compound List (TCL) VOCs by EPA Methods 5035/8260. The analytical results will be provided with NYSDEC ASP Category B deliverables for an independent third party data validation as detailed in the QAPP.

5.0 REPORTING

5.1 Monthly Progress Reports

As outlined in the Administrative Order, monthly progress reports will be prepared detailing all significant developments since the time period covered by the preceding progress report, including the actions performed and any problems encountered, analytical data received during the reporting period, and the developments anticipated during the next reporting period, including a schedule or actions to be performed, anticipated problems, and planned resolutions of past or anticipated problems. These reports will include recommendations and supporting data for performance based actions and progress toward performance objectives.

5.2 Remedial Action Report

A Remedial Action Report will be completed after the Spill Area is remediated to include:

- An introduction and background summarizing the Spill Area history and remedial action requirements.
- A summary of the remedial activities undertaken at the Spill Area.
- A chronology of the remedial construction events, including dates for all major milestones.
- A performance summary as indicated by comparison of recorded construction to performance standards and quality control requirements per the QAPP and Construction Quality Assurance Project Plan (CQAPP; included as Volume 2 of the RAWP). This will include descriptions of any deviations from the RAWP and associated corrective measures taken; and other pertinent information necessary to document that the Site activities were carried out in accordance with the RAWP and the approved design plans and specifications.
- Observations and lessons learned, including a description of any remedial component that significantly altered project costs from those anticipated.

6.0 APPROVALS

All performance based actions will be subject to USEPA written approval prior to implementation. Requests for approval will be submitted by UMC with required reporting as detailed in Section 4.0, above, or by other acceptable communication, if necessary.

7.0 REFERENCES

1. Administrative Order for Remedial Action, Lehigh Valley Railroad (LVRR) Derailment Superfund Site, LeRoy, NY. CERCLA 02-2014-2010. United States Environmental Protection Agency, Region 2, March 2014.

2. New York State Department of Environmental Conservation (NYSDEC) Record of Decision (ROD) & Supplemental Memorandum (EPA), LVRR Derailment Superfund Site, LeRoy, NY. March 1997 & May 2002.

3. Spill Site Soil Investigation Report (RI/FS), LVRR Derailment Superfund Site, LeRoy, NY. Rust Environmental & Infrastructure of New York, October 1996.

4. Pre-Remedial Design Soil Data Summary & Addendum, LVRR Derailment Superfund Site, LeRoy, NY. Unicorn Management Consultants, LLC (UMC), December 2010 & January 2011.

5. Soil Remedial Design Report, LVRR Derailment Superfund Site, LeRoy, NY. Benchmark Environmental Engineering & Science, PLLC on behalf of UMC, September 2013.

VOLUME 6

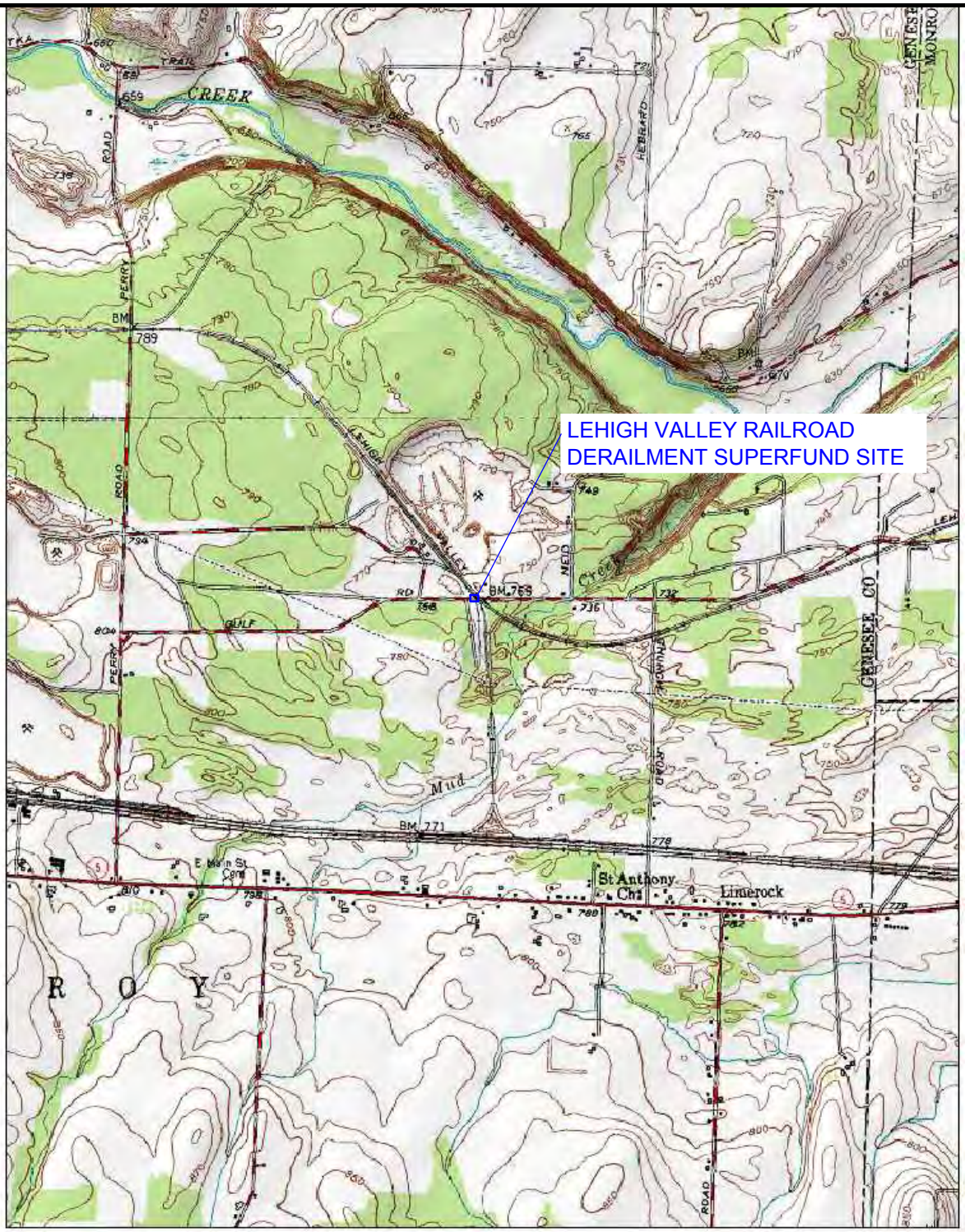
OPERATIONS PLAN

(TO BE DRAFTED FOLLOWING PILOT TESTING AND COMPLETION OF THE FINAL REMEDIAL DESIGN)

FIGURES

F:\CAD\Benchmark\Unicorn\LVRR Site\95% REMEDIAL DESIGN REPORT\Figure 1; Regional Vacinity Map.dwg

FIGURE 1



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(716) 856-0599

PROJECT NO.: 0276-013-001

DATE: JUNE 2014

DRAFTED BY: BLR

REGIONAL VICINITY MAP

REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR

LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

F:\CAD\Benchmark\Unicorn\LVRR Site\95% REMEDIAL DESIGN REPORT\Figure 2; Spill Area Map.dwg

DATE: JUNE 2014
DRAFTED BY: BLR

SPILL AREA MAP

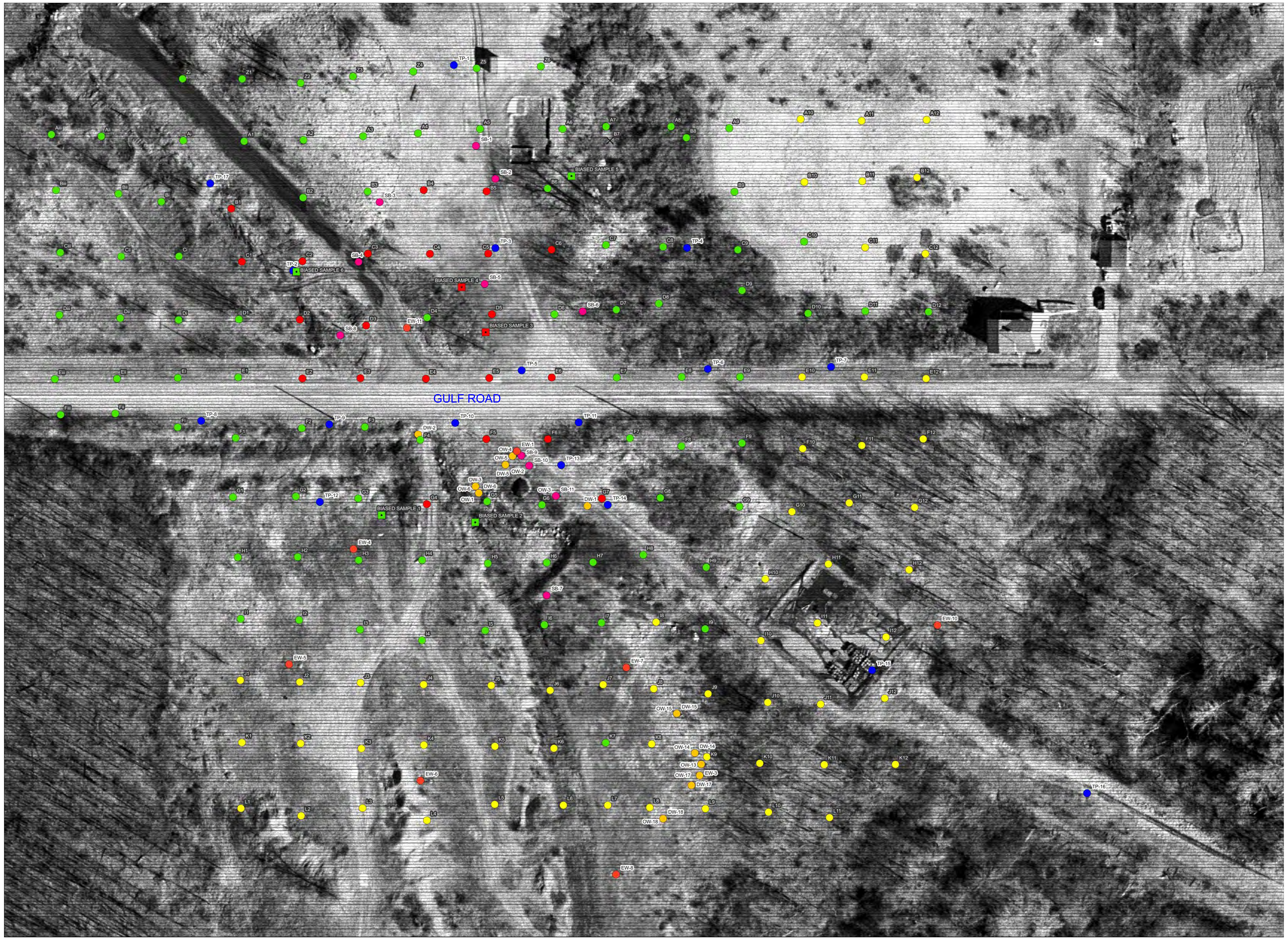
REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE □

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-001



New York State

Legend

Present Soil Boring Locations

- Biased Sample Below 7000 ppb
- Biased Sample Above 7000 ppb
- Soil Boring Below 7000 ppb
- Soil Boring Above 7000 ppb
- Sampled But Not Analyzed (SBNA)
- No Recovery

Historic Soil Boring Locations

- Bedrock Vapor Observation Wells
- Bedrock Vapor Extaction Wells
- Historic Soil Boring Locations
- Test Pit Locations

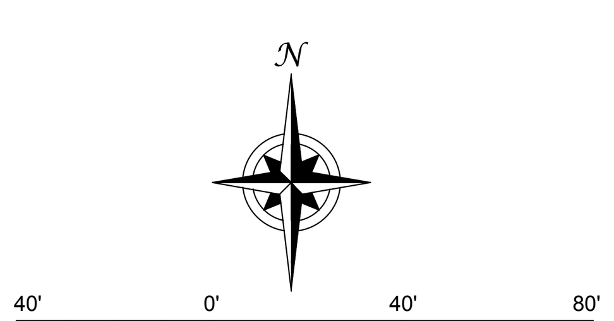
NOTES:

1.) HISTORIC SOIL BORING LOCATIONS ARE APPROXIMATE.

2.) PRESENT SOIL BORING LOCATIONS ARE GEOREFERENCED BASED UPON SURVEY DATA COLLECTED BY CLOUGH HARBOR ASSOCIATES ON SEPTEMBER 14TH AND 20TH 2010.

3.) SOIL SAMPLES DESIGNATED GREEN WERE SUBMITTED FOR ANALYSIS BUT THESE ANALYSES DID NOT DETECT TRICHLOROETHENE (TCE) OR CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE) AT CONCENTRATIONS EXCEEDING THE REMEDIAL ACTION OBJECTIVES (RAOs) FOR THOSE ANALYTES OF 7 MG/KG AND 3 MG/KG, RESPECTIVELY.

4.) SOIL SAMPLES COLORED RED INDICATE TCE OR CIS-1,2-DCE WAS DETECTED IN ONE OR MORE SAMPLES COLLECTED AT THAT LOCATION IN CONCENTRATIONS EXCEEDING THE RAOS.



SCALE: 1 INCH = 40 FEET
SCALE IN FEET
(approximate)

BASEMAP PER UNICORN MANAGEMENT CONSULTANTS, LLC "FIGURE 3"

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-011

REVISIONS

NO.	BY	DATE	REMARKS
1	BLR	8/30/2013	ADDITIONAL NOTES ADDED

SEAL

DRAWN BY: BLR

DATE: JUNE 2014

CHECKED BY:

APPROVED BY:

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UM□ PRE-R□ I□□ESTIGATIO□ SAMPLE LO□ATIO□S

REMEDAIL ACTION WORK PLAN

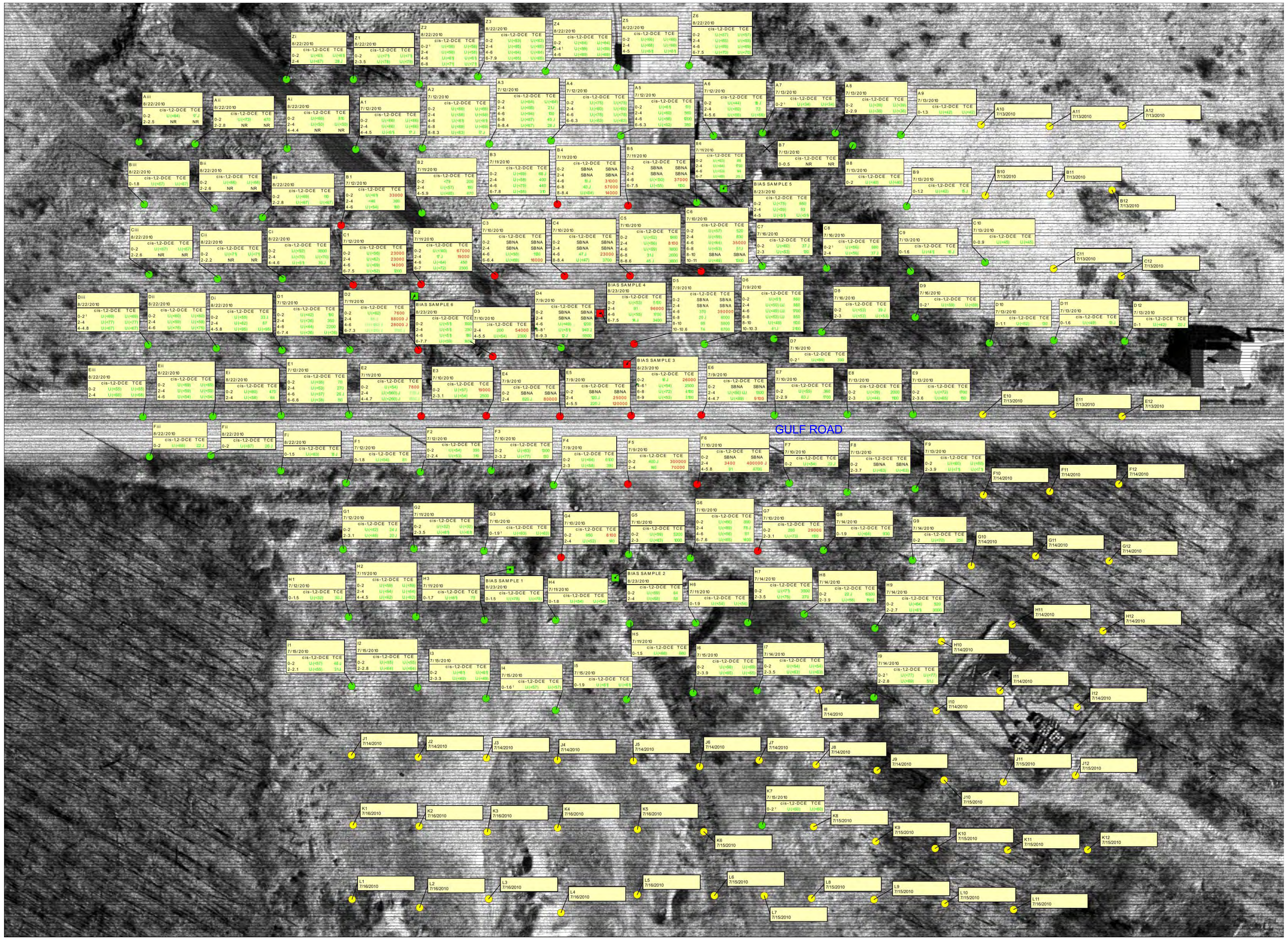
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LEROY, NEW YORK

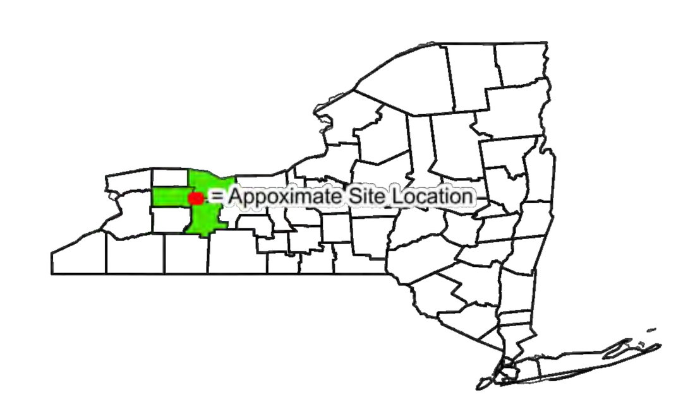
PREPARED FOR

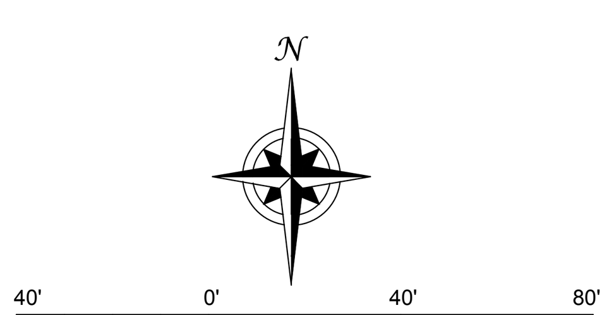
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE □



BASEMAP PER UNICORN MANAGEMENT CONSULTANTS, LLC "FIGURE 4"





SCALE: 1 INCH = 40 FEET
SCALE IN FEET
(approximate)

Legend

Present Soil Boring Locations

- Biased Sample Below 7000 ppb
- Biased Sample Above 7000 ppb
- Soil Boring Below 7000 ppb
- Soil Boring Above 7000 ppb
- Sampled But Not Analyzed (SBNA)
- X No Recovery

NOTES:

1.) DATA ARE LISTED AS PARTS PER BILLION (ppb).

2.) U = NON DETECT, DETECTION LIMITS LISTED IN PARENTHESES ( ).

3.) 1 INDICATES THE SOIL SAMPLE WAS SUBMITTED TO THE LABORATORY FOR MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSIS.

4.) THE SOIL CLEAN-UP CRITERIA FOR TRICHLOROETHENE (TCE) AND CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE) ARE ESTABLISHED IN THE SITE RECORD OF DECISION (ROD) EXECUTED BY THE NYSDEC ON MARCH 28, 1997.

5.) SOIL SAMPLES DESIGNATED GREEN WERE SUBMITTED FOR ANALYSIS BUT THESE ANALYSES DID NOT DETECT TCE OR CIS-1,2-DCE AT CONCENTRATIONS EXCEEDING THE REMEDIAL ACTION OBJECTIVES (RAOs) FOR THOSE ANALYTES OF 7 MG/KG AND 3 MG/KG, RESPECTIVELY.

6.) SOIL SAMPLES COLORED RED INDICATE TCE OR CIS-1,2-DCE WAS DETECTED IN ONE OR MORE SAMPLES COLLECTED AT THAT LOCATION IN CONCENTRATIONS EXCEEDING THE RAOS.

BENCHMARK
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BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-011

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1	BLR	8/30/2013	ADDITIONAL NOTES ADDED

SEAL

UM□ PRE-R□ I□□ESTIGATIO□ RESULTS

REMEDAIL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LEROY, NEW YORK

PREPARED FOR

LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

DRAWN BY: BLR
DATE: JUNE 2014
CHECKED BY:
APPROVED BY:

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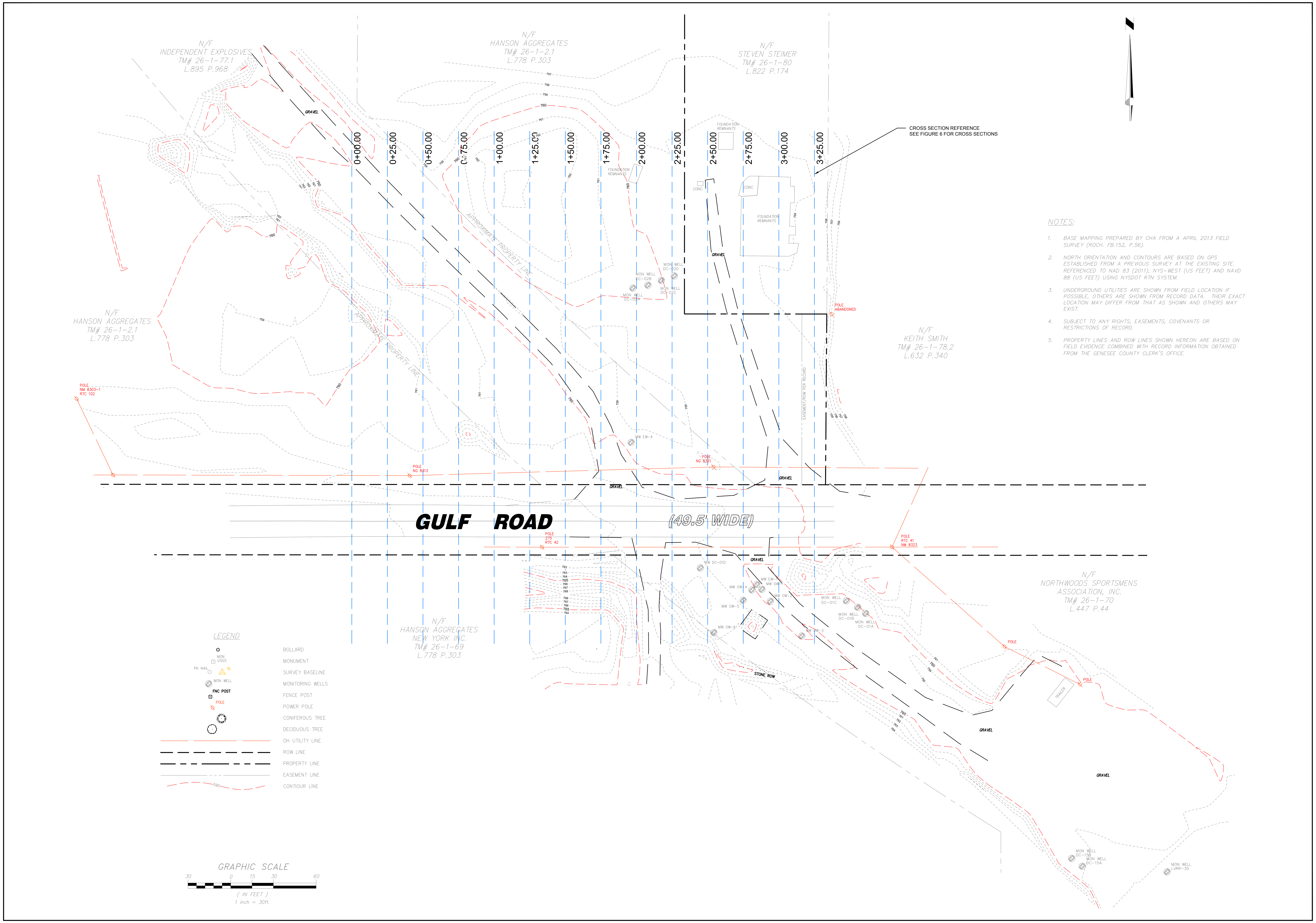
FIGURE □


N/F
INDEPENDENT EXPLOSIVES
TM# 26-1-77.1
L.895 P.968
N/F
HANSON AGGREGATES
TM# 26-1-2.1
L.778 P.303
N/F
STEVEN STEIMER
TM# 26-1-80
L.822 P.174
N/F
HANSON AGGREGATES
TM# 26-1-2.1
L.778 P.303
N/F
KEITH SMITH
TM# 26-1-78.2
L.632 P.340
N/F
HANSON AGGREGATES
NEW YORK INC.
TM# 26-1-69
L.778 P.303
N/F
NORTHWOODS SPORTSMENS
ASSOCIATION, INC.
TM# 26-1-70
L.447 P.44
0+00.00
0+25.00
0+50.00
0+75.00
1+00.00
1+25.00
1+50.00
1+75.00
2+00.00
2+25.00
2+50.00
2+75.00
3+00.00
3+25.00
CROSS SECTION REFERENCE
SEE FIGURE 6 FOR CROSS SECTIONS
GULF ROAD
(49.5' WIDE)
APPROXIMATE PROPERTY LINE
EASEMENT/ROW PER RECORD
STONE ROW
GRAVEL
POLE ABANDONED
NOTES:
1. BASE MAPPING PREPARED BY CHA FROM A APRIL 2013 FIELD SURVEY (ROCH. FB.152, P.56).
2. NORTH ORIENTATION AND CONTOURS ARE BASED ON GPS ESTABLISHED FROM A PREVIOUS SURVEY AT THE EXISTING SITE. REFERENCED TO NAD 83 (2011), NYS-WEST (US FEET) AND NAVD 88 (US FEET) USING NYSDOT RTN SYSTEM.
3. UNDERGROUND UTILITIES ARE SHOWN FROM FIELD LOCATION IF POSSIBLE, OTHERS ARE SHOWN FROM RECORD DATA. THEIR EXACT LOCATION MAY DIFFER FROM THAT AS SHOWN AND OTHERS MAY EXIST.
4. SUBJECT TO ANY RIGHTS, EASEMENTS, COVENANTS OR RESTRICTIONS OF RECORD.
5. PROPERTY LINES AND ROW LINES SHOWN HEREON ARE BASED ON FIELD EVIDENCE COMBINED WITH RECORD INFORMATION OBTAINED FROM THE GENESEE COUNTY CLERK'S OFFICE.
LEGEND
BOLLARD
MONUMENT
SURVEY BASELINE
MONITORING WELLS
FENCE POST
POWER POLE
CONIFEROUS TREE
DECIDUOUS TREE
OH UTILITY LINE
ROW LINE
PROPERTY LINE
EASEMENT LINE
CONTOUR LINE
GRAPHIC SCALE
30 0 15 30 60
(IN FEET)
1 inch = 30ft.

BENCHMARK
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SUITE 300
BUFFALO, NY 14218
(716) 856-0599

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□ROSS SE□TIO□ REFERE□□E

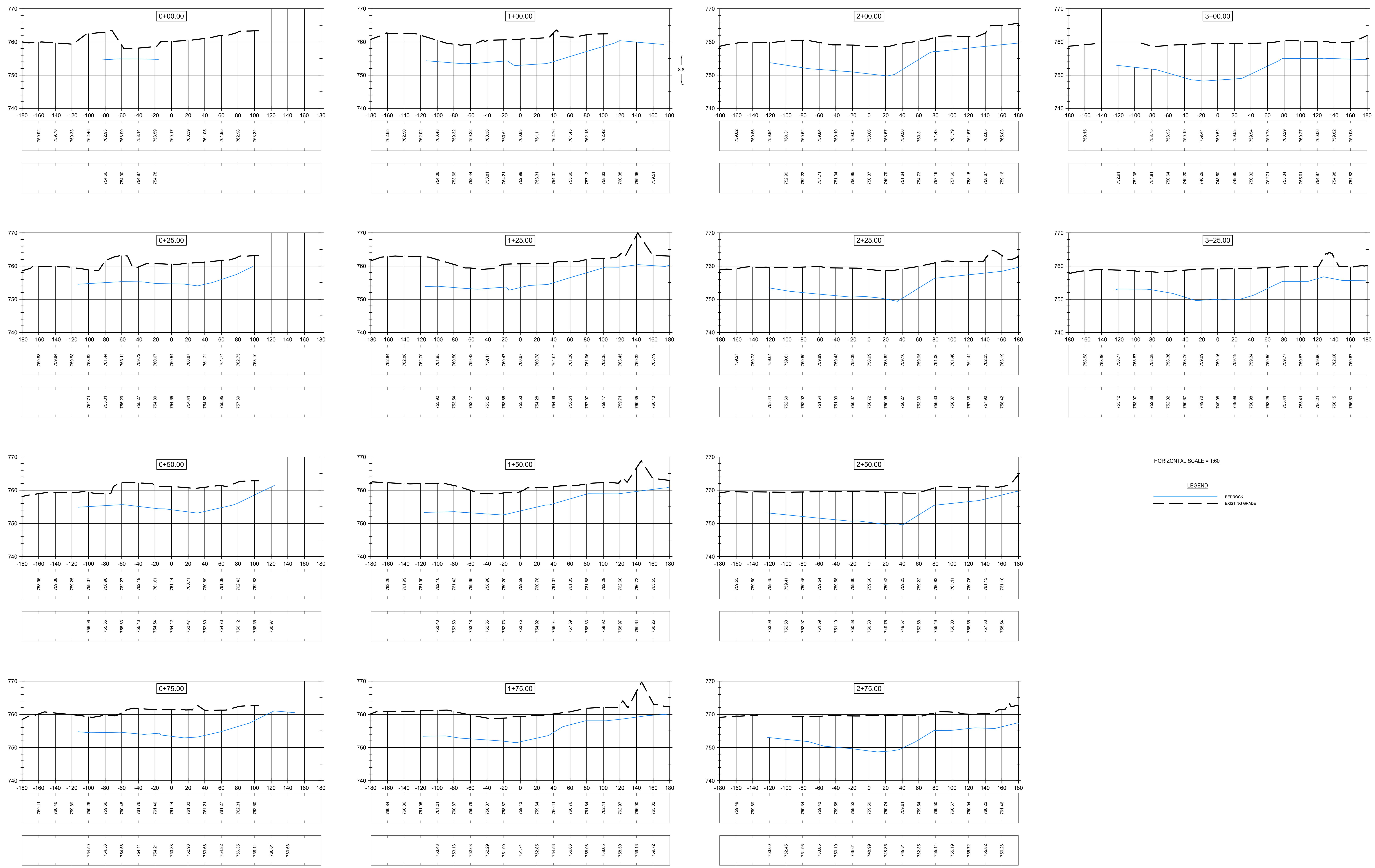
REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LEROY, NEW YORK

PREPARED FOR

LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE □



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□E□RO□□ □ROSS SE□TIO□S

REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

LEROY, NEW YORK

PREPARED FOR

LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

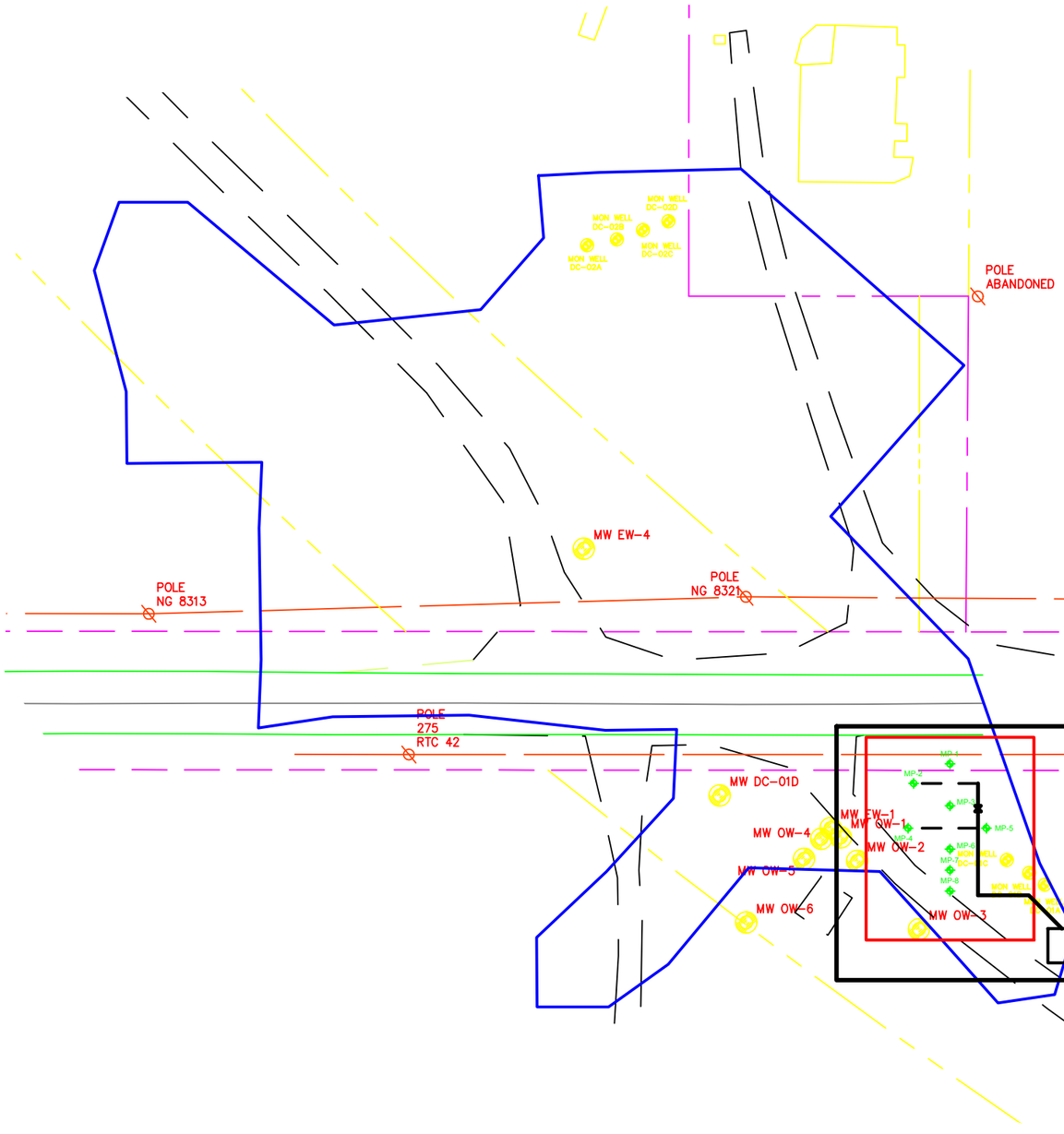
FIGURE □

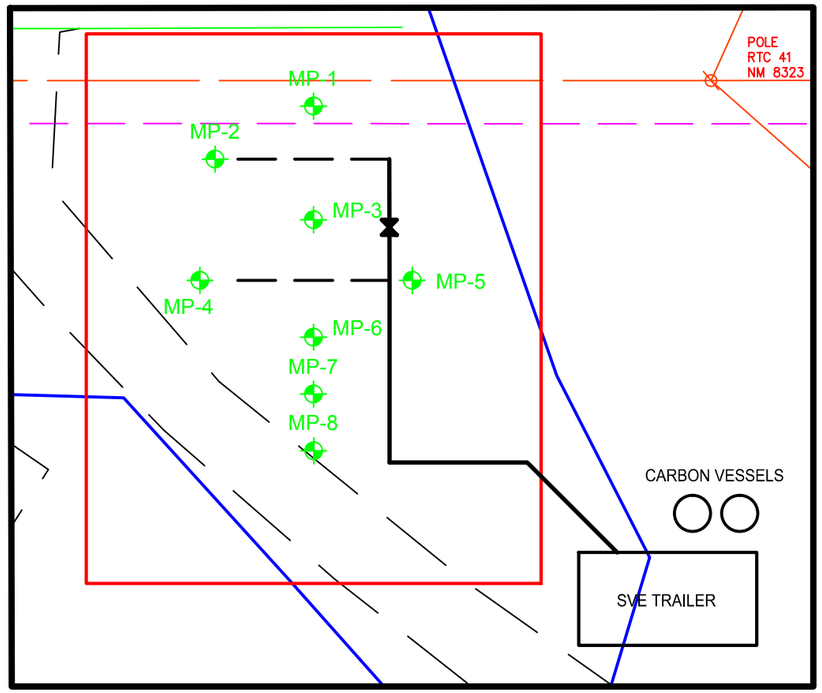
F:\CAD\Benchmark\Unicorn\LVRR Site\95% REMEDIAL DESIGN REPORT\Figure 7: Pilot Test Layout.dwg

N

50' 0' 50' 100'

SCALE: 1 INCH = 50 FEET
SCALE IN FEET
(approximate)





INSET: SCALE 1" = 20'

LEGEND:

- 4"Ø SCH. 40 PVC
- 2" Ø SCH. 40 SLOTTED PVC
- MON WELL — MONITORING WELLS
- POLE — POWER POLE
- MP-3 — MONITORING POINTS
- OH UTILITY LINE
- ROW LINE
- PROPERTY LINE
- EASEMENT LINE
- 10-MIL POLY VAPOR BARRIER
- SPILL AREA BOUNDARY

DATE: JUNE 2014
DRAFTED BY: BLR

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BUFFALO, NY 14218
(716) 856-0599

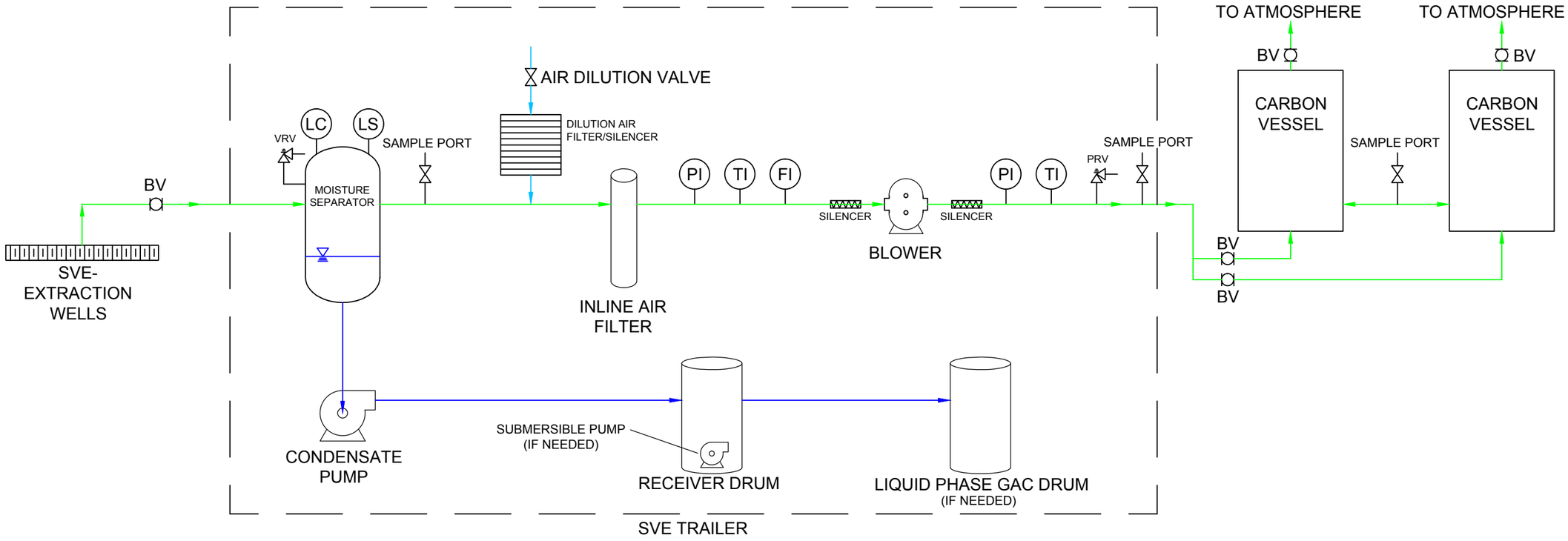
JOB NO.: 0276-013-001

PILOT TEST LAYOUT

REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE



LEGEND:

VRV	VACUUM RELIEF VALVE
PRV	PRESSURE RELIEF VALVE
LC	LEVEL CONTROL
LS	LEVEL SWITCH
PI	PRESSURE INDICATOR
FI	FLOW INDICATOR
TI	TEMPERATURE INDICATOR
BV	BALL VALVE

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BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-001

REMEDIAL SYSTEM FLOW SCHEMATIC

REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

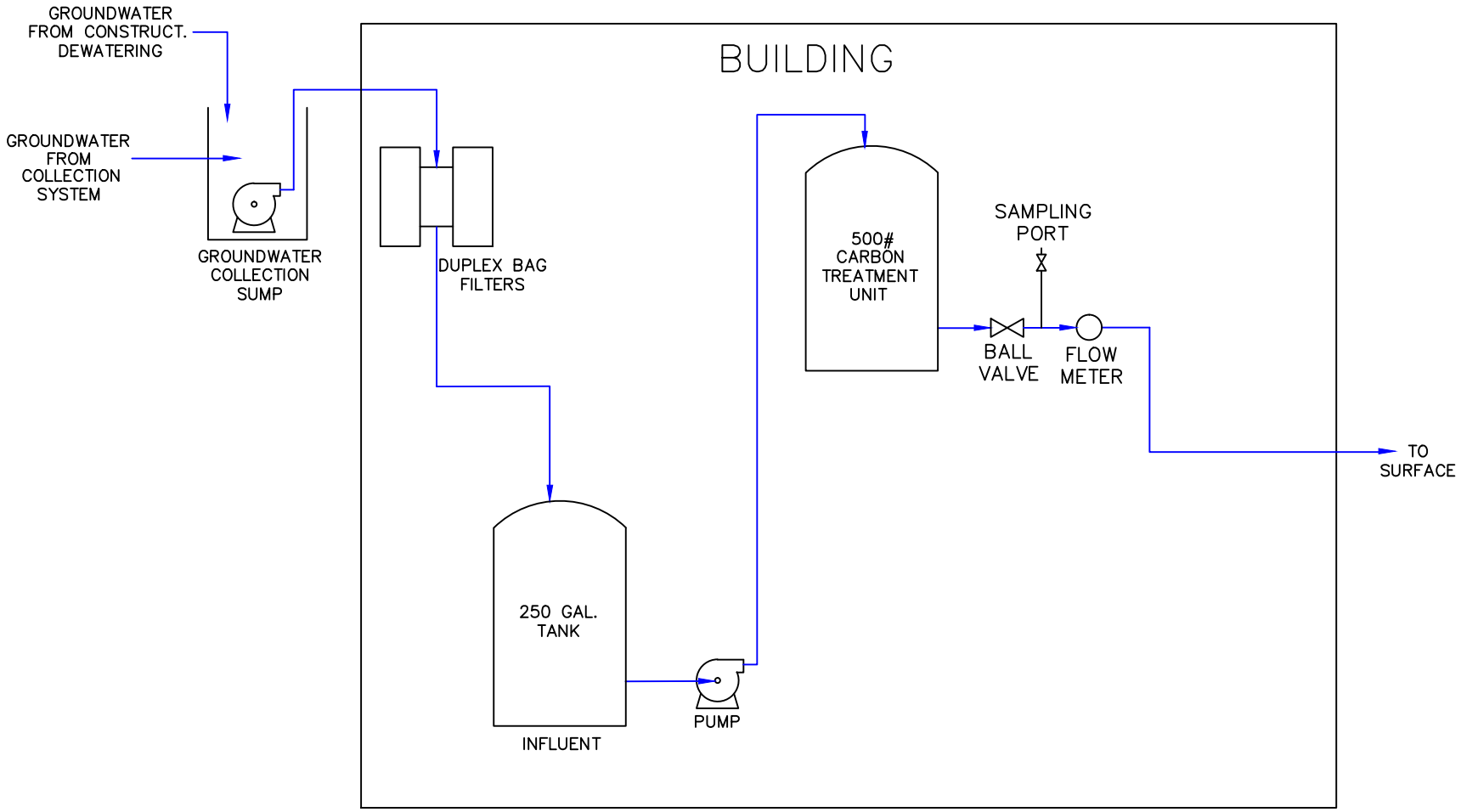
PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE

DATE: JUNE 2014
DRAFTED BY: BLR

F:\CAD\Benchmark\Unicorn\LVRR Site\95% REMEDIAL DESIGN REPORT\Figure 8: Remedial System Flow Schematic.dwg

F:\CAD\Benchmark\Unicorn\LVRR Site\95% REMEDIAL DESIGN REPORT\Figure 9; Water Treatment Flow Schematic.dwg



WATER TREATMENT FLOW SCHEMATIC

REMEDIAL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

PROJECT NO.: 0276-013-001
DATE: JUNE 2013
DRAFTED BY: BLR

F:\CAD\Benchmark\Unicorn\LVRR Steel\95% REMEDIAL DESIGN REPORT\Figure 10; Proposed Soil Sampling Locations.dwg

N

80' 0' 80' 160'

SCALE: 1 INCH = 80 FEET
SCALE IN FEET
(approximate)

LEGEND:

- PRIOR REMEDIAL OBJECTIVE EXEEDANCE LOCATION (TO BE RE-SAMPLED)
- PROPOSED NEW SAMPLE LOCATIONS
- SPILL AREA BOUNDARY

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-001

PROPOSED POST REMEDIAL SOIL SAMPLING LOCATIONS

REMEDAIL ACTION WORK PLAN
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

FIGURE 1

DATE: JUNE 2014
DRAFTED BY: BLR

FIGURE 11a - RA WORK PLAN PROJECT SCHEDULE
OU-1 REMEDIAL ACTION
LVRR DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

ID	Task Name
1	Effective Date of Administrative Order for Remedial Action
2	Supervising Contractor Approved
3	Submit Draft Remedial Action Work Plan
4	Start of USEPA Review and Comment Period
5	Prepare/Negotiate Site Access Agreements

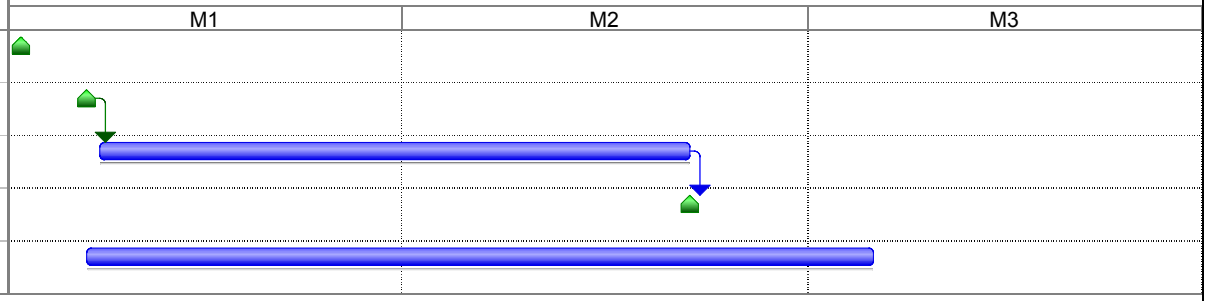


FIGURE 11b - PILOT TEST PROJECT SCHEDULE
OU-1 REMEDIAL ACTION
LVRR DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

ID	Task Name
1	USEPA Approval of RA Work Plan
2	Revise and Resubmit RA Work Plan
3	Pilot Test Installation
4	USEPA Inspection of Pilot Test Setup
5	Run Pilot Test
6	Review Pilot Test Data & Prepare Design Modifications
7	Submit Pilot Test Report & Design Modifications
8	Start of USEPA Review and Comment Period

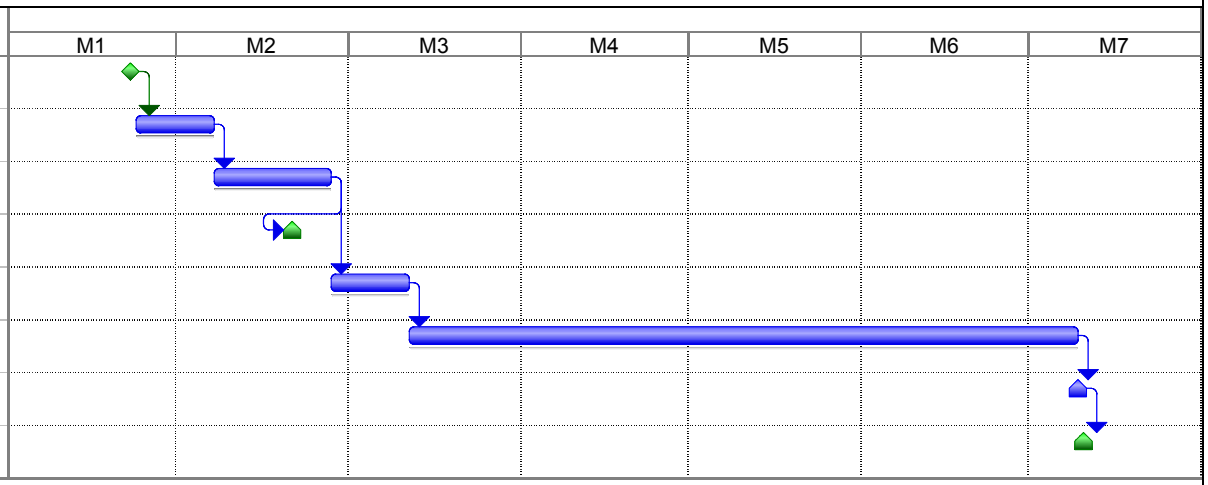


FIGURE 11c - SVE SYSTEM CONSTRUCTION PROJECT SCHEDULE
OU-1 REMEDIAL ACTION
LVRR DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

ID	Task Name
1	USEPA Approval of Pilot Test Report
2	Revise and Resubmit Pilot Test Report & Modifications to EPA
3	Mobilization, Temporary Power, Fencing
4	Installation of Full-Scale SVE Systems
5	Submit Operations & Maintenance Plan to USEPA
6	USEPA Inspection of Full Scale System Construction
7	Startup/Shakedown and System Balancing
8	USEPA Inspection of Operating System
9	Full-Scale Operation of SVE Systems
10	Confirmatory Boring Investigation and Data Summary
11	Prepare Remedial Action (RA) Report
12	Start of USEPA Review and Comment Period

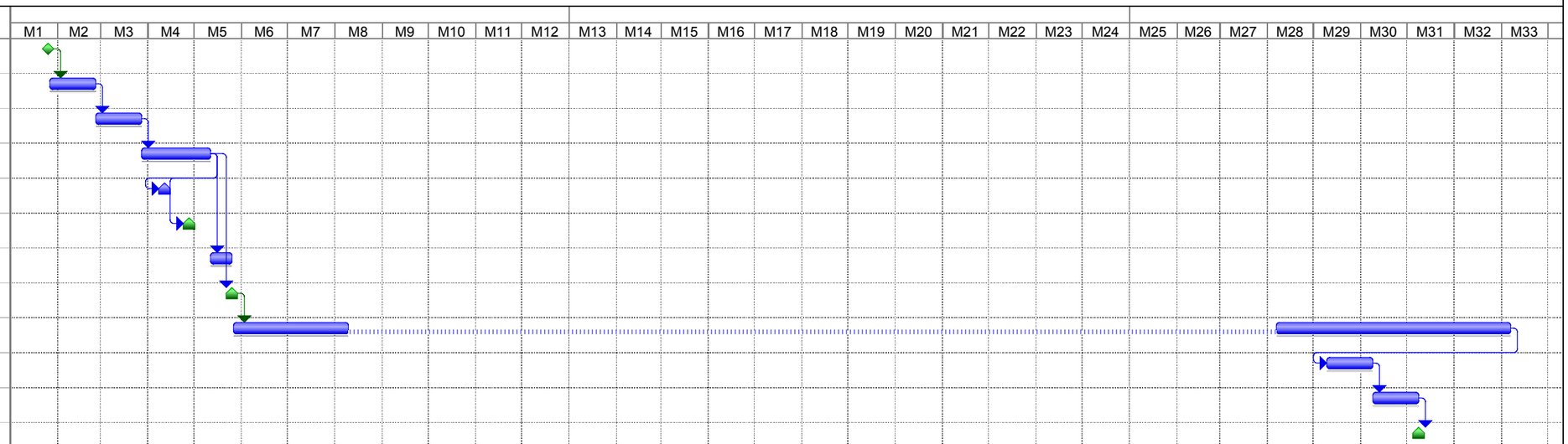
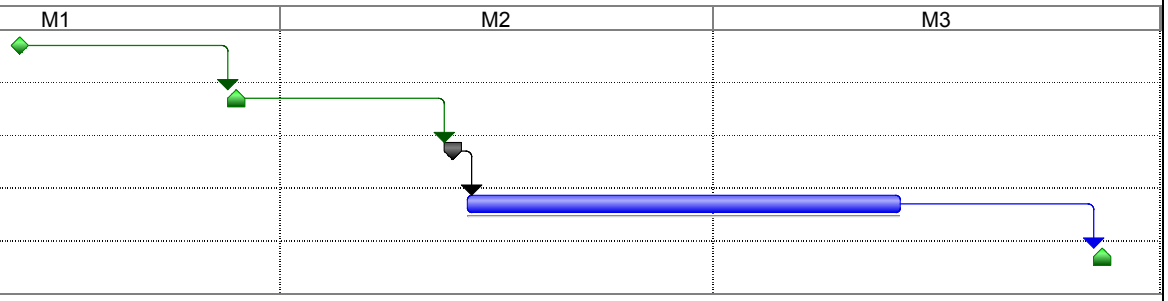


FIGURE 11d - POST-REMEDIAL PROJECT SCHEDULE
OU-1 REMEDIAL ACTION
LVRR DERAILMENT SUPERFUND SITE
LEROY, NEW YORK

ID	Task Name
1	USEPA Approval of Remedial Action Report
2	USEPA Inspection
3	Submit Final Remedial Action Report
4	Decommission System and Restore Site
5	USEPA Issues Certificate of Completion



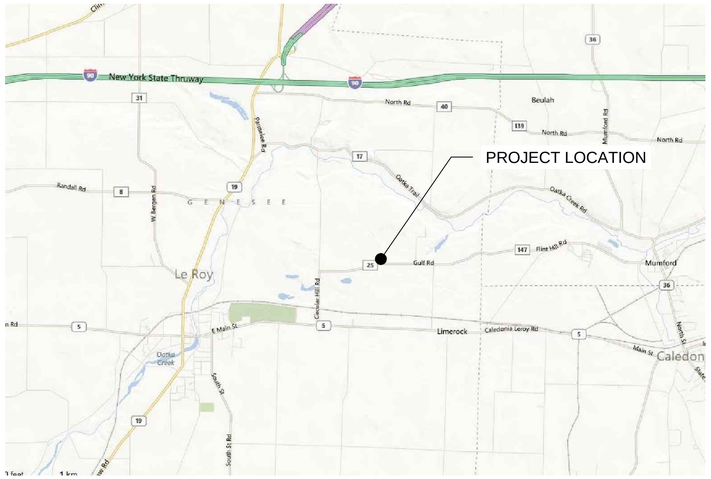
APPENDIX A

DESIGN PLAN SET

SOIL VAPOR EXTRACTION SYSTEM DESIGN

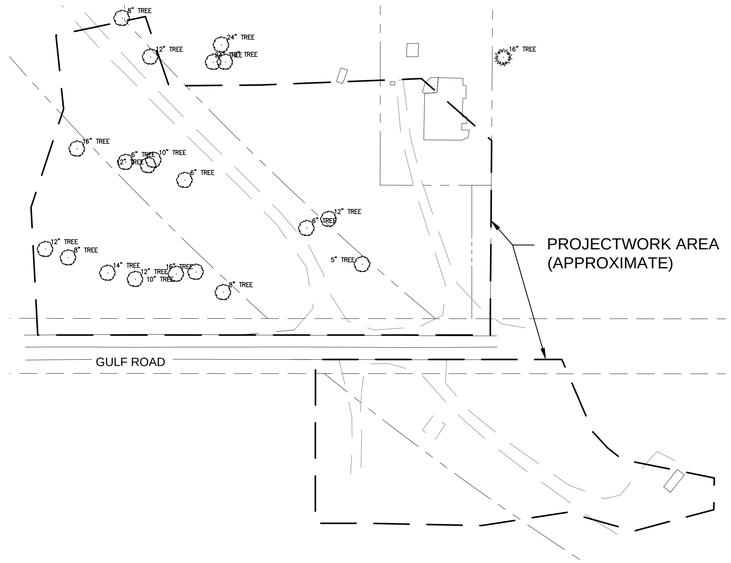
LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
SPILL AREA SOILS
INDEX NO. CERCLA-02-2006-2006

TOWN OF LEROY, GENESEE COUNTY, NEW YORK



REGIONAL MAP
N.T.S.

SITE VICINITY & LOCATION
N.T.S.



PROJECT BOUNDARY
N.T.S.

PACKAGE PREPARED BY:

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC
2558 Hamburg Turnpike, Suite 300 • Buffalo, NY 14218 • (716) 856-0599

DRAWING INDEX

DRAWING TITLE	SHEET NUMBER
TITLE SHEET	T-1
EXISTING SITE PLAN	C-1
PRE-REMEDIAL GRADING AND RESTORATION PLAN	C-2
SVE SYSTEM LAYOUT	C-3
SVE SYSTEM DETAILS	C-4
ELECTRICAL POWER PLAN	E-1

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ENGINEERING &
SCIENCE, PLLC
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SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-001

REVISIONS

NO.	BY	DATE	REMARKS

SEAL

DRAWN BY: AJZ
DATE: JUNE 2013
CHECKED BY: THF
APPROVED BY: THF

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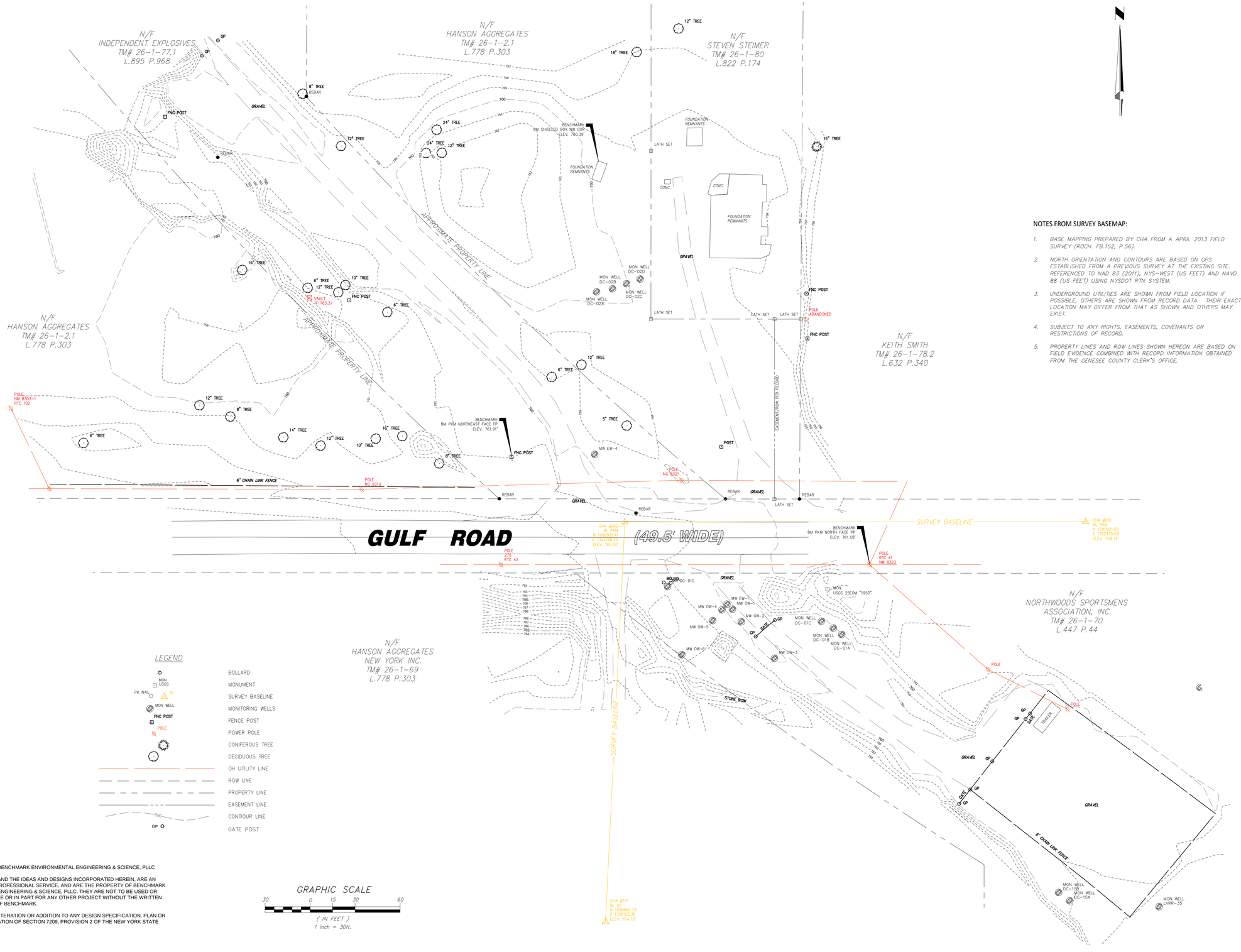
TITLE SHEET

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
SOIL VAPOR EXTRACTION SYSTEM DESIGN
TOWN OF LEROY, GENESEE COUNTY, NEW YORK
PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

T-1



NOTES FROM SURVEY BASEMAP:

1. BASE MAPPING PREPARED BY CHA FROM A APRIL 2013 FIELD SURVEY (ROCH. FB.152, P.56).
2. NORTH ORIENTATION AND CONTOURS ARE BASED ON GPS ESTABLISHED FROM A PREVIOUS SURVEY AT THE EXISTING SITE. REFERENCED TO NAD 83 (2011), NYS-WEST (US FEET) AND NAVD 88 (US FEET) USING NYSDOT RTN SYSTEM.
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LEGEND

- BOLLARD
- MONUMENT
- SURVEY BASELINE
- MONITORING WELLS
- FENCE POST
- POWER POLE
- CONIFEROUS TREE
- DECIDUOUS TREE
- OH UTILITY LINE
- ROW LINE
- PROPERTY LINE
- EASEMENT LINE
- CONTOUR LINE
- GATE POST

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GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 inch = 30ft.

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0276-013-001

REVISIONS

NO.	BY	DATE	REMARKS

SEAL

DRAWN BY: AJZ
DATE: JUNE 2013
CHECKED BY: THF
APPROVED BY: THF

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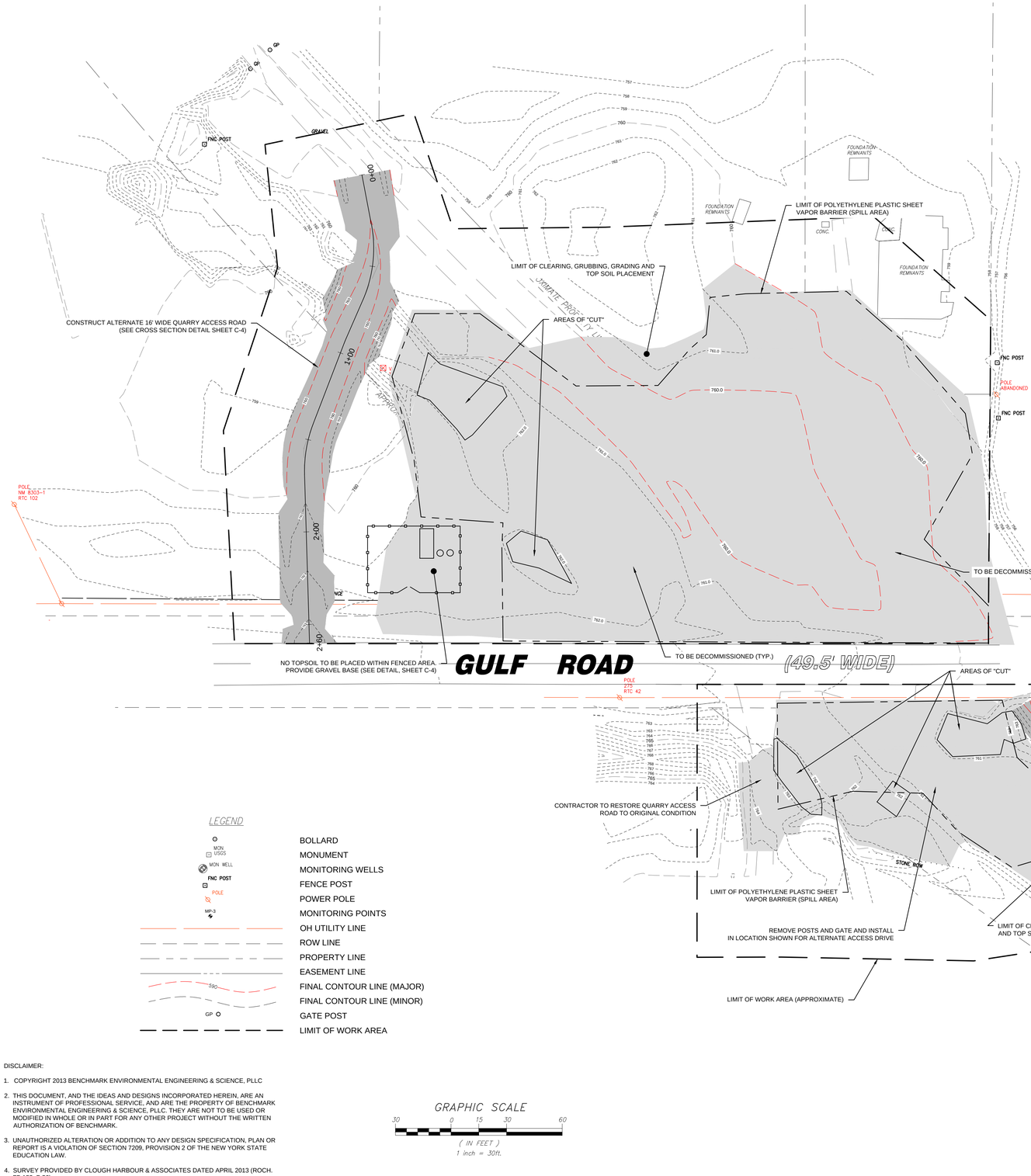
EXISTING SITE PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE
SOIL VAPOR EXTRACTION SYSTEM DESIGN
TOWN OF LEROY, GENESEE COUNTY, NEW YORK
PREPARED FOR:
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

C-1



NOTES:

SVE SYSTEM CONSTRUCTION:

A. SUBGRADE:
1. FINAL ELEVATIONS AND GRADING ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON ACTUAL VOLUME OF EXCAVATION SPOILS GENERATED.
2. ALL CUT MATERIALS (INCLUDING EXCESS TRENCH SPOILS) GENERATED DURING GRADING AND SUBGRADE SVE SYSTEM CONSTRUCTION TO BE PLACED IN LOW AREAS, AND PROOF-ROLLED BY CONTRACTOR PRIOR TO PLACEMENT OF IMPORT SOIL. CONTRACTOR SHALL PROOF-ROLL SUBGRADE WITH A STATIC ROLLER WEIGHING EIGHT TO TEN TONS. AREAS THAT HEAVE OR RUT UNDER THE WEIGHT OF THE ROLLER SHALL BE STABILIZED. NO CUT MATERIAL FROM SPILL AREA SHALL BE PLACED OUTSIDE OF SPILL AREA. ALL ACCESS ROAD CONSTRUCTION CUT MATERIAL SHALL BE DISBURSED AND GRADED ADJACENT TO THE ACCESS ROAD OR AS APPROVED BY OWNER OR ENGINEER.

B. IMPORT SOIL:
1. IMPORT SOIL SHALL BE TOPSOIL MEETING PRODUCT QUALITY REQUIREMENTS PER PROJECT SPECIFICATIONS.
2. PLACE AND SPREAD TOPSOIL TO A MINIMUM DEPTH OF 6 INCHES WITH LOW GROUND PRESSURE TRACKED EQUIPMENT.
3. PROOF ROLL TOPSOIL IN AREAS BENEATH VAPOR BARRIER WITH A STATIC ROLLER WEIGHING EIGHT TO TEN TONS.

C. VAPOR BARRIER:
1. PLACE POLY VAPOR BARRIER PER PROJECT SPECIFICATIONS. OVERLAP 18" AT SEAMS AND SECURE WITH SAND BAG BALLAST.

D. RESTORATION:
1. AFTER INSTALLATION OF POLY VAPOR BARRIER, RAKE AND SEED AREAS OUTSIDE VAPOR BARRIER LIMITS.
2. UPON SATISFACTORY COMPLETION OF SVE ACTIVITIES AS DETERMINED BY ENGINEER, DECOMMISSION ALL EQUIPMENT AND REMOVE ALL ABOVE-GRADE PIPING, FENCING, TEMPORARY POWER, BALLAST, AND LINER MATERIALS. CUT EXTRACTION POINT RISERS AND SVE MONITORING POINTS 6 INCHES BELOW GRADE AND SEAL WITH HYDRATED BENTONITE PELLETS.
3. RAKE EXPOSED AREAS AND SEED WITH 100 POUNDS PER ACRE OF SEED CONFORMING TO THE REQUIREMENTS IN THE SPECIFICATIONS.
4. APPLY SEED BY DRY OR HYDROSEED METHOD. SPREAD ANTI-EROSION MULCH WITHIN 2 DAYS OVER AREAS THAT ARE SEEDED VIA THE DRY METHOD AND ANCHOR MULCH BY SPRAYING WITH LIQUID TACKIFIER AT A RATE OF 10 TO 13 GALLONS PER 1000 SF.
5. PREVENT FOOT OR VEHICULAR TRAFFIC OR THE MOVEMENT OF EQUIPMENT OVER THE SEEDED AREAS.
6. AFTER SEEDLINGS APPEAR IN 2 TO 3 WEEKS, RESEED ALL BARE SPOTS LARGER THAN 18 INCHES IN DIAMETER.

APPROXIMATE CUT/FILL VOLUMES (NORTH ACCESS ROAD)	
CUT	135 CY ±
FILL	108 CY ±
NET	27 CY (CUT)

APPROXIMATE CUT/FILL VOLUMES (NORTH OF GULF ROAD)	
CUT	32 CY ±
FILL	1,074 CY ±
NET	1,042 CY

APPROXIMATE CUT/FILL VOLUMES (SOUTH ACCESS ROAD)	
CUT	108 CY ±
FILL	28 CY ±
NET	80 CY (CUT)

APPROXIMATE CUT/FILL VOLUMES (SOUTH OF GULF ROAD)	
CUT	69 CY ±
FILL	189 CY ±
NET	120 CY

NOTES:
1. FINAL GRADES SHOWN REPRESENT TOP OF 6" TOPSOIL. CONTRACTOR TO GRADE BELOW GRADES SHOWN IN AREAS OF "CUT" TO ACHIEVE FINAL GRADE OF TOPSOIL.
2. FILL VOLUMES REPRESENT TOPSOIL VOLUME TO ACHIEVE FINAL GRADES IN AREAS OF FILL.
3. FILL VOLUMES AND GRADES SHOWN FOR ACCESS ROADS REPRESENT TOP OF 6" R.O.C. (SEE DETAIL). CONTRACTOR TO GRADE BELOW GRADES SHOWN IN AREAS OF "CUT" TO ACHIEVE FINAL GRADE OF 6" R.O.C.
4. MONITORING WELLS ARE TO BE PROTECTED DURING SITE ACTIVITIES.

LEGEND

BOLLARD	
MONUMENT	MON. MSGS
MONITORING WELLS	MON. WELL
FENCE POST	FNC POST
POWER POLE	POLE
MONITORING POINTS	MP-3
OH UTILITY LINE	
ROW LINE	
PROPERTY LINE	
EASEMENT LINE	
FINAL CONTOUR LINE (MAJOR)	590
FINAL CONTOUR LINE (MINOR)	
GATE POST	GP
LIMIT OF WORK AREA	

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GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 inch = 30ft.

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BUFFALO, NY 14218
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JOB NO.: 0276-013-001

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DATE: JUNE 2013
CHECKED BY: THF
APPROVED BY: THF

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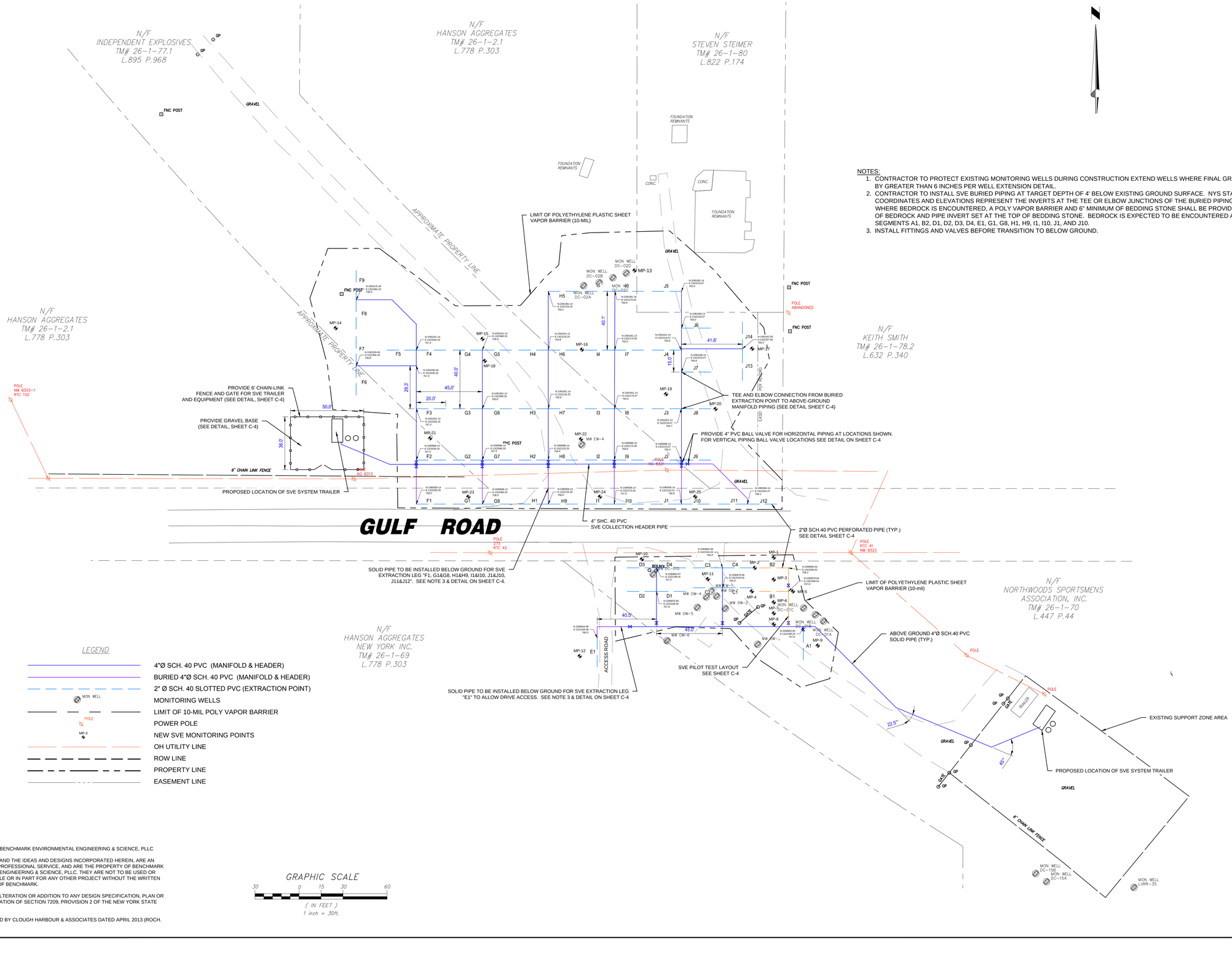
PRE-REMEDIAL GRADING AND RESTORATION PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

SOIL VAPOR EXTRACTION SYSTEM DESIGN
TOWN OF LEROY, GENESEE COUNTY, NEW YORK

PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

C-2



LEGEND

- 4"Ø SCH. 40 PVC (MANIFOLD & HEADER)
- BURIED 4"Ø SCH. 40 PVC (MANIFOLD & HEADER)
- 2" Ø SCH. 40 SLOTTED PVC (EXTRACTION POINT)
- MONITORING WELLS
- LIMIT OF 10-MIL POLY VAPOR BARRIER
- POWER POLE
- NEW SVE MONITORING POINTS
- OH UTILITY LINE
- ROW LINE
- PROPERTY LINE
- EASEMENT LINE

NOTES:

1. CONTRACTOR TO PROTECT EXISTING MONITORING WELLS DURING CONSTRUCTION EXTEND WELLS WHERE FINAL GRADE RISES BY GREATER THAN 6 INCHES PER WELL EXTENSION DETAIL.
2. CONTRACTOR TO INSTALL SVE BURIED PIPING AT TARGET DEPTH OF 4' BELOW EXISTING GROUND SURFACE. NYS STATE PLANE COORDINATES AND ELEVATIONS REPRESENT THE INVERTS AT THE TEE OR ELBOW JUNCTIONS OF THE BURIED PIPING. IN CASES WHERE BEDROCK IS ENCOUNTERED, A POLY VAPOR BARRIER AND 6" MINIMUM OF BEDDING STONE SHALL BE PROVIDED ON TOP OF BEDROCK AND PIPE INVERT SET AT THE TOP OF BEDDING STONE. BEDROCK IS EXPECTED TO BE ENCOUNTERED AT PIPE SEGMENTS A1, B2, D1, D2, D3, D4, E1, G1, G8, H1, H9, I1, I10, J1, AND J10.
3. INSTALL FITTINGS AND VALVES BEFORE TRANSITION TO BELOW GROUND.

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JOB NO.: 0276-013-001

REVISIONS

NO.	BY	DATE	REMARKS
1	BLR	8/30/2013	ADDITIONAL VALVES ADDED
2	BLR	8/30/2013	ADDITIONAL MONITORING POINTS ADDED
3	BLR	8/30/2013	BURIED SOLID PIPE ADDED TO LAYOUT
4	BLR	8/30/2013	CALLOUT TEXT MODIFIED

SEAL

DRAWN BY: AJZ
DATE: JUNE 2013
CHECKED BY: THF
APPROVED BY: THF

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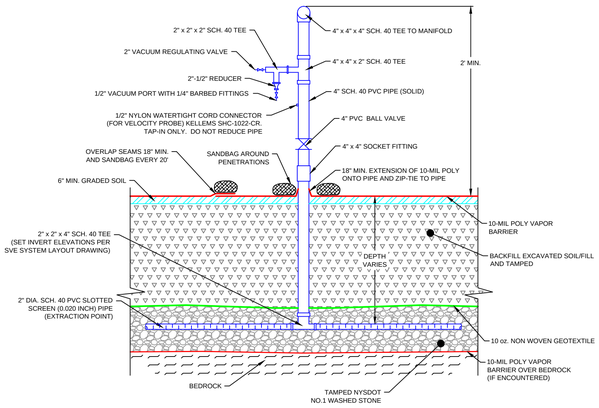
SVE SYSTEM LAYOUT

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

SOIL VAPOR EXTRACTION SYSTEM DESIGN
TOWN OF LEROY, GENESEE COUNTY, NEW YORK

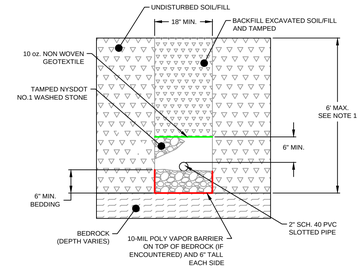
PREPARED FOR:
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

C-3



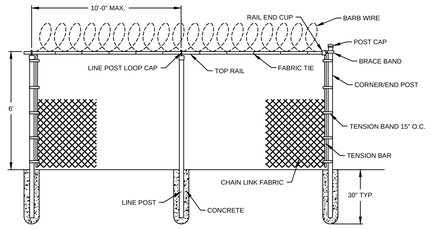
SVE VACUUM TEE CONNECTION DETAIL

NOT TO SCALE



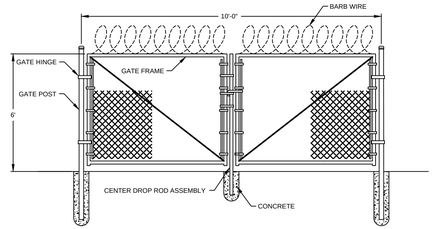
SVE VACUUM PIPE TRENCH DETAIL

NOT TO SCALE



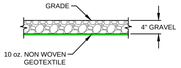
CHAIN LINK FENCE DETAIL

NOT TO SCALE



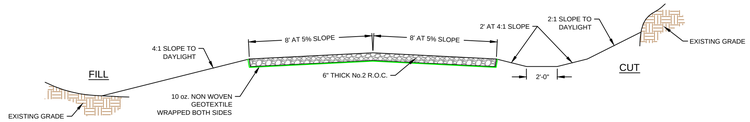
GATE DETAIL

NOT TO SCALE



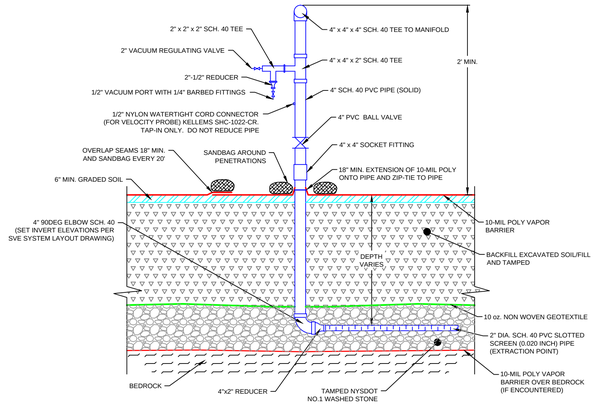
SVE TRAILER GROUND DETAIL

NOT TO SCALE



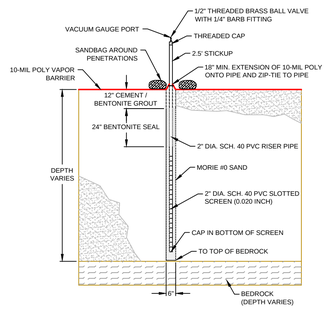
16' ACCESS ROAD DETAIL

NOT TO SCALE



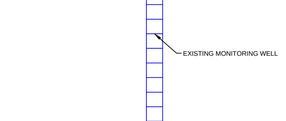
SVE VACUUM ELBOW CONNECTION DETAIL

NOT TO SCALE



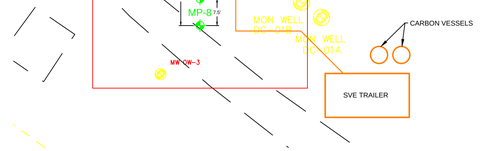
TYPICAL SVE MONITORING POINTS CONSTRUCTION DETAIL

NOT TO SCALE



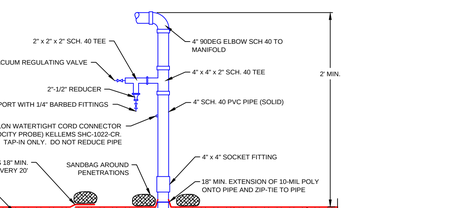
MONITORING WELL EXTENSION DETAIL

NOT TO SCALE



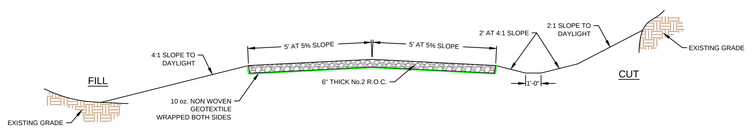
PILOT TEST PLAN

SCALE: 1" = 20'



BURIED SOLID PIPE TO EXTRACTION PIPING DETAIL

NOT TO SCALE



10' ACCESS ROAD DETAIL

NOT TO SCALE

NOTES:

1. EXCAVATION DEPTH TO BE NO MORE THAN 6' DEEP OR UNTIL BEDROCK IS REACHED, WHICHEVER IS LESSOR.
2. CONTRACTOR IS TO PROVIDE PIPE SUPPORT EVERY 10'-0".
3. CONTRACTOR IS TO PROVIDE PROTECTION SURROUNDING ALL WELLS AND MONITORING POINTS.

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JOB NO: JOB##

REVISIONS

NO.	BY	DATE	REMARKS
1	BLR	8/30/2013	BURIED SOLID PIPE DETAIL ADDED
2	BLR	8/30/2013	ADDITIONAL MONITORING POINTS ADDED

SEAL

DRAWN BY: AJZ / BLR
DATE: JUNE 2013
CHECKED BY: THF
APPROVED BY: THF

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SVE SYSTEM DETAILS

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

SOIL VAPOR EXTRACTION SYSTEM DESIGN
TOWN OF LEROY, GENESEE COUNTY, NEW YORK

PREPARED FOR:
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

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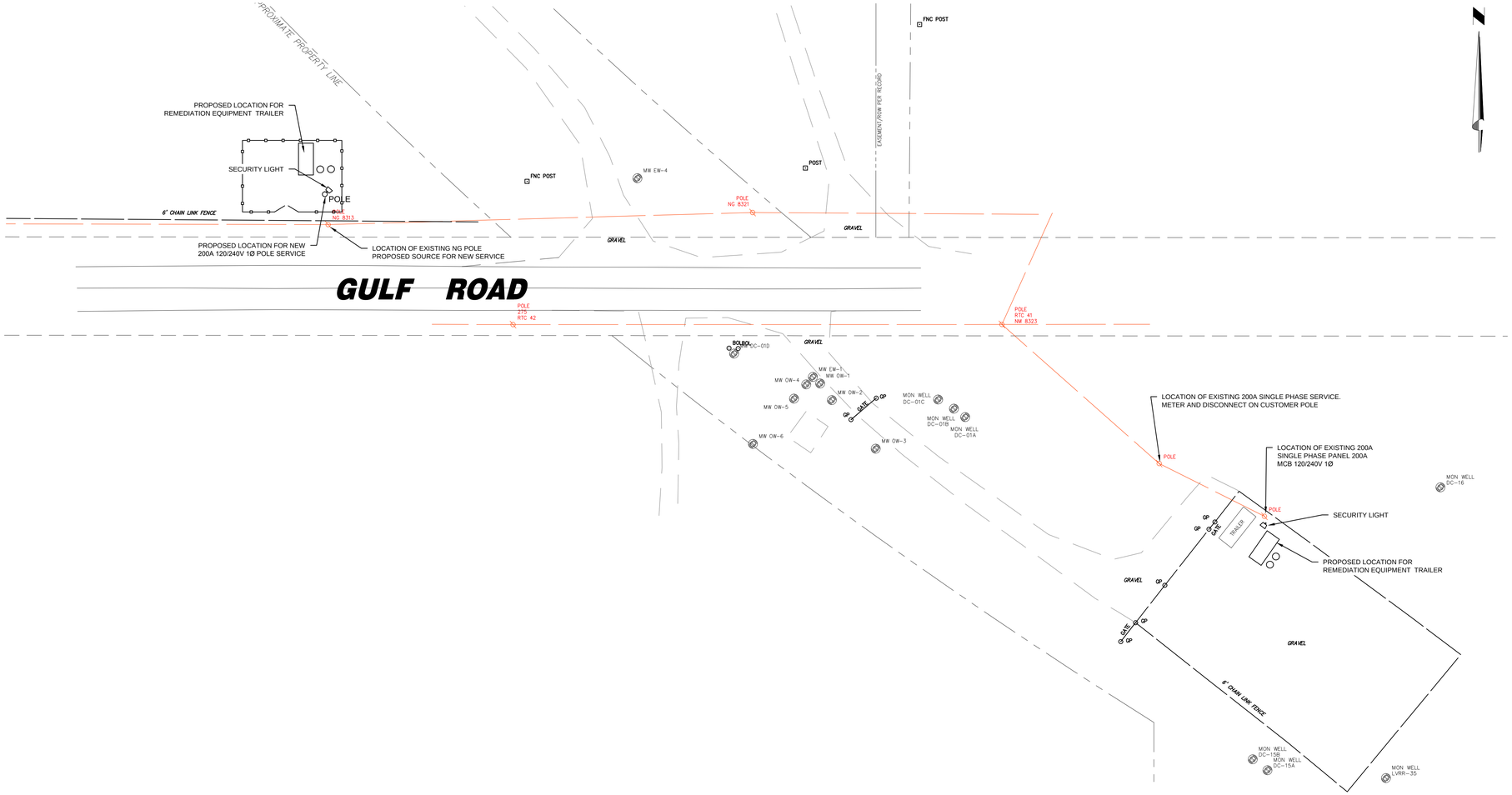
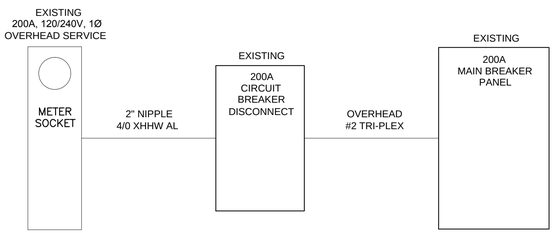
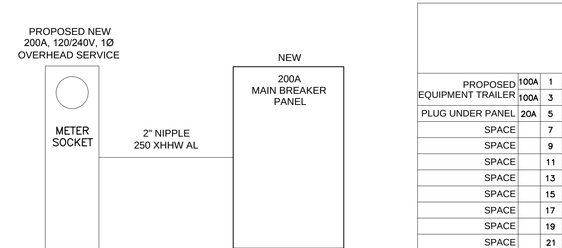




EXISTING

200A

SPACE		1	2	20A	PLUG UNDER PANEL
SPACE		3	4		SPACE
50A RECEPTACLE	50A	5	6		SPACE
	50A	7	8		SPACE
PROPOSED EQUIPMENT TRAILER	100A	9	10		SPACE
	100A	11	12		SPACE
SPACE		13	14		SPACE
SPACE		15	16		SPACE
OFFICE TRAILER	90A	17	18		SPACE
	90A	19	20		SPACE
SPACE		21	22		SPACE
SPACE		23	24		SPACE
SPACE		25	26		SPACE
SPACE		27	28		SPACE
SPACE		29	30		SPACE



200A

PROPOSED EQUIPMENT TRAILER	100A	1	2		SPACE
	100A	3	4		SPACE
PLUG UNDER PANEL	20A	5	6		SPACE
SPACE		7	8		SPACE
SPACE		9	10		SPACE
SPACE		11	12		SPACE
SPACE		13	14		SPACE
SPACE		15	16		SPACE
SPACE		17	18		SPACE
SPACE		19	20		SPACE
SPACE		21	22		SPACE
SPACE		23	24		SPACE
SPACE		25	26		SPACE
SPACE		27	28		SPACE
SPACE		29	30		SPACE

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GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 inch = 30ft.

ELECTRICAL NOTES:

1. TWO EQUIPMENT TRAILERS TO BE PLACED ON SITE AT OPPOSITE ENDS.
2. TRAILER ON SOUTH SIDE OF GULF ROAD TO BE FED FROM EXISTING 200A POLE SERVICE AND TO BE CONNECTED WITH #2 CU TYPE GC CORD.
3. TRAILER ON NORTH SIDE OF GULF ROAD TO BE FED FROM PROPOSED NEW 200A POLE SERVICE AND TO BE CONNECTED WITH #2 CU TYPE GC CORD.
4. NEW SERVICE TO BE INSTALLED AND GROUNDED PER NFPA 70 - NEC.
5. CIRCUIT BREAKER SIZE FOR TRAILERS TO BE VERIFIED ON SITE.
6. ELECTRICAL CONTRACTOR TO SUPPLY AND INSTALL UTILITY TYPE POLE FOR NEW SERVICE.

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NO.	BY	DATE	REMARKS

SEAL

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DATE: JUNE 2013
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ELECTRICAL POWER PLAN

LEHIGH VALLEY RAILROAD DERAILMENT SUPERFUND SITE

SOIL VAPOR EXTRACTION SYSTEM DESIGN
TOWN OF LEROY, GENESEE COUNTY, NEW YORK

PREPARED FOR
LEHIGH VALLEY RAILROAD COMPANY
ON BEHALF OF UNICORN MANAGEMENT CONSULTANTS, LLC

E-1

APPENDIX B

ALS ENVIRONMENTAL ANALYTICAL SERVICES AND QUALITY ASSURANCE MANUAL

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QUALITY ASSURANCE MANUAL

ALS Environmental
Rochester Facility
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www.alsglobal.com

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QUALITY ASSURANCE MANUAL

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1.0 TABLE OF CONTENTS

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Tables Page

Figures Page

Appendices

Please note that the Appendices provide current information at the time of the revision, but are updated only upon annual review. Please contact the laboratory for up-to-date information.

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2.0 INTRODUCTION AND COMPANY QUALITY ASSURANCE POLICY

ALS is a diversified international analytical laboratory group which first established its operations in Queensland, Australia in 1975. ALS has an enviable reputation for delivering a quality service which includes accurate and timely data, expert support and a culture of safety and innovation. ALS employs over 8000 staff worldwide, and operates more than 240 laboratories in 40 countries across Africa, Asia, Australia, Europe, North America and South America. ALS operates internationally in 6 distinct service areas which include Coal, Environmental, Food, and Pharmaceutical, Industrial, Minerals and Tribology. ALS services specifically support mining and exploration, commodity certification, environmental monitoring, equipment maintenance, food and pharmaceutical quality assurance and industrial operations. The Company is now one of the largest analytical laboratory groups in the world. For up-to-date information about ALS please refer to our website at www.alsglobal.com.

The Rochester Facility is professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, air, and other material.

QUALITY POLICY STATEMENT

The policy at ALS is to use good professional practices, to maintain quality, to uphold the highest standard of service, and to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. Policies and procedures are established in order to meet requirements of accreditation bodies, NELAC, ISO, and applicable programs, such as the Department of Defense (DOD) Environmental Laboratory Accreditation Program, as well as client's quality objectives. This policy is implemented and enforced through the unequivocal commitment of management, at all levels, to the Quality Assurance (QA) principles and practices outlined in this manual. Quality Management Systems are established, implemented and maintained by management. Systems are designed so that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. Quality Systems are applicable to all fields of testing in which the laboratory in involved. The primary responsibility for quality rests with each individual within the laboratory organization. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. All laboratory employees are required to familiarize themselves with the quality documentation and to implement the policies and procedures in their work. All employees shall be trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality. The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work. The laboratory also strives for improvement through varying continuous improvement initiatives and projects.

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Quality Control (QC) procedures are used to continually assess performance of the laboratory and quality systems. ALS maintains control of analytical results by adhering to written standard operating procedures (SOPs), using analytical control parameters with all analyses, and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

This QAM is applicable to the Rochester, NY facility. The information in this QAM has been organized according to requirements found in the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (2003 and 2009), the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, USEPA, 2001; and *General Requirements for the Competence of Testing and Calibration Laboratories*, ISO/IEC17025:2005.

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3.0 PROGRAM DESCRIPTION

The purpose of the QA program at ALS is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality.

3.1 Quality Management Systems

In support of this mission, the laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Program Manager (QA PM) with corporate oversight by the Quality Assurance Manger USA. These systems are based upon ISO 17025:2005 standards, upon which fundamental programs (NELAC 2003, 2009 and DoD QSM) are based. Implementation and documentation against these standards are communicated in corporate policy statements, this QAM, and SOPs. Actual procedures, actions and documentation are defined in both administrative and technical SOPs. Figure 3-1 shows the relationships of the quality systems and associated documentation. Quality systems include:

- Standard Operating Procedures
- Sample Management and Chain of Custody procedures
- Statistical Control Charting
- Standards Traceability
- Ethics Training
- Document Control
- Corrective Action Program
- Management Reviews
- Demonstration of Capability

The effectiveness of the quality system is assessed in several ways, including:

- Internal and External Audits covering all aspects of the organization
- Annual Management Reviews
- Analysis of Customer Feedback
- Internal and External Proficiency Testing

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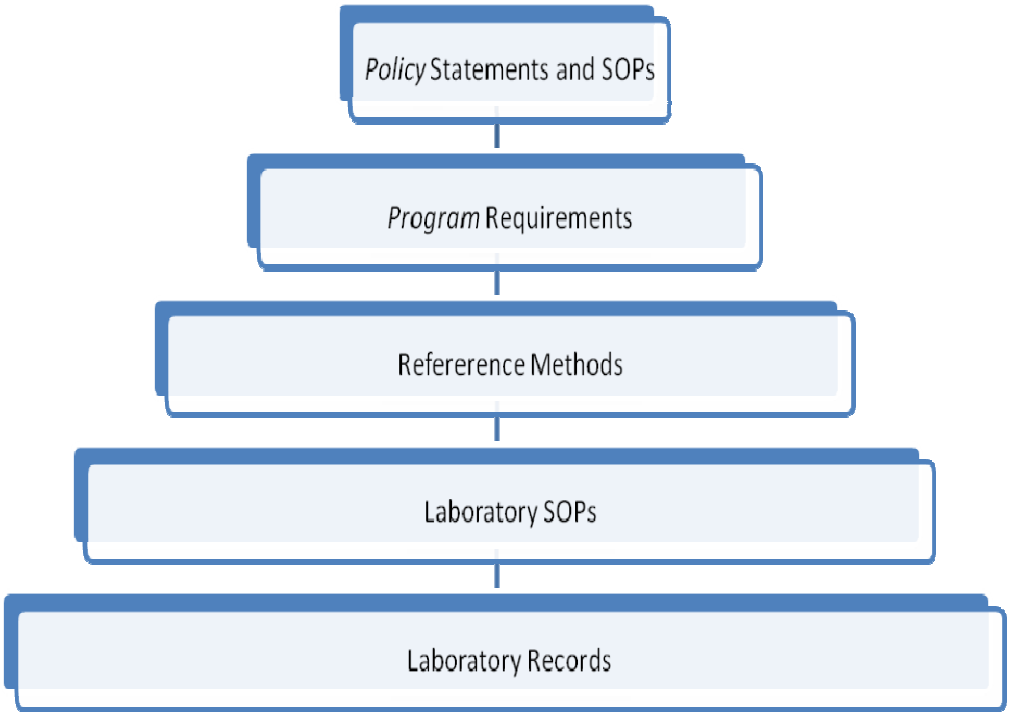
Figure 3-1

Relationships of Quality Management Systems and Documentation



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3.2 Facilities, Equipment, and Security

The ALS Rochester facility features 23564 square feet of laboratory and administrative workspace at its Rochester, NY location. The facility is secured using a proximity reader entry system. The laboratory design provides safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. ALS minimizes laboratory contamination sources by employing janitorial and maintenance staff to ensure that good housekeeping and facilities maintenance are performed. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas include:

- Sample Management Office including shipping and receiving
- Separate sample storage areas. See section 7 for further discussion of storage.
- Metals Sample Preparation Laboratory
- Metals Instrumentation Laboratory
- Toxicity Characteristic Leachate Procedure Laboratory
- Water Chemistry & General Chemistry Laboratory
- Semi-volatile Organics Preparations, Gas Chromatography, Gas Chromatography/Mass Spectrometry, and High Performance Liquid Chromatography Laboratory
- Air Laboratory (Volatiles by GC/MS from canisters)
- Volatile Organics Laboratory (Gas Chromatography and Gas Chromatography/Mass Spectrometry including a separate standard preparation laboratory) Laboratory
- Microbiology Laboratory
- Soil Characteristics Laboratory
- Laboratory Deionized Water System
- Field Garage
- Laboratory Management, Client Service, Report Generation and Administration
- Data Archival
- Information Technology (IT) and LIMS
- Hazardous Waste Storage Area

Figure 3-2 shows the facility floor plan. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Appendix C lists the major equipment, illustrating the laboratory's overall capabilities and depth.

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3.3 Technical Elements of the Quality Assurance Program

The laboratory's technical procedures are based upon procedures published by various agencies or organizations (See Section 17). The Quality Assurance Program provides to the laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained by the QA department. This includes method approvals and audit administration. In addition, internal audits are performed to assess compliance with policies and procedures. SOPs are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix A and SOPs in Appendix F.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, technical training and preventive maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

3.4 Operational Assessments and Service to the Client

The laboratory uses a number of systems to assess its daily operations. In addition to the routine quality control (QC) measurements, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients including; on-time performance, customer complaints, training reports and non-conformity reports. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

ALS utilizes a number of different methods to ensure that adequate resources are available for service demands. Senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. All Requests for Proposal (RFP) documents are reviewed by the Project Chemist and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Project Plans (QAPPs) if available. Status/production meetings are also conducted regularly with the laboratory and project managers to inform the staff of the status of incoming work, future projects, or project requirements.

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When a customer requests a modification to an SOP, policy, or standard specification the Project Manager will discuss the proposed deviation with the Client Services Manager, Laboratory Director, and department manager to obtain approval for the deviation. The QA PM may also be involved. All project-specific requirements must be on-file and with the service request upon logging in the samples. The modification or deviation must be documented. A Project-Specific Communication Form, or similar, may be used to document such deviations.

The laboratory shall afford clients cooperation to clarify the client's request and to monitor the laboratory's performance in relation to the work performed, provided that the laboratory ensures confidentiality to other clients. The laboratory maintains and documents timely communication with the client for the purposes of seeking feedback and clarifying customer requests. Feedback is used and analyzed to improve the quality of services. The *SOP for Handling Customer Feedback* (ADM-FDBK) is in place for these events.

3.5 Document Control and Records

Procedures for control and maintenance of documents are described in the *SOP for Document Control (CE-GEN-005).* The requirements of the SOP apply to all laboratory logbooks (standards, maintenance, run logbooks, etc), certificates of analysis, SOPs, QAMs, quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled documents.

Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QA PM, or designee, and ensure that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file. Logbook entries are standardized following the *SOP for Making Entries into Logbooks and onto Benchsheets* (CE-QA-007). The entries made into laboratory logbooks are reviewed and approved on a quarterly basis.

A records system is used which ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in the *SOP for Data Archiving (ADM-ARCH).*

External documents relative to the management system are managed by the QA PM. To prevent the use of invalid and/or outdated external documents, the laboratory maintains a master list of current documents and their availability. The list is reviewed before making the documents available. External documents are not issued to personnel.

3.6 Subcontracting

Analytical services are subcontracted when the laboratory needs to balance workload or when the requested analyses are not performed by the laboratory. Subcontracting is only done with the knowledge and approval of the client and to qualified laboratories. Subcontracting to another ALS laboratory is preferred over external-laboratory subcontracting. Further, subcontracting is done using capable and qualified laboratories. Established procedures are

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used to qualify external subcontract laboratories. These procedures are described in the *SOP for Qualification of Subcontract Laboratories (CE-QA-004)*

3.7 Procurement

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. The Policy for Standards and Reagents Expiration Dates provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in the *SOP for Procurement and Control of Lab Services and Supplies* (CE-GEN-007). Also, refer to section 9.4 for a discussion of reference materials.

Receipt procedures include technical review of the purchase order/request to verify that what was received is identical to the item ordered. The laboratory checks new lots of reagents for unacceptable levels of contamination prior to use in sample preservation, sample preparation, and sample analysis by following the *SOP for Checking New Lots of Chemicals for Contamination* (ADM-CTMN).

3.8 Review of Requests, Tenders and Contracts (Procedures for Accepting New Work)

Requests for new work are reviewed prior to signing any contracts or otherwise agreeing to perform the work. The specific methods to be used are agreed upon between the laboratory and the client. A capability review is performed to determine if the laboratory has or needs to obtain certification to perform the work, to determine if the laboratory has the resources (personnel, equipment, materials, capacity, skills, expertise) to perform the work, and if the laboratory is able to meet the client's required reporting and QC limits. The results of this review are communicated to the client and any potential conflict, deficiency, lack of appropriate accreditation status, or concerns of the ability to complete the client's work are resolved. Any differences between the request or tender and the contract shall be resolved before any work commences. The client should be notified at this time if work is expected to be subcontracted. Each contract shall be acceptable both to the laboratory and the client. Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work. If a contract needs to be amended after work has commenced, the contract review process is repeated and any amendments are communicated to all affected personnel. Changes in accreditation status affecting ongoing projects must be reported to the client.

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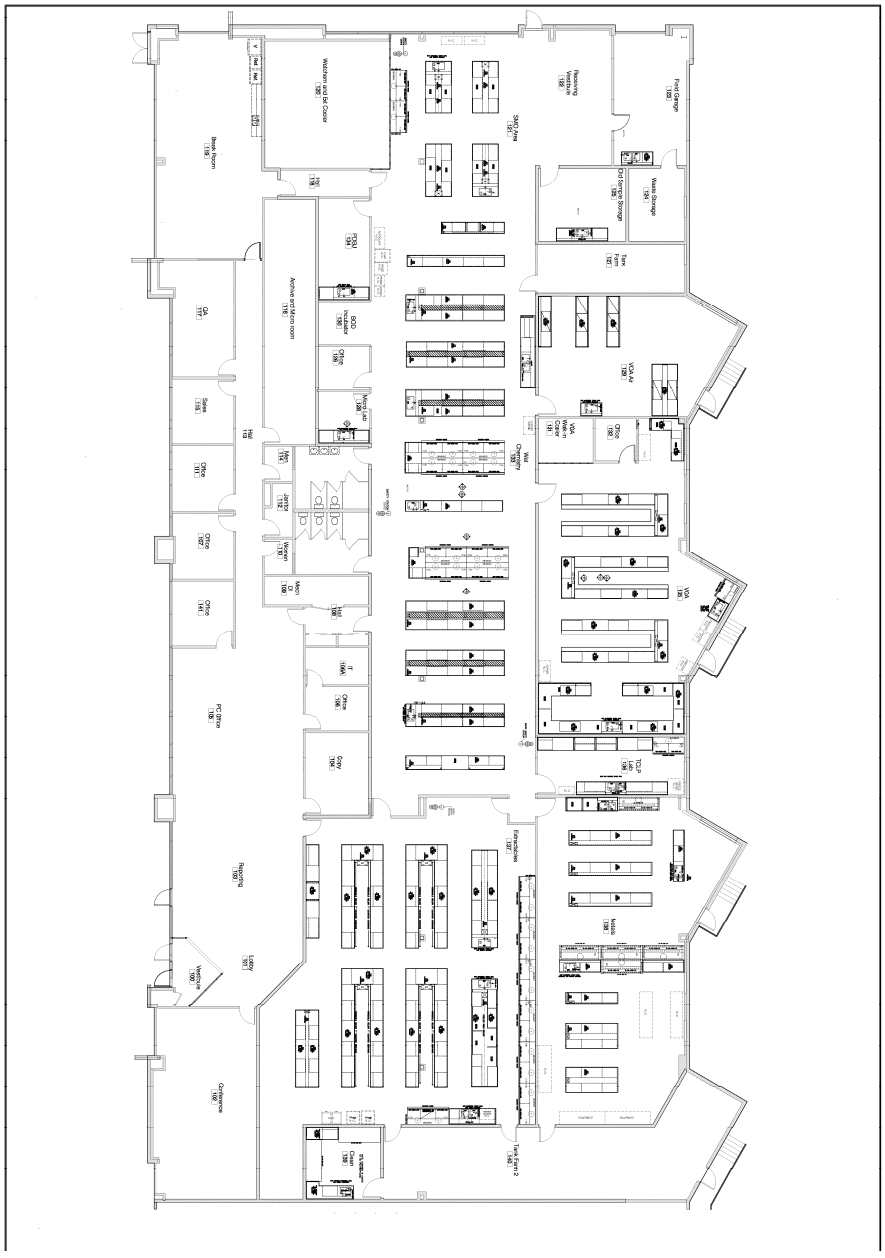
Figure 3-2
ALS/Rochester Laboratory Floor Plan



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4.0 PROFESSIONAL CONDUCT, DATA INTEGRITY, AND ETHICS

ALS is committed to achieving the highest standards of ethical conduct. Three mechanisms have been designed to achieve these goals: the Code of Conduct Employment Agreement, the Confidentiality Agreement, and the Ethics and Data Integrity Policy. Together, these agreements ensure freedom from undue internal and external commercial, financial, and other pressures or influences that could adversely affect the quality of work. They protect customers' confidential information and ALS' proprietary rights. They ensure avoidance of activities that would diminish confidence in the competence, impartiality, judgment or integrity of any ALS laboratory and staff.

4.1 Professional Conduct

The Code of Conduct and Confidentiality Agreements are administered by the Human Resources Department during orientation. Original signed training records are maintained by the HR department in secure personnel files. The Code of Conduct agreement provides a framework for decisions and actions in relation to conduct in employment. It underpins commitment to a duty of care to all employees and to customers receiving our services. The agreement covers a wide range of topics including, but not limited to, personal and professional behavior, conflicts of interest, gifts, confidentiality, legal compliance, security of information, and reporting fraud.

The following are examples of the standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action.
- Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.
- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible.
- It is the responsibility of all ALS employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. The nature of our business and the well being of our company and of our clients is dependent upon protecting and maintaining proprietary company/client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action. All employees sign a confidentiality agreement upon hire to protect the company and client's confidentiality and proprietary rights.

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4.2 Prevention and Detection of Improper, Unethical or Illegal Actions

It is the intention of ALS to proactively prevent and/or detect any improper, unethical or illegal action conducted within the laboratory. This is performed by the implementation of a program designed for not only the detection but also prevention. Prevention consists of educating all laboratory personnel in their roles and duties as employees, company policies, inappropriate practices, and their corresponding implications as described here.

In addition to education, appropriate and inappropriate practices are included in SOPs such as manual integration, data review and specific method procedures. Electronic and hardcopy data audits are performed regularly, including periodic audits of chromatographic electronic data. Requirements are described in the SOP for Internal Quality Assurance Audits (CE-QA001)and details are listed in laboratory administrative SOPs. All aspects of this program are documented and retained on file according to the company policy on record retention.

The Whistleblower Policy is intended to encourage and enable employees to raise concerns they may have regarding the practices of other members of the company and to promote responsible disclosure about issues where the interests of others are at risk. The policy has provisions to ensures the whistleblowers safety from retaliation or retribution. Employees are encouraged to raise concerns directly with supervisors or managers, but may contact the independent service FAIRCALL (by KPMG) to report concerns anonymously.

4.3 Laboratory Data Integrity and Ethics Training

Each employee receives Data Integrity/Ethics Training within one month of hire. On an ongoing basis, all employees receive annual ethics refresher training. Topics covered are documented in writing and all training is documented. It is the responsibility of the QA PM to ensure that the training is conducted as described.

Key topics covered are the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues, and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

Trainees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution.

The training session includes many concepts and topics, numerous examples of improper actions (defined by DoD as deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional), legal and liability implications (company and personal), causes, prevention, awareness, and reporting mechanisms.

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4.4 Management and Employee Commitment

ALS makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the ALS Employee Handbook. This includes:

- ALS Corporate FAIRCALL Program – An anonymous and confidential reporting system available to all employees that is used to communicate misconduct and other concerns. The program shall help minimize negative morale, promote a positive work place, and encourage reporting suspected misconduct without retribution. Associated upper management is notified and the investigations are documented.
- Use of flexible work hours. Within reason and as approved by supervisors, employees are allowed flexible work hours in order to help ease schedule pressures which could impact decision-making and work quality.
- Operational and project scheduling assessments are continually made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads. Procedures for subcontracting work are established, and within the ALS laboratory network additional capacity is typically available for subcontracting, if necessary.
- Gifts and Favors – To avoid possible conflict of interest implications, employees do not receive unusual gifts or favors to, nor accept such gifts or favors from, persons outside the Company who are, or may be, in any way concerned with the projects on which the Company is professionally engaged.

All employees are required to sign and adhere to the requirements set forth in the Code of Conduct, Laboratory Ethics and Data Integrity Procedures (CE-GEN-001), and Confidentiality Agreement.

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5.0 ORGANIZATION AND RESPONSIBILITIES

The ALS/Rochester staff, consisting of approximately 50 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds and experience, and provide the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks.

ALS is committed to providing an environment that encourages excellence. All employees share the responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 5-1 lists the ALS/Rochester personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B. The individuals listed below with the authority to stop work also have the authority to resume work. Only the individual that stopped work may authorize the resumption of work.

- The role of the **Laboratory Director** is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program and is responsible for overall laboratory efficiency and the financial performance of the Rochester facility. The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.
- The responsibility of the **Quality Assurance Program Manager** (QA PM) is to oversee implementation of the quality program and to coordinate QA activities within the laboratory. The QA PM is responsible for ensuring compliance with NELAC standards (and ISO, DoD QSM, etc. as applicable). The QA PM works with laboratory staff to establish effective quality control and assessment plans and has the authority to stop work in response to quality problems. The QA PM is responsible for maintaining the QA Manual and performing an annual review of it; reviewing and approving SOPs and ensuring the annual review of each SOP; maintaining QA records such as metrological records, archived logbooks, PT study results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; performing internal QA audits; preparing QA activity reports; etc. The QA PM reports directly to the Laboratory Director and also reports indirectly to the Chief Quality Officer. It is important to note that when evaluating data, the QA PM does so in an objective manner and free of outside, or managerial, influence.

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- The USA Quality Assurance Manger is responsible for the overall QA program at all the ALS Analytical laboratories in the United States. The USA Quality Assurance Manager is responsible for oversight of QA PMs regulatory compliance efforts (NELAC, ISO, DOD, etc). The USA Quality Assurance Manger performs internal audits at each laboratory; maintains a database of laboratory certification/accreditation programs; approves company-wide SOPs; provides assistance to the laboratory QA staff and laboratory managers; prepares a quarterly QA activity report; etc.

➢ In the case of absence of the Laboratory Director or QA PM, deputies are assigned to act in that role. Default deputies for these positions are the Client Services Manager or Organics Department Manager (for the Laboratory Director) and the USA Quality Assurance Manager or Laboratory Director (for the QA PM).

- The **Environmental Health and Safety Officer** (EH&S) is responsible for the administration of the laboratory health and safety policies. This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S officer is also designated as the Chemical Hygiene Officer. The EH&S Officer has a dotted-line reporting responsibility to the ALS EH&S Director.
- The **Client Services Manager** is responsible for the Client Services Department (customer services/project managers, and Electronic Data Deliverables group) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. The sample management office handles all the activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.
- The **Project Manager** is a scientist assigned to each client to act as a technical liaison between the client and the laboratory. The project chemist is responsible for ensuring that the analyses performed by the laboratory meet all project, contract, and regulatory-specific requirements. This entails coordinating with the ALS laboratory and administrative staff to ensure that client-specific needs are understood and that the services ALS provides are properly executed and satisfy the requirements of the client.
- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a quality control program meeting department needs. Each **Department Supervisor** has the responsibility to ensure that quality control functions are carried out as planned, and to guarantee the production of high quality data. Department supervisors have the responsibility to monitor the day-to-day operations to ensure that productivity and data quality objectives are met. Each department supervisor has the authority to stop work in response to quality problems in their area. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.
- The **Sample Management Office** plays a key role in the laboratory QA program by maintaining documentation for all samples received by the laboratory,. The sample management office staff is also responsible for the proper disposal of samples after analysis.

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- **Information Technology** (IT) staff are responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) generation, and data back-up, archival and integrity operations.

Table 5-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Michael Perry.	37	Laboratory Director/Technical Director
Lisa Reyes.	26	Quality Assurance Program Manager
Janice Jaeger	23	Client Services Manager
Christine Kutzer	20	Inorganics Department Supervisor
Thomas Walton	23	Volatiles Department Supervisor
Gregg LaForce	10	Sample Management Office Supervisor
Meghan Pedro.	11	Extractables Preparation Supervisor/ Environmental Health
Michael Cymbal	22	Semivolatile Organics Supervisor/ Information Technology

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6.0 INFORMATION MANAGEMENT

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. ALS management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies. Appendix C lists major computing equipment.

6.1 Software Quality Assurance Plan

ALS has defined practices for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the *Software Quality Assurance Plan (SQAP)*. The purpose of the SQAP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of this plan are policies for software validation and control.

6.2 IT Support

The local ALS Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data. A software inventory is maintained. Additional IT responsibilities are described in the SQAP.

In addition to the local IT department, ALS corporate IT provides support for network-wide systems. ALS also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

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6.3 Information Management Systems

ALS has various systems in place to address specific data management needs. The ALS Laboratory Information Management System (LIMS) is used to manage sample information, sample tracking, sample workload projections, sample result storage, reporting, and invoicing. The LIMS is used to track the status of a sample and is important in maintaining internal chain of custody. Access is controlled by password.

ALS currently uses StarLIMS v.9 throughout the laboratory. This data management and retrieval system is deployed via Citrix XenApp Server from a centralized application server farm located in Portland, OR. This LIMS system utilizes Oracle 10g R1 as its database server, which runs on a Linux Operating System. The system allows the user to acquire data from instrumentation and to generate ASCII, spreadsheet, database, and/or print files.

6.4 Backup and Security

ALS laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving. Differential and full backups are performed and stored according to ADM-BACKUP.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non- ALS access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. ALS uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

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7.0 SAMPLE MANAGEMENT

7.1 Sampling and Sample Preservation

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. ALS recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, USEPA SW-846, and state-specific sampling guidelines, if applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

ALS uses the sample preservation, container, and holding-time recommendations published in a number of documents. The primary documents of reference are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IV and New Methods for hazardous waste samples; USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; EPA 40CFR parts 136 and 141; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples (see Section 18 for complete citations). The container, preservation and holding time information for these references is summarized in Table 7-1 for soil, water, and drinking water. The current EPA CLP Statement of Work should be referred to for CLP procedures. Where allowed by project sampling and analysis protocols the holding time for sediment, soil, and tissue samples may be extended for a defined period when stored frozen at -20°C.

ALS routinely provides sample containers with appropriate preservatives for our clients. Containers are purchased as precleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for the sample containers are available to clients if requested. Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are tested by the laboratory to ensure that they are free of interferences and documented. Our sample kits typically consist of foam-lined, precleaned shipping coolers, (cleaned inside and out with appropriate cleaner, rinsed thoroughly and air-dried), specially prepared and labeled sample containers individually wrapped in protective material, (VOC vials are placed in a specially made, foam holder), chain-of-custody (COC) forms, and custody seals. Container labels and custody seals are provided for each container. See SOP, ADM-CTMN for information about the testing of chemicals added as preservatives. See SOP, SMO-BPS for more specific information regarding the packing and shipping of sample kits. See SOP, SMO-GEN for the Sample Acceptance Policy.

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Figure 7-1 shows the chain-of-custody form routinely used at ALS and included with sample kits. For large sample container shipments, the containers may be shipped in their original boxes. Such shipments will consist of several boxes of labeled sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) to allow the sampling personnel to process the sample containers and return them to ALS. The proper preservative is added to the sample containers prior to shipment, unless otherwise instructed by the client.

ALS keeps client-specific shipping requirements on file and utilizes major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. ALS also provides courier service that makes regularly scheduled trips to the Rochester, Syracuse and Buffalo areas.

When ALS ships environmental samples to other laboratories for analysis each sample bottle is wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during shipping. The sample management office (SMO) follows formalized procedures (SMO-GEN) for maintaining the samples' chain of custody, packaging and shipment.

7.2 Sample Receipt and Handling

Standard Operating Procedures (SMO-GEN) are established for the receiving of samples into the laboratory. These procedures ensure that samples are received and properly logged into the laboratory, and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received.

Once samples are delivered to the ALS sample management office (SMO), a Cooler Receipt and Preservation Check Form (CRPF - See Figure 7-2 for an example) is used to assess the shipping cooler and its contents as received by the laboratory personnel. Verification of sample integrity includes the following activities:

- Assessment of custody seal presence/absence;
- Temperature of sample containers upon receipt;
- Chain of custody documents properly used (entries in ink, signature present, etc.);
- Sample containers checked for integrity (broken, leaking, etc.);
- Sample is clearly marked and dated (bottle labels complete with required information);
- Appropriate containers (size, type) are received for the requested analyses;
- Sample container labels and/or tags agree with chain of custody entries (identification, required analyses, etc.);
- Assessment of proper sample preservation (if inadequate, corrective action is employed); and
- VOC containers are inspected for the presence/absence of bubbles. (Assessment of proper preservation of VOC containers is performed by lab personnel).

Samples are logged into a Laboratory Information Management System (LIMS). Any anomalies or discrepancies observed during the initial assessment are recorded on the CRPF and COC documents. Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Chemist and client have reached a satisfactory resolution, the login process may continue and analysis may begin.

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During the login process, each sample container is given a unique laboratory code. The laboratory code consists of the local ALS laboratory, the year in which the samples were logged, a folder number unique to the job, and an extension for the sample number within that job. The format of the laboratory code is as follows:

e.g. Lab Code R1203233-001 = R - Rochester
12 - Year 2012
03233- Folder Number (sequential number of jobs logged in that year)
001 – Sample number in that Folder.

The LIMS generates a Service Request Summary that contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates and other pertinent information. The service request is reviewed by the appropriate Project Chemist for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Samples are stored as per method requirements until they undergo analysis, unless otherwise specified, using various refrigerators or freezers, or designated secure areas. ALS/Rochester has two walk-in cold storage units which house the majority of sample containers received at the laboratory. The dedicated storage area for VOC samples are monitored using storage blanks, as described in the *SOP for Volatile Storage Blanks (VOC-BLANK)*. ALS also has freezers capable of storing samples at -20° C. The temperature of each sample storage unit is monitored daily and the data recorded in a logbook. Maximum/minimum thermometers have also been placed in the walk-in refrigerators to provide a record of the storage conditions to which samples are exposed.

ALS adheres to the method-prescribed or project-specified holding times for all analyses. The sampling date and time are entered into the LIMS system at the time of sample receipt and login. Analysts then monitor holding times by obtaining analysis-specific reports from the LIMS. These reports provide holding time information on all samples for the analysis, calculated from the sampling date and the holding time requirement. To document holding time compliance, the date and time analyzed is printed or written on the analytical raw data. For analyses with a holding time prescribed in hours it is essential that the sample collection time is provided, so holding time compliance can be demonstrated. If not, the sample collection time is assumed as the earliest in the day (i.e. the most conservative).

Unless other arrangements have been made in advance, most aqueous and soil samples are retained at 0-6°C in refrigerators for at least 30 days from receipt. Samples are required to be held for at least 60 days. Samples removed from the refrigerators are moved to an ambient temperature storage room as needed for an additional 30 days. Upon expiration of these time limits, the samples are either returned to the client or disposed of according to approved disposal practices. All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the Sample Disposal SOP (SMO-SPLDIS). It should be noted that all waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with all applicable local and Federal laws. The bar coding system used to track samples through the lab, including disposal, produces cradle to grave sample history for each sample aliquot.

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7.3 Sample Custody

Sample custody transfer at the time of sample receipt is documented using chain-of-custody (COC) forms accompanying the samples. During sample receipt, it is also noted if custody seals were present. This is described in the *SOP for Sample Receiving (SMO-GEN)*. Figure 7-1 is a copy of the chain-of-custody form routinely used at ALS.

Facility security and access is important in maintaining the integrity of samples received at ALS. Access to the laboratory facility is limited by use of locked exterior doors with a proximity card entry, except for the reception area doors, which are manned during business hours and locked at all other times. The ALS facility is equipped with an alarm system.

A barcoding system is used to document internal sample custody. Each person removing or returning samples from/to sample storage while performing analysis is required to document this custody transfer. The system uniquely identifies the sample container and provides an electronic record of the custody of each sample. For sample extracts and digestates the analyst documents custody of the sample extract or digestate by signing on the benchsheet, or custody record, that they have accepted custody. The procedures are described in the *SOP for Sample Tracking and Internal Chain of Custody (SMO-ICOC).*

7.4 Project Setup

The analytical method(s) used for sample analysis are chosen based on the client's requirements. Unless specified otherwise, the most recent versions of reference methods are used. For SW-846 methods, some projects may require the most recent *promulgated* version, and some projects may require the most recent *published* version. The Project Chemist will ensure that the correct method version is used. LIMS codes are chosen to identify the analysis method used for analysis. The Project Chemist ensures that the correct methods are selected for analysis, deliverable requirements are identified, and due dates are specified on the service request. To communicate and specify project-specific requirements, a Project Specific Communication Form is used.

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
Bacterial Tests						
Coliform, Fecal and Total	SM9223B	W	Sterile P,G	100	Cool, ≤6°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Inorganic Tests						
Alkalinity	SM2320B	W	P,G	250	Cool, ≤6°C no headspace	14 days
Ammonia	350.1	W	P,G	250	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Ammonia	350.1	S, NAq	P,G	8 oz.	Cool, ≤6°C	28 days
Ash, Percent	ASTM D482	NonAq Liq	P,G	8 oz.	Cool, ≤6°C	None Listed
Biochemical Oxygen Demand (BOD/ CBOD)	SM5210B	W	P,G	1000	Cool, ≤6°C	48 hours
Bromide	300.0/9056	W	P,G	250	Cool, ≤6°C (not required)	28 days
Bromide	9056	Naq, S	P,G	4 oz.	Cool, ≤6°C (not required)	None listed
BTU (Heat Content)	ASTM D4809	NAq, S	P,G	250, 4 oz.	Cool, ≤6°C	None listed
Chemical Oxygen Demand (COD)	410.4	W	P,G	250	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Chemical Oxygen Demand (COD)	410.4	S, NAq	G	4 oz.	Cool, ≤6°C	28 days
Chloride	300.0/ 9056/ SM4500Cl E	W	P,G	250	Cool, ≤6°C (not required)	28 days
Chloride	9056	Naq, S	P,G	4 oz.	Cool, ≤6°C (not required)	None listed
Chlorine, Total Residual	SM4500Cl F	W	P,G	500	None Required- field analysis preferred	15 minutes
Chlorine Demand	SM 409A	W	P,G	500	Cool, ≤6°C	None listed
Chlorophyll a - spectrophotometric	SM 10200H	W	P,G, or filter	1000 or filter	Filter immediately and freeze filter	3 weeks
Chlorophyll a - fluorometric	SM 10200H	W	P,G, or filter	100 or filter	Filter immediately and freeze filter	3 weeks
Color	SM2120B	W	P,G	100	Cool, ≤6°C	48 hours

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
Cyanide, Total, Free, and Amenable to Chlorination	335.4/ SM4500CNG /9012A/ D7237/ D7284	W	P,G	250	Cool, ≤6°C, NaOH to pH>12	14 days
Cyanide, Weak Acid Dissociable	SM4500CN G	W	P,G	250	Cool, ≤6°C, NaOH to pH >12	14 days
Cyanide, Total	9012	S	P,G	250	Cool, ≤6 °C	14 days
Density	ASTM D4052	NonAq Liq	P,G	250	None	None listed
Ethylene Glycol	NYSDEC 89-9	W	G	3x40 mL	Cool, ≤6°C	None listed
Fluoride	300.0/9056	W	P,G	250	Cool, ≤6°C (not required)	28 days
Fluoride	9056	Naq, S	P,G	4 oz.	Cool, ≤6°C (not required)	None listed
Hardness	SM2340C	W	P,G	250	HNO_3 to pH<2	6 months
Hydrogen Ion (pH)	SM4500 H+B/ 9040	W	P,G	100	None Required – field analysis preferred	15 minutes
Ignitability – closed cup	1010	Liquid	G	3 x 40mL	Cool, ≤6°C	14 days
Iron, Ferrous	SM 3500 Fe D	W	P,G	250	Cool, ≤6 °C, no headspace	Immediate (24 hours – Field preferred)
Ignitability – open cup	ASTM D92	S	G	4oz.	Cool, ≤6°C	None listed
Iodide	300	W	P,G	250	Cool, ≤6°C	28 days suggested
Kjeldahl and Organic Nitrogen	351.2	W	P,G	250	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Kjeldahl and Organic Nitrogen	351.2	S, NAq	P,G	4oz.	Cool, ≤6°C	28 days
Nitrate	300.0/9056	W	P,G	250	Cool, ≤6°C	48 hours
Nitrate	9056	Naq, S	P,G	4 oz	Cool, ≤6°C	None listed
Nitrate-Nitrite	353.2	W	P,G	250	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Nitrite	300.0/9056/ 353.2	W	P,G	250	Cool, ≤6°C	48 hours
Nitrite	9056	S, Naq	P,G	4 oz	Cool, ≤6°C	None listed
Odor	SM 2150B	W	G	300 mL	None	Immediate
Orthophosphate	365.1	W	P,G	250	Filter Immediately, Cool, ≤6°C	48 hours

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
Perchlorate	6850	W,S	G	250 plastic, 4 oz. amber	Cool, ≤6°C Keep headspace	28 days
Perchlorate	6850	T	G	4 oz. amber	Freeze, ≤-10°C	28 days
Phenolics, Total	420.4/9066	W	Amber G Only	250	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Phenolics, Total	9066	S	G	4 oz.	Cool, ≤6°C	28 days
Phenolics, Total	9066	NAq	G	250	Cool, ≤6°C	28 days
Phosphorus, Total	365.1	W	P,G	250	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Phosphorus, Total	365.1	S, NAq	P,G	4 oz.	Cool, ≤6°C	28 days
Reactive Cyanide and Sulfide	Chpt7/9010	W,S	P,G	10g	Cool, ≤6 °C	None listed
Residue, Total	SM2540B	W	P,G	250 or 1000	Cool, ≤6°C	7 days
Residue, Filterable (TDS)	SM2540C	W	P,G	250	Cool, ≤6°C	7 days
Residue, Nonfilterable (TSS)	SM2540D	W	P,G	1000	Cool, ≤6°C	7 days
Residue, Settleable	SM2540F	W	P,G	1000	Cool, ≤6°C	48 hours
Residue, Volatile (TVS, TVSS, TVDS)	160.4	W	P,G	250	Cool, ≤6°C	7 days
Residue, Volatile	SM 2540G	S	P,G	4 oz.	Cool, ≤6°C	none
Silica, Dissolved	USGS I-2700-85	W	P Only	250	Cool, ≤6°C	28 days
Silicon	CAS SOP	S, Naq	P	250	Cool, ≤6°C	None listed
Specific Conductance	120.1	W	P,G	100	Cool, ≤6°C	28 days
Specific Gravity	ASTM D1475	NonAq Liq	P,G	250	None	None listed
Sulfate	300.0/9056	W	P,G	250	Cool, ≤6°C	28 days
Sulfate	9056	Naq, S	G	4 oz.	Cool, ≤6°C	28 days
Sulfide, Acid Soluble	SM 4500-S F /9034	W	P,G	500	Cool, ≤6°C, Add Zinc Acetate plus NaOH to pH>9 No headspace	7 days
Sulfide, Acid Soluble	9030B/9034	S	P,G	4 oz.	Cool, ≤6°C No headspace	7 days
Sulfide, Acid Volatile (AVS)	EPA Draft 1991	S	G	8 oz.	Cool, ≤6°C No headspace	14 days
Sulfite	SM 4500-SO32-B	W	P,G	250	None Required- field analysis preferred	15 minutes
Sulfur – Peroxide Digestion	300	W,S,Naq	P,G	250	Cool, ≤6°C	None

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DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
Sulfuric Acid	8	A impingers	P,G	250	None	None
Surfactants (MBAS)	SM 5540C	W	P,G	500	Cool, ≤6°C	48 hours
Temperature	170.1	W	P,G	50	None Required	Analyze immediately
Turbidity	180.1	W	P,G	100	Cool, ≤6°C	48 hours
UV Absorbing Constituents	SM 5910 B	W	P,G	250	Cool, ≤6°C	48 hours
Water, Percent	ASTM E203	W	P,G	4 oz.	Cool, ≤6°C	None listed
Metals						
Chromium VI	218.6	W (not Drinking Water)	P,G	250	Cool, ≤6°C Buffering = pH 9.3-9.7 with specific solution	24 hours: 28 days if buffered
Chromium VI	218.6	Drinking Water	P,G	250	Cool, ≤6°C Buffering = pH 9.0-9.5 with specific solution	24 hours: 5 days if buffered
Chromium VI	218.7	Drinking Water	P,G	250	Cool, ≤6°C Buffering = pH >8 with specific solution	14 days
Chromium VI	7199	W	P,G	250	Cool, ≤6°C	24 hours
Chromium VI	SM3500CrB	W	P,G	250	Cool, ≤6°C	24 hours
Chromium VI	7196A/ 7199	S	P,G	4 oz.	Cool, ≤6°C	30 days until digestion; 7 days until pH adjustment and analysis
Mercury, Low Level	1631	W	Fluoropolymer bottle and cap	500	5 mL 1:1 HCl Cool ≤6°C until BrCl Room Temp after BrCl	28 days to BrCl 90 days from collection to analysis
Mercury	245.1/7470	W	P,G	250	HNO_3 to pH<2	28 days
Mercury	245.5/7471	S	P,G	4 oz.	Cool, ≤6°C	28 days
Metals, except Chromium VI and Mercury	200.7/200.8/ 6010/06020/ 7010	W	P,G	250	HNO_3 to pH<2	180 days
Metals, except Chromium VI and Mercury	6010/6020/ 7010	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	180 days
Metals, except Chromium VI and Mercury	6010/6020	Tissue	G, Teflon-Lined Cap	4 oz.	Freeze, ≤-10°C	180 days

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
Organics						
Oil and Grease	1664A	W	G, Teflon-Lined Cap	1000	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Organic Carbon, Total (TOC)	SM20 5310C /9060	W	G	250 amber	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Total Inorganic Carbon (TIC)	SM20 5310C	W	G	250	Cool, ≤6°C	28 days
Organic Carbon, Total (TOC)/ Total Inorganic Carbon (TIC)	EPA Lloyd Kahn	S	G	4 oz	Cool, ≤6°C, no headspace	14 days
Organic Carbon, Total (TOC)/ Total Inorganic Carbon (TIC	EPA Lloyd Kahn	NAq	G	4 oz	Cool, ≤6°C, no headspace	None listed
Petroleum Hydrocarbons, Total Recoverable (gravimetric)	1664A	W	G, Teflon-Lined Cap	1000	Cool, ≤6°C, HCl or H_2SO_4 to pH<2	28 days
Petroleum Hydrocarbons, Total	310-13	W	G, Teflon-Lined Cap	2x1000	Cool, ≤6°C,	7 days until extraction; 40 days after extraction
Petroleum Hydrocarbons, Total	310-13	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	14 days until extraction; 40 days after extraction
Volatile Organics						
Purgeable Halocarbons and Aromatics (including BTEX, Oxygenates)	524.2/ 601/ 602/ 624/ 8021/ 8260	W	G, Teflon-Lined Septum Cap	3x40	**No Residual Chlorine Present**: HCl to pH<2, Cool, ≤6°C, No Headspace **Residual Chlorine Present**: 25mg $Na_2S_2O_3$, HCl to pH<2, Cool, ≤6°C, No Headspace	14 days 7 days if not chemically preserved
Purgeable Halocarbons and Aromatics (including BTEX, Oxygenates)	8021/8260	S	G, Teflon-Lined Cap	2 oz.	Cool, ≤6°C, Minimize Headspace	14 days
Purgeable Halocarbons and Aromatics (including BTEX, Oxygenates)	8021/8260	S - 5035	G, Teflon-Lined, Septum Cap	5g cores in 2x40 DI 1x40 MeOH Or 3 x 5g cores	Cool, ≤6°C or freeze Cool, ≤6°C or freeze, in coring tool, lab transfer to 2x40 DI 1x40 MeOH within 48 hours	14 days
Acrolein	624/8260	W	G, Teflon-Lined Septum Cap	3x40	Adjust pH to 4-5, Cool, ≤6°C, No Headspace or If not pH 4-5	14 days 3 days if not adjusted to pH 4-5

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
Petroleum Hydrocarbons, Volatile (Gasoline-Range Organics)	8015	W	G, Teflon-Lined Septum Cap	3x40	Cool, ≤6°C, HCl to pH<2 No Headspace	14 days 7 days if not chemically preserved
Petroleum Hydrocarbons, Volatile (Gasoline-Range Organics)	8015	S	G, Teflon-Lined Cap	8 oz.	Cool, ≤6°C Minimize Headspace	14 days
Dissolved Gases	RSK-175	W	G, Teflon-Lined Septum Cap	3x40	Cool, ≤6°C, HCl to pH<2 No Headspace	14 days 7 days if not chemically preserved
Volatiles	TO-15	Air	Canisters	6 L	None Required	30 days recommended
			Tedlar Bags	1L or 3L		3 days
Semivolatile Organics						
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics)	8015	W	G, Teflon-Lined Cap	2x1000	Cool, ≤6°C	7 days until extraction 40 days after extraction
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics)	8015	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	14 days until extraction; 40 days after extraction
EDB and DBCP	504.1	W	G, Teflon-Lined Cap	3x40	Cool, ≤6°C, No Headspace	28 days until extraction; 24 hours after extraction
EDB and DBCP	8011	W	G, Teflon-Lined Cap	3x40	Cool, ≤6°C, No Headspace	14 days until extraction; 14 days after extraction
Non-Halogenated Organics	8015	W,S, NAq	G, Teflon-Lined Cap	3x40, 4 oz.	Cool, ≤6°C, No Headspace[g]	14 days
Phenols, Phthalate Esters, Nitrosamines, Nitroaromatics and Cyclic Ketones, Haloethers, Chlorinated Hydrocarbons	625/ 8270	W	G, Teflon-Lined Cap	2x1000.	Cool, ≤6°C, store in dark[g]	7 days until extraction; 40 days after extraction
Phenols, Phthalate Esters, Nitrosamines, Nitroaromatics and Cyclic Ketones, Haloethers, Chlorinated Hydrocarbons	8270	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C, store in dark	14 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons	610/625/ 8310/ 8270	W	G, Teflon-Lined Cap	2x1000.	Cool, ≤6°C, Store in Dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons	8270	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C, Store in Dark	14 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons	8270	T	G, Teflon-Lined Cap	4 oz.	Freeze, ≤-10°C, Store in Dark	14 days until extraction; 40 days after extraction
Organochlorine Pesticides	608/ 8081	W	G, Teflon-Lined Cap	2x1000	Cool, ≤6°C, Adjust pH to 5-9 unless extracted within 72 hours	7 days until extraction; 40 days after extraction
Organochlorine Pesticides	8081	S, NAq	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	14 days until extraction; 40 days after extraction
Organochlorine Pesticides	8081	T	G, Teflon-Lined Cap	Hexane rinsed double aluminum foil and double bag	Frozen, ≤-20°C	Check client QAP 14/40 RIM Frozen 1 year for EPA Region 1

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
PCBs	608/8082	W,S	G, Teflon-Lined Cap	2x1000, 4 oz.	Cool, ≤6°C	1 year until extraction and analysis
PCB Homologs	680	W	G, Teflon-Lined Cap	2x1000	Adjust pH to 5-9, Cool, ≤6°C, If not pH 5-9	7 days until extraction 40 days after extraction, 72 hours
PCB Homologs	680	T,S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	None listed
Chlorinated Herbicides	8151	W	G, Teflon-Lined Cap	2x1000	Cool, ≤6°C	7 days until extraction; 40 days after extraction
Chlorinated Herbicides	8151	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	14 days until extraction; 40 days after extraction
Metabolic/Fatty/Organic Acids	In house	W	G, Teflon-Lined Cap	2x40mL	Cool, ≤6°C, H_3PO_4	28 days recommended
Carbonyl Compounds (Formaldehyde)	8315	W	G, Teflon-Lined Cap	500	Cool, ≤6°C	3 days until extraction, 3 days after extraction
Carbonyl Compounds (Formaldehyde)	8315	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	14 days
Explosives	8330	W	G, Teflon-Lined Cap	1000	Cool, ≤6°C	7 days until extraction; 40 days after extraction
Explosives	8330	S	G, Teflon-Lined Cap	4 oz.	Cool, ≤6°C	14 days until extraction; 40 days after extraction
1,4-Dioxane	522	W	G, Teflon-Lined Cap	500	Dechlorinate Na_2SO_3, Cool, ≤6°C, pH <4 Na_2HSO_4	28 days until extraction; 28 days after extraction
Toxicity Characteristic Leaching Procedure (TCLP)						
Mercury	7470	HW	P,G	100g/ 1000mL	Sample: Cool, ≤6°C TCLP extract: HNO_3 to pH<2	28 days until extraction; 28 days after extraction
Metals, except Mercury	6010	HW	P,G	100g/ 1000mL	Sample: Cool, ≤6°C TCLP extract: HNO_3 to pH<2	180 days until extraction; 180 days after extraction
Volatile Organics	8260	HW	G, Teflon-Lined Cap	25g	Sample: Cool, ≤6°C Minimize Headspace TCLP extract: Cool, ≤6°C, HCl to pH<2, No Headspace	14 days until extraction; 14 days after extraction
Semivolatile Organics	8270	HW	G, Teflon-Lined Cap	100g/ 1000mL	Sample: Cool, ≤6°C, Store in Darkg TCLP extract: Cool, ≤6°C, Store in Dark	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction
Organochlorine Pesticides	8081	HW	G, Teflon-Lined Cap	100g/ 1000mL	Sample: Cool, ≤6°C TCLP extract: Cool, ≤6°C	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction
Chlorinated Herbicides	8151	HW	G, Teflon-Lined Cap	100g/ 1000mL	Sample: Cool, ≤6°C TCLP extract: Cool, ≤6°C	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction

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Table 7-1
Sample Preservation and Holding Times

DETERMINATION	METHOD	MATRIX[b]	CONTAINER[c]	PREFERRED VOLUME (mL)	PRESERVATION	MAXIMUM HOLDING TIME[a]
CLP						
Volatile Organics	OLM04.3	W,S	G, Teflon-Lined Cap	3x40	W-Cool, ≤6°C, Minimize Headspace Soil – see SOP	10 days[h]
Semivolatile Organics	OLM04.3	W,S	G, Teflon-Lined Cap	2x1000	Cool, ≤6°C, Store in Dark[g]	5 days until extraction;[h,i] 40 days after extraction
Organochlorine Pesticides and PCBs	OLM04.3	W,S	G, Teflon-Lined Cap	2x1000	Cool, ≤6°C	5 days until extraction;[h,i] 40 days after extraction

a Holding time is from collection to analysis unless otherwise specified
b W=Water, S=Soil or Sediment, A = Air, HW = Hazardous Waste, T=Tissue, NAq = Non-Aqueous Liquid
c P=Polyethylene G=Glass
d For chlorinated water samples
e The recommended maximum holding time is variable, and is dependent upon the geographical proximity of sample source to the laboratory
g If the water sample contains residual chlorine, 10% sodium thiosulfate is used to dechlorinate.
h Number of days following sample receipt at the laboratory
i Ten days until extraction for soil, sediment, and sludge samples.

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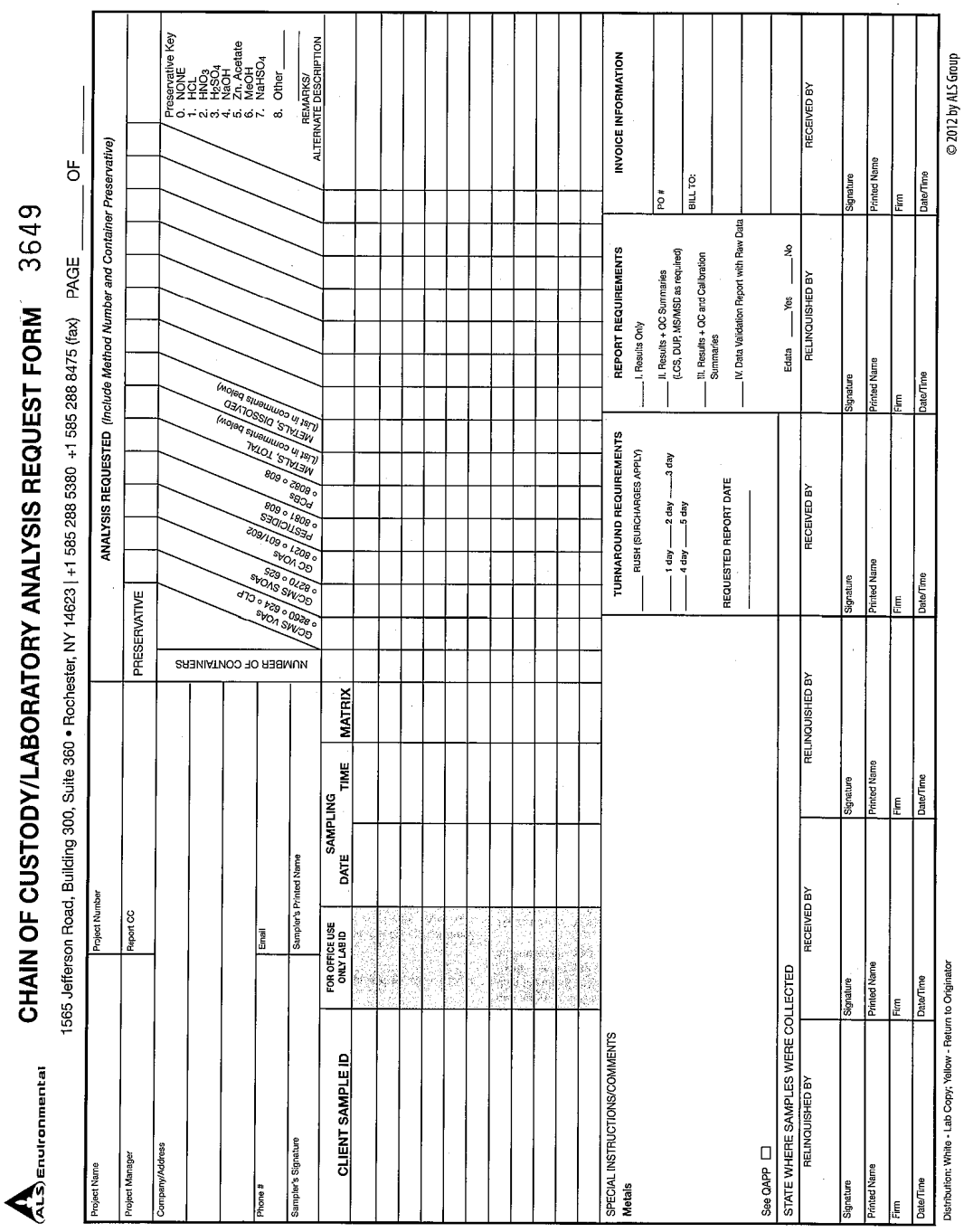
Figure 7-1
Chain of Custody Form



ALS Environmental

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM 3649

1565 Jefferson Road, Building 300, Suite 360 • Rochester, NY 14623 | +1 585 288 5380 +1 585 288 8475 (fax) PAGE _____ OF _____

Project Name | Project Number | Project Manager | Report CC | Company/Address | Phone # | Email | Sampler's Signature | Sampler's Printed Name

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

PRESERVATIVE | NUMBER OF CONTAINERS

GC/MS VOAs ○ 8260 ○ 624 ○ CLP
GC/MS SVOAs ○ 8270 ○ 625
GC VOAs ○ 8021 ○ 601/602
PESTICIDES ○ 8081 ○ 608
PCBs ○ 8082 ○ 608
METALS, TOTAL (List in comments below)
METALS, DISSOLVED (List in comments below)

Preservative Key
0. NONE
1. HCL
2. HNO3
3. H2SO4
4. NaOH
5. Zn. Acetate
6. MeOH
7. NaHSO4
8. Other _____

REMARKS/ ALTERNATE DESCRIPTION

CLIENT SAMPLE ID	FOR OFFICE USE ONLY LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX

SPECIAL INSTRUCTIONS/COMMENTS
Metals

See QAPP ☐

TURNAROUND REQUIREMENTS
_____ RUSH (SURCHARGES APPLY)
_____ 1 day _____ 2 day _____ 3 day
_____ 4 day _____ 5 day
REQUESTED REPORT DATE
_____

REPORT REQUIREMENTS
_____ I. Results Only
_____ II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
_____ III. Results + QC and Calibration Summaries
_____ IV. Data Validation Report with Raw Data
Edata _____ Yes _____ No

INVOICE INFORMATION
PO #
BILL TO:

STATE WHERE SAMPLES WERE COLLECTED

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	Signature	Signature	Signature	Signature	Signature
Printed Name	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name
Firm	Firm	Firm	Firm	Firm	Firm
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - Lab Copy; Yellow - Return to Originator

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Figure 7-2

Cooler Receipt and Preservation Check Form

Project/Client_____Folder Number_____.

Cooler received on_____ by:_____**COURIER:** ALS UPS FEDEX VELOCITY CLIENT

1.	Were custody seals on outside of cooler?			YES	NO	
2.	Were custody papers properly filled out (ink, signed, etc.)?			YES	NO	
3.	Did all bottles arrive in good condition (unbroken)?			YES	NO	
4.	Did VOA vials, Alkalinity, or Sulfide have significant* air bubbles?			YES	NO	N/A
5.	Were **Ice** or **Ice packs** present?			YES	NO	
6.	Where did the bottles originate?			ALS/ROC, CLIENT		
7.	Temperature of cooler(s) upon receipt:	_____	_____	_____	_____	_____
	Is the temperature within 0° - 6° C?:	Yes	Yes	Yes	Yes	Yes
	If No, Explain Below	No	No	No	No	No

Date/Time Temperatures Taken: _____

Thermometer ID: IR GUN#3 / IR GUN#4 Reading From: Temp Blank / Sample Bottle

If out of Temperature, note packing/ice condition &Client Approval to Run Samples:

All Samples held in storage location _____ by _____ on _____ at _____
5035 samples placed in storage location _____ by _____ on _____ at _____

PC Secondary Review: _____

Cooler Breakdown: Date :_____Time:_____by:_____

1.	Were all bottle labels complete (*i.e.* analysis, preservation, etc.)?	YES	NO
2.	Did all bottle labels and tags agree with custody papers?	YES	NO
3.	Were correct containers used for the tests indicated?	YES	NO
4.	Air Samples: Cassettes / Tubes Intact Canisters Pressurized Tedlar® Bags Inflated		N/A

Explain any discrepancies: _____

pH	Reagent	YES	NO	Lot Received	Exp	Sample ID	Vol Added	Lot Added	Final pH
≥12	NaOH								
≤2	HNO_3								
≤2	H_2SO_4								
<4	$NaHSO_4$								
Residual Chlorine (-)	For TCN Phenol and 522			If present, contact PM to add ascorbic acid Or sodium sulfite (522)					
	$Na_2S_2O_3$	-	-						
	Zn Aceta	-	-						
	HCl	*	*						

*Not to be tested before analysis – pH tested and recorded by VOAs or GenChem on a separate worksheet

Yes = All samples OK

No = Samples were preserved at lab as listed

PM OK to Adjust: _____

Bottle lot numbers:_____
Other Comments:

PC Secondary Review: _____

*significant air bubbles: VOA > 5-6 mm : WC >1 in. diameter

H:\SMODOCS\Cooler Receipt 5.doc

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8.0 ANALYTICAL PROCEDURES

ALS employs methods and analytical procedures from a variety of external sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, EPA 40CFR parts 136 and 141, and Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 17.0. Other published procedures, such as state-specific methods, program-specific methods, or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection limit, the concentration of the analyte being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by ALS is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix G. Further details are described below.

8.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks.

ALS maintains SOPs for use in both technical and administrative functions. SOPs are written following standardized format and content requirements as described in the *SOP for Preparation of Standard Operating Procedures*. Each SOP is reviewed and approved by a minimum of two managers (the Technical Director and the Quality Assurance Program Manager). All technical SOPs undergo a documented annual review to make sure current practices are described. The QA PM maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents. The procedures for document control are described in the *SOP for Document Control* (CE-GEN005). In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in the *SOP for Making Entries into Logbooks and onto Benchsheets* (CE-QA007). Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

8.2 Deviation from Standard Operating Procedures

When a customer requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the project chemist handling that project must discuss the proposed deviation with the department manager in charge of the analysis and obtain their approval to accept the project. The project chemist is responsible for documenting the approved or allowed deviation from the SOP by placing a detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

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For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the appropriate supervisor, manager, the laboratory director, or other level of authority. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.

8.3 Modified Procedures

ALS strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a "Modified" method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating procedures are available to analysts and are also available to our clients for review, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

8.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.
2) All (field) samples in a batch are of the same matrix.
3) The QC samples to be processed with the (field) samples include:
   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination.

   b) Laboratory Control Sample

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

* A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.

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4) A single lot of reagents is used to process the batch of samples.
5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.
6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours between the start of processing of the first and last sample of the batch.
7) (Field) samples are assigned to batches commencing at the time that sample processing begins. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.
8) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).
9) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.
10) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.
11) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

8.5 Specialized Procedures

ALS not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples at our various locations are trace-level Mercury and Methylmercury analyses, reductive precipitation metals analysis, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs).

8.6 Sample Cleanup

ALS commonly employs several cleanup procedures to minimize known common interferences prior to analysis. EPA methods (3620, 3640, 3660, and 3665) for cleanup of sample extracts for organics analysis are routinely used to minimize or eliminate interferences that may adversely affect sample results and data usability.

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9.0 CALIBRATION PROCEDURES

All equipment and instruments used at ALS are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Calibration is performed according to the applicable analytical methodology. Calibration procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials.

All analytical measurements generated at ALS are performed using materials and/or processes that are traceable to a reference material. Metrology equipment (analytical balances, thermometers, etc.) is verified using reference materials traceable to National Standards of Measurement such as National Institute of Standards and Technology (NIST). These primary reference materials are themselves reverified on an annual basis. Vendors used for metrology support are required to verify compliance to International Standards by supplying the laboratory with a copy of their scope of accreditation.

Equipment subjected to overloading or mishandling, or has been shown by verification to be defective; is taken out of service until it is repaired. The equipment is placed back in service only after verifying, by calibration, that the equipment performs satisfactorily.

9.1 Temperature Control Devices

Temperatures are monitored and recorded for all of the temperature-regulating support equipment such as refrigerators, freezers, ovens, and incubators. Bound record books are kept which contain daily-recorded temperatures, acceptance criteria and the initials of the technician who performed the checks. The procedure for performing these measurements is provided in the *SOP for Calibration Check Procedures for Support Equipment (SOP ADM-DALYCK).* The SOP also includes the use of acceptance criteria and correction factors. Refrigerators and freezers containing samples are monitored continuously with max/min thermometers.

Where the operating temperature is specified as a test condition the temperature is recorded on the raw data. All thermometers are uniquely identified and the calibration is checked annually (or quarterly for digital devices) against a thermometer traceable to National Standards of Measurement such as National Institute of Standards and Technology (NIST). The traceable thermometer is recertified by a vendor accredited to A2LA or ISO/IEC 17025:2005 International Standard every two years. Calibration records are maintained by the QAPM.

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9.2 Analytical Balances

Analytical balances are serviced on an annual basis by a professional metrology organization. New certificates of calibration for each balance are issued to the laboratory on an annual basis. The calibration of each analytical balance is checked by the user each day of use with Class-1 verified weights bracketing the working range. The reference weights are verified annually by the metrology organization. Bound record books are kept which contain the recorded measurements, identification and location of equipment, acceptance criteria and the initials of the user who performed the checks. See SOP SMO-DALYCK for instructions and further information.

9.3 Water Purification Systems

ALS uses a Siemens water purification systems designed to produce deionized water meeting method specifications. The system consists of a series of pumps, filters, and resin beds designed to yield deionized water meeting the specifications of ASTM Type II water, and *Standard Methods for the Examination of Water and Wastewater* (SM1080, 20th Ed.) *High Quality* water. The conductivity and pH are checked by the laboratory every business day using meters calibrated according to GEN-9040/SM4500H+B and GEN-120.1. Other checks are performed regularly by the subcontracted water system service. These checks are discussed further in ADM-DALYCK. The laboratory may use the results of laboratory method blanks for impromptu checks of TOC, TDS, and chloroform if a problem is suspected. The water in the volatiles department is further purified by a Millipore polishing system.

9.4 Source and Preparation of Standards and Reference Materials

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors have fulfilled the requirements for ISO 9001 certification and/or are accredited by A2LA. ALS relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., Baker, Spex, etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The date that the standard is received in the laboratory is marked on the container. See the *SOP for Making Entries into Logbooks and onto Benchsheets* (CE-QA007) for more detailed information.

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Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled with standard name, analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the *SOP for Making Entries into Logbooks and onto Benchsheets* (SOP No. CE-QA007). To ensure traceability, all standards are labeled with an in-house code that can be traced back to the original stock standard received by the vendor and thus, the certificate of analysis. Prior to introduction into the analytical system/process, reference materials are verified for accuracy with a second, independent source of the material. In addition, the independent source of reference material is also used to check the calibration standards for signs of deterioration. All standards, reagents and reference materials shall be stored per analytical SOP requirements to ensure their integrity. Safe handling and transportation of these materials are discussed in the respective analytical SOP and/or Laboratory Safety Manual.

9.5 Inductively Coupled Plasma-Atomic Emission Spectrograph (ICP-AES)

Each emission line on the ICP is calibrated daily against a blank and three standards. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.7, 6010C, CLP SOW, etc.). Calibration policies are described in the *SOP for Initial Calibration (SOP ADM-ICAL).*

9.6 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Each element of interest is calibrated daily against a blank and three standards. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.8, 6020A, CLP SOW, etc.). Calibration policies are described in the *SOP for Initial Calibration (SOP ADM-ICAL).*

9.7 Atomic Absorption Spectrophotometers (AAS)

These instruments are calibrated daily using a minimum of four standards and a blank. Calibration is validated using reference standards, and is verified at a minimum frequency of once every ten samples. Calibration policies are described in the *SOP for Initial Calibration (SOP ADM-ICAL).*

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9.8 GC/MS Systems

All GC/MS instruments are calibrated at a minimum of five different concentration levels for the analytes of interest or at a number of levels as prescribed by the method (e.g. The 600 numbered methods require a minimum of three levels), using procedures outlined in Standard Operating Procedures (SOPs) and/or appropriate USEPA method citations. All SRMs used for this function are "EPA-Certified." Compounds must show a method-specified response factor in order for the calibration to be considered valid. Compounds in the Calibration Verification Standard must also meet method specifications for percent difference from the multipoint calibration. Method-specific instrument tuning is regularly checked using bromofluorobenzene (BFB) for volatile organic chemical (VOC) analysis, or decafluorotriphenylphosphine (DFTPP) for semi-volatile analysis. Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed. Calibration policies are described in the *SOP for Initial Calibration (SOP ADM-ICAL).*

9.9 Gas Chromatographs and High Performance Liquid Chromatographs

Calibration and standardization follow SOP guidelines and/or appropriate USEPA method citations. All GC and HPLC instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise). The lowest standard is equivalent to the method reporting limit; additional standards define the working range of the GC or LC detector. Results are used to establish response factors (or calibration curves) and retention-time windows for each analyte. Calibration is verified at a minimum frequency of once every ten samples, unless otherwise specified by the reference method. Calibration policies are described in the *SOP for Initial Calibration (SOP ADM-ICAL).*

9.10 LC/MS Systems

Calibration and tuning procedures are included in analytical SOPs written specifically for these tests. In general, multiple concentration levels for the analytes of interest are used to generate calibration curves. All reference materials used for this function are vendor-certified standards. Calibration and tuning verification is performed at SOP-defined intervals. Any other system performance checks are described in the applicable SOP. Calibration policies are described in the *SOP for Initial Calibration (SOP ADM-ICAL).*

9.11 UV-Visible Spectrophotometer (manual colorimetric analyses)

Routine calibrations for colorimetric analyses involve generating a 5-point calibration curve including a blank. Correlation coefficients must meet method or SOP specifications before analysis can proceed. Independent calibration verification standards (ICVs) are analyzed with each batch of samples. Continuing calibration is verified at a minimum frequency of once every ten samples.

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9.12 Flow Injection Analyzer (automated colorimetric analysis)

A minimum of five standards and a blank (unless otherwise specified in the applicable SOP) are used to calibrate the instrument daily. Standard ALS acceptance limits are used to evaluate the calibration curve prior to sample analysis. All linear regressions must have a correlation coefficient of 0.995 or better before analysis may proceed.

9.13 Ion Chromatographs

Calibration of the ion chromatograph (IC) involves generating a minimum of a 5-point calibration curve. A correlation coefficient of 0.995 or better for the curve is required before analysis can proceed. Quality Control (QC) samples that are routinely analyzed include blanks and laboratory control samples. The target analytes typically determined by the IC include nitrate, chloride, fluoride, and sulfate.

9.14 Turbidimeter

Calibration of the turbidimeter requires analysis of formazin and polymer standards measured as NTU. Quality Control samples that are routinely analyzed include blanks, and duplicates.

9.15 Ion-selective electrode

The method-prescribed numbers of standards are used to calibrate the electrodes before analysis. The slope of the curve must be within acceptance limits before analysis can proceed. Quality Control samples that are routinely analyzed include blanks, LCSs and duplicates.

9.16 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following the *SOP Use and Calibration of Mechanical Volumetric Dispensing Devices (ADM-PCAL)*. Both accuracy and precision verifications are performed, at intervals applicable to the pipet and use. The results of all calibration verifications are recorded in bound logbooks.

9.17 Other Instruments

Calibration for the total organic carbon (TOC), and other instruments is performed following manufacturer's recommendations and applicable SOPs.

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10.0 QUALITY CONTROL

A primary focus of the ALS QA Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis on field samples, acceptable method performance is established by performing demonstration of capability analyses. Performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. ALS has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the test methodology or are statistically derived based on the laboratory's historical data. Quality Control objectives are defined below.

10.1 Quality Control Objectives

10.1.1 Demonstration of Capability - A demonstration of capability (DOC) is made prior to using any new test method or when a technician is new to the method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control sample material may be obtained from an outside source or may be prepared in the laboratory. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results may be used to meet this requirement, provided acceptance criteria is met.

10.1.2 Accuracy - Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination).

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ALS utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

10.1.3 Precision - Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability - the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility - the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

10.1.4 Control Limits - The control limits for accuracy and precision originate from two different sources. For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values. Control limits are updated periodically when new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the QA PM. The new control limits replace the previous limits and data is assessed using the new values. Current acceptance limits for accuracy and precision are available from the laboratory. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses. Procedures for establishing control limits are found in the *SOP for Control Limits* (ADM-CTRL_LIM).

10.1.5 Representativeness - Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. ALS has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. See the *SOP for Sample Preparation, Compositing and Subsampling ADM-SPLPREP.* Further, analytical SOPs specify appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

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10.1.6 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc). Only data of known quality can be compared. The objective is to generate data of known quality with the highest level of comparability, completeness, and usability. This is achieved by employing the quality controls listed below and standard operating procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using ALS or project-specified data qualifiers.

10.1.7 Completeness - Completeness is a measure of the amount of valid data that is obtained, compared to the amount that is expected. It is expected that all analyses conducted in accordance with the approved analytical methods and standard laboratory operating procedures will meet QC acceptance criteria for 95% of the samples tested, however, the ALS objective for completeness is 100%.

$$\text{Completeness (\%)} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100$$

10.2 Method Detection Limits, Method Reporting Limits, and Limits of Detection/Quantitation

Method Detection Limits (MDL) for methods performed at ALS are determined during initial method set up and if any significant changes are made. If an MDL study is not performed annually, the established MDL is verified by performing a limit of detection (LOD) verification on every instrument used in the analysis. The MDLs are determined by following the *SOP for Performing Method Detection Limits Studies and Establishing Limits of Detection and Quantitation (ADM-MDL),* which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAP and DoD protocols, the validity of MDLs is verified using LOD verification samples.

The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. limit of quantitation- LOQ). LOQ are analyzed on an annual basis and cannot be lower than the lowest calibration standard. Current MDLs and MRLs are available from the laboratory.

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10.3 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below.

10.3.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is an analyte-free matrix (water, soil, etc.) subjected to the entire preparation and analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, glass beads, Teflon chips or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, < ½ MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

10.3.2 Calibration Blanks

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

10.3.3 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of either analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

10.3.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

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10.3.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed *after* calibration but *prior to* sample analysis, in order to verify the validity and accuracy of the standards used for calibration. Once it is determined that there is no defect or error in the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

10.3.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

10.3.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP-MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

10.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

$$Recovery\ (\%) = (M/T) \times 100$$

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

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10.3.9 Laboratory Control Samples

The laboratory control sample (LCS) is an aliquot of analyte-free water or analyte-free solid (or anhydrous sodium sulfate or equivalent) to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

$$Recovery\ (\%) = (M/T) \times 100$$

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.10 Laboratory Fortified Blanks - LFB

A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure. A LFB is required with every batch of drinking water samples.

10.3.11 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is (are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

$$Recovery\ (\%) = (S - A) \times 100 \div T$$

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

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10.3.12 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

$$\textit{Relative Percent Difference (RPD)} = (S1 - S2) \times 100 \div S_{ave}$$

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

10.3.13 Interference Check Samples

An interference check sample (ICS) is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria and any project-specific criteria.

10.3.14 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

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10.3.15 Control Charting

The generation of control charts is routinely performed at ALS. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted using Quality Analyst software. Control charts are available to monitor the data and to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements (every 6 months for state specific and method specific requirements - all other methods are monitored every 12 months). The Quality Assurance Program Manager compares the newly generated statistical limits to the old and determines whether the new acceptance criteria is to replace the previous criteria. Investigative action may be taken if charts reveal a potential problem with data quality. See SOP for *Determination of Statistical Control Limits* (ADM-CRTL-LIM). Old charts are archived for a period of 5 years.

10.3.16 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS undergoes a rigorous cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at ALS; each is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

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11.0 DATA PROCESSING, VALIDATION, AND REPORTING

ALS reports the analytical data produced in its laboratories to the client via the certified analytical report. This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

11.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. The resulting data set is either manually entered into LIMS (e.g., field data), manually entered into an electronic spreadsheet and electronically transferred into LIMS (e.g., titrimetric or microbiological data) or is electronically transferred into LIMS from the software used to process the original data set (e.g., chromatographic software). Once the complete data set has been transferred into LIMS, it is reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the data is forwarded to the supervisor or second qualified analyst, who performs a full secondary review of the data. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable, the laboratory supervisor, departmental manager or designated laboratory staff approves the data in LIMS. Once approved, the reporting department generates the appropriate hardcopy and/or electronic copy of the final report. An electronic copy is saved for archival. The final report is reviewed by the Project Manager for client specifications and completeness. Data review procedures are described in the *SOP for Laboratory Data Review Process.*

Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the *SOP for Making Entries into Logbooks and onto Benchsheets* (CE-QA007).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the “before” and “after” integrations and including them in the raw data records. The policies and procedures are described in the *SOP for Manual Integration of Chromatographic Peaks* (CE-QA002).

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11.2 Confirmation Analysis

11.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.
- The sample meets all of the following requirements:
    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring. Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.
    2. All analytes have been previously analyzed in sample(s) from the same source, identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

11.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
    1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).
    2. When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.
- GC/MS Methods - Two criteria are used to verify identification:
    1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.
    2. The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.

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11.3 Data Review and Validation of Results

The integrity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures may include (as necessary) a check of the accuracy of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAP Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, and project-specific QAPPs.

- Method Calibration – Following the analysis of calibration blanks and standards according to the applicable SOP, the calibration correlation coefficient, average response factor, etc. is calculated and compared to specified criteria. If the calibration meets criteria, analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.
- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications or a new initial calibration is performed.
- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results, the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.

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- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures as described in the applicable SOP may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed, the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRLs including alternative analysis.
- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. The procedure to determine which result to report is described in the SOP for *Confirmation of Organic Analyte Identification and Quantitation (ADM-CONFIRM).* If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed, the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRLs including additional cleanup.
- Surrogate Results (Organic) – The percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is reprepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.
- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sampled consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL.

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- Laboratory Control Sample Results – The LCS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples re-extracted or re-analyzed or the data reported with the appropriate qualifiers.
- Matrix Spike Results – The MS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results are reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

11.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package is reviewed by a trained chemist. Prior to release of the report to the client, the project chemist reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is filed in project files by service request number for archiving. ALS maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data are calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The *SOP for Data Reporting and Report Generation* addresses the flagging and qualification of data. The ALS-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the project chemist to explain problems with a specific analysis or sample, etc.

For subcontracted analyses, the Project Chemist verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Chemist accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the client.

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11.5 Documentation

ALS maintains a records system which ensures that all laboratory records of analysis data retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. The archiving system is described in the *SOP for Data Archiving* and the records retention policies are in the *SOP for Records Management (CE-GEN003)* . In the event that the laboratory transfers ownership or goes out of business, laboratory records shall be retained for the contracted period and clients shall be notified prior to early destruction or disposal of samples or data.

11.5.1 Documentation and Archiving of Sample Analysis Data

The client report is archived electronically as a .pdf file.

The supporting records are retained in hardcopy for each set of analyses performed. These records include:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns;
- Logbook ID number for the appropriate standards;
- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

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11.6 Deliverables

In order to meet individual project needs, ALS provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 11-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) the following specialized deliverables:

- ACOE/HTRW – Army Corps of Engineers specified data package and reporting requirements (HTRW, CERP, FUDS, etc.)
- AFCEE – Air Force Center for Environmental Excellence project-specific reporting

When requested, ALS provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

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Table 11-1
Descriptions of ALS Standard Data Deliverables

Tier I. Routine Certified Analytical Report (CAR) includes the following:

1. Transmittal letter
2. Chain of custody documents and sample/cooler receipt documentation
3. Sample analytical results
4. Method blank results
5. Surrogate recovery results and acceptance criteria for applicable organic methods
6. Dates of sample preparation and analysis for all tests
7. Case narrative - **optional**

Tier II. In addition to the Tier I Deliverables, this CAR includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Laboratory Control Sample result(s) with calculated recovery and including associated acceptance criteria
4. Case narrative - **optional**

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:

1. Case narrative - **required**
2. Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits

Note: Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS will be included.

Tier IV. Full Data Validation Package.

1. All raw data associated with the sample analysis, including but not limited to:
   a. Preparation and analysis bench sheets and instrument printouts,
   b. For organics analyses, all applicable chromatograms, spectral, confirmation, and manual integration raw data. For GC/MS this includes tuning results, mass spectra of all positive hits, and the results and spectra of TIC compounds when requested.
   c. QC data,
   d. Calibration data (initial, verification, continuing, etc),
   e. Calibration blanks or instrument blanks (as appropriate to method).
2. If a project QAPP or program protocol applies, the report will be presented as required by the QAPP.

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12.0 PERFORMANCE AND SYSTEM AUDITS*

Quality audits are an essential part of ALS's quality assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

12.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of ALS are conducted regularly by various regulatory agencies and clients. Appendix G lists the certification and accreditation programs in which ALS participates. Programs and certifications are added as required. Additionally, internal system audits of ALS are conducted regularly under the direction of the Quality Assurance Program Manager. The internal audit procedures are described in the *SOP for Internal Audits (CE-QA001)*. The internal audits are performed as follows:

- Comprehensive lab-wide audit – performed over the course of each year. This audit is conducted such that systems, technical operations, hardcopy data, and electronic data are assessed.
- Hardcopy report audits – 5% per month.
- Chromatographic electronic data audits –. Each quarter, Mint Miner software is used to screen randomly selected data. The screening results are used to further investigate and evaluate compliance with the SOP for Manual Integration (CE-QA002), interpretation of data, and comparison of raw data with approved data. At least two sequences are audited, one of which includes an initial calibration.

All audit findings, and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within a defined timeframe. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the corrective action period (if not already provided).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

*Please note that many SOPs reference Section 12 of the Quality Assurance Manual for Figures for Corrective Action. This information is now found in the text of Section 11 of this Manual.

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12.2 Performance Audits

ALS also participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. General procedures for these analyses are described in the SOP for *Proficiency Sample Testing Analysis* (CE-QA006). ALS routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.
- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil PT studies, 2 per year.
- Underground Storage Tank PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Program Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are reviewed by the QA PM, Laboratory Director, the laboratory staff, and the USA Quality Assurance Manager. For any results outside acceptance criteria, the analysis data is reviewed to identify a root cause for the deficiency, and corrective action is taken and documented through nonconformance (NCAR) procedures.

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13.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at ALS (e.g., ICP/MS and ICP systems, GC/MS systems, atomic absorption spectrometers, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at ALS contain extensive information about the instruments used at the laboratory.

An initial demonstration of analytical control is required on every instrument used at ALS before it maybe used for sample analysis. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- Instrument Name, manufacturer, make, model and type
- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at ALS. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the section supervisor. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. In the case of non-routine repair of capital equipment, the section supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. Each laboratory section maintains a critical parts inventory. The parts inventories include the items needed to perform the preventive maintenance procedures listed in Appendix D.

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This inventory or "parts list" also includes the items needed to perform any other routine maintenance and certain in-house non-routine repairs such as gas chromatography/mass spectrometry jet separators and electron multipliers and ICP/MS nebulizer. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;
- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

See the table in Appendix E for a list of preventive maintenance activities and frequency for each instrument.

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14.0 CORRECTIVE AND PREVENTIVE ACTION

The laboratory takes all appropriate steps necessary to ensure all sample results are reported with acceptable quality control results. When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and take corrective action to address the nonconformance.

Nonconforming events such as errors, deficiencies, deviations from SOP, proficiency (PT) failure or results that fall outside of established QC limits are documented using a *Nonconformity and Corrective Action Report* form (See Figure 14-1), or similar format. The procedure and responsibilities for addressing nonconforming work is defined in the SOP CE-QA008 *Nonconformance and Corrective Action.* Nonconformances are reported to the client using various means (voice, email, narrative, etc). When a nonconformance occurs that casts doubt on the validity of the test results or additional client instructions are needed, the Project Chemist notifies the client the within 10 business days of the discovery. This gives the laboratory time to ascertain the extent and significance of the problem. The QA PM reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The Nonconformity and Corrective Action Report (NCAR) is filed in the associated service request file and a copy is kept by the QA PM. The QA PM periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate project chemist is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). Failure to meet established analytical controls, such as the quality control objectives, prompts corrective action. Corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, the department manager, and/or the QA PM may examine and pursue alternative solutions. In addition, the appropriate project chemist is notified in order to ascertain if the client needs to be notified.

Part of the corrective action process involves determining the root cause. Identifying the root cause of a nonconformance can be difficult, but important for implementing effective corrective action. Root cause principles are used to determine assignable causes, which leads to corrective action taken to prevent recurrence. Various preventive action processes are used for eliminating a potential problem or averting a problem before it occurs. This is explained in the *SOP for Preventive Action* (ADM-PA).

In addition to internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The person who initially receives the feedback (typically the project chemist) is responsible for documenting the complaint. If the project chemist is unable to satisfy the customer, the complaint is brought to the attention of the Client Services Manager, Laboratory Director, or QA PM for final resolution. The complaint and resolution are documented. The procedure is described in the *SOP for Handling Customer Feedback* (ADM-FDBK).

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Figure 14-1

Nonconformity and Corrective Action Report

NCAR No: *Assigned by QA*

PROCEDURE (SOP or METHOD): EVENT DATE: _____

EVENT:
- ☐ Missed Holding Time
- ☐ Method Blank Contamination
- ☐ Equipment Failure
- ☐ SOP Deviation
- ☐ QC Failure
- ☐ Login Error
- ☐ Unacceptable PT Sample Result
- ☐ Other (describe):
- ☐ Lab Error (spilled sample, spiking error, etc.)
- ☐ Project Management Error

INCLUDE NUMBER OF SAMPLES / PROJECTS / CUSTOMERS / SYSTEMS AFFECTED

DETAILED DESCRIPTION

ORIGINATOR: _____ DATE: _____

PROJECT MANAGER(S): _____ NOTIFIED BY: _____ DATE: _____

ROOT CAUSE OF NON-CONFORMITY (POTENTIAL CAUSES COULD BE TRAINING, COMMUNICATION, SPECIFICATIONS, EQUIPMENT, KNOWLEDGE)

What is the cause of the error or finding:

CORRECTIVE ACTION AND OUTCOME

Re-establishment of conformity must be demonstrated and documented. Describe the steps that were taken, or are planned to be taken, to correct the particular Nonconformity and prevent its reoccurrence. Include Project Manager Instructions here.

Is the data to be flagged in the Analytical Report with an appropriate qualifier? ☐ **No** ☐ **Yes**

APPROVAL AND NOTIFICATION

Supervisor Verification and Approval of Corrective Action _____ Date: _____
Comments:

QA PM Verification and Approval of Corrective Action _____ Date: _____
Comments:

Project Manager Verification and Approval of Corrective Action _____ Date: _____
Comments:

Customer Notified by ☐ Telephone ☐ Fax ☐ E-mail ☐ Narrative ☐ Not notified

(Attach record or cite reference where record is located.)

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15.0 QUALITY ASSURANCE REPORTS AND MANAGEMENT REVIEW*

Quality assurance requires an active, ongoing commitment by ALS personnel at all levels of the organization. Communication and feedback mechanisms are designed so that analysts, supervisors and managers are aware of QA issues in the laboratory. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a narrative if problems were encountered with the analyses. A Non-Conformity and Corrective Action Report (NCAR) (see Section 14.0) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and addressed.

It is the responsibility of each laboratory unit to provide the project chemist with a final report of the data, accompanied by signature approval. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate project chemist, who in turn reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A case narrative is written by the project chemist to explain any unusual problems with a specific analysis or sample, etc.

- The QA PM provides overview support to the project chemists as required (e.g., contractually specified, etc.). The QAPM is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QAPM provides the Laboratory Director with quarterly reports that summarize the various QA/QC activities that occurred during the previous quarter.

An annual management review of the quality and testing systems is performed as described in the *SOP for Laboratory Management Review* (CE-QA005). This is done to identify any necessary changes or improvements to the quality system or quality assurance policies. This review is documented in a Managerial Review of the Laboratory's Quality Systems and Testing Activities and sent to senior management.

*Please note that many SOPs reference Section 15 of the Quality Assurance Manual for handling out of control data. This information is now found in the text of Section 14 of this Manual.

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16.0 PERSONNEL TRAINING

Technical position descriptions are available for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment at ALS are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at ALS. Safety training begins with the reading of the *Environmental Health and Safety Manual.* Employees are also required to attend periodic safety meetings where additional safety training may be performed by the Environmental, Health and Safety Officer. All formal intracompany meetings at ALS are to begin with a Safety Moment.

Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s). Quality Systems training begins with Quality Assurance orientation for new employees and reading the Quality Assurance Manual. During the employees first month, the employee receives Ethics training and learns about ALS quality systems. Each employee participates in annual Ethics Refresher training, which is part of the ALS Improper Practices Prevention Program.

ALS also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the Company. Ongoing training occurs for all employees through a variety of mechanisms. The corporate, company-wide training and development program, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

All technical training is documented and records are maintained in the QA department. Training requirements and its documentation are described in the *SOP for Documentation of Training*. (CE-QA003). A training plan is developed whenever an employee starts a new procedure to new position. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of capability. Where the analyst performs the entire procedure, a generic training plan may be used.

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16.1 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (SOP) for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).
- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision.
- Where spiking is not possible but QC standards are used ("non-spiked" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples with acceptable accuracy and precision.
    - Where one of the three above is not possible, see the special requirements in CE-QA003.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 16-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

16.2 Continuing Demonstration of Proficiency

A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind sample analyses using the test method, or a similar test method using the same technology. I.e. PT sample or QC sample blind to the analyst.
- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.
- If the above cannot be performed, see the special requirements in CE-QA003.

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16.3 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and ALS resumes. QA maintains a database to record the various technical skills and training acquired while employed by ALS. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in the *SOP for Documentation of Training* (CE-QA003).

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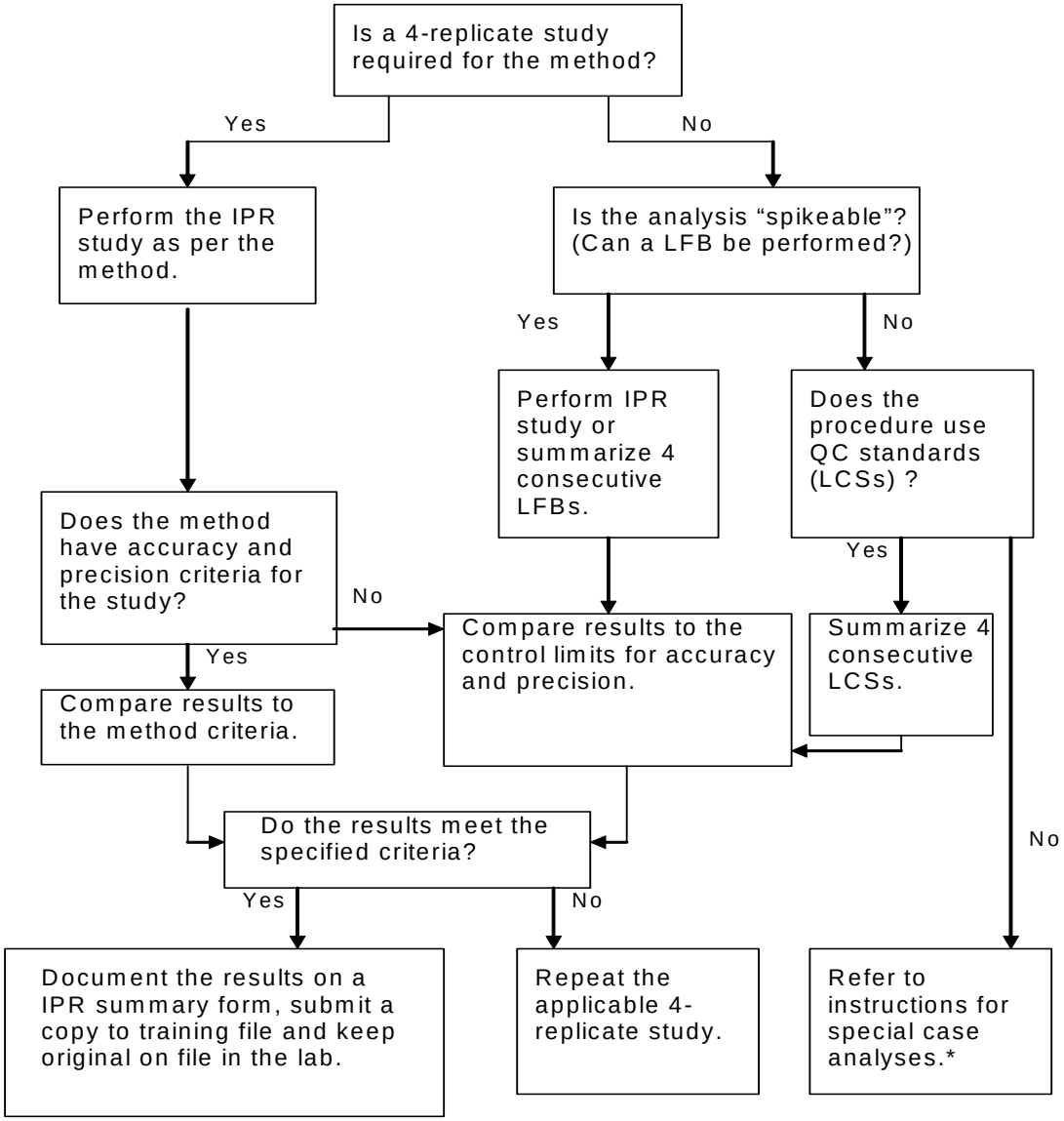
Figure 16-1
Initial Demonstration of Capability Requirements



* Refer to the SOP for Documentation of Training for details.

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17.0 REFERENCES FOR QUALITY SYSTEMS, EXTERNAL DOCUMENTS, MANUALS, STANDARDS, AND ANALYTICAL PROCEDURES

The analytical methods used at ALS generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at ALS are taken from the following references:

- National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.
- TNI Standard, The NELAC Institute, 2009.
- American National Standard *General requirements for the competence of testing and calibration laboratories,* ANSI/ISO/IEC 17025:2005(E)
- *DoD Quality Systems Manual for Environmental Laboratories,* Version 4.1, 4/22/2009.
- *DoD Quality Systems Manual for Environmental Laboratories,* Version 4.2, 10/25/2010.
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 4th Edition, EPA 815-B-97-001 (March 1997).
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986) and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Final Update IV (February 2007), and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4.
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).
- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).
- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.
- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.
- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.
- *Standard Methods for the Examination of Water and Wastewater*, 18th Edition (1992); 19th Edition (1995), 20th Edition (1998). See Introduction in Part 1000.
- 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act.

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- 40 CFR Part 141, National Primary Drinking Water Regulations.
- State-specific total petroleum hydrocarbon methods for the analysis of samples for gasoline, diesel, and other petroleum hydrocarbon products.
- Annual Book of ASTM Standards, Part 31, Water.
- EPA Contract Laboratory Program, Statement of Work for Organic Analysis, SOW Nos. OLM03.1, OLM03.2, OLM04.2, and OLM04.3.
- EPA Contract Laboratory Program, Statement of Work for Inorganic Analysis, SOW No. ILM05.3.
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA-540/R-94/012 (February 1993).
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA-540/R-94/013 (February 1994).

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APPENDIX A

LIST OF QA PROGRAM DOCUMENTS AND STANDARD OPERATING PROCEDURES

Please note that the Appendices provide current information at the time of the revision, but are updated only upon annual review. Please contact the laboratory for up-to-date information.

Please also note that many SOPs reference this Appendix (A) for the Equipment List. The Equipment List is now found in Appendix C of this Quality Assurance Manual.

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ALS/ROCHESTER APPROVED SIGNATORIES

The following ALS/Rochester employees are authorized to issue certified analytical reports and sign other critical documents (such as QAPPs, other program protocols, etc.). In the event that these individuals are not available, an assigned designee or the Chief Operating Officer may approve these documents.

Employee:	Position:
Michael Perry	Laboratory Director/Technical Director
Lisa Reyes	Quality Assurance Program Manager
Janice Jaeger	Client Services Manager
Karen Bunker	Project Manager
Carl Beechler	Project Manager
Deb Patton	Project Manager
Vicky Collom	Quality Assurance Assistant (QA documents)

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ALS/Rochester QA Program Documents

Software Quality Assurance Plan	7/11/05 QA Office
Master Logbook of Laboratory Logbooks	QA-1 and QA-12 QA Office
Thermometer Calibration Logbook	QA-2 QA Office
Signature Log	QA Office
Balance Service Records	QA Office
Spectrophotometer Verification Records	QA Office
Internal, External, and Performance Audits	QA Office
Management Reports	QA Office
Training Records	QA Office
QC Charts	QA Office
Non-Conformities	QA Office
SOP Master Copies	QA Office
Data Quality Objective Table	P:\QAQC\QA_DOCUM\QCLIMITS\QAMTBLS\2012\QC limits ROC DQO 2012.xls
Data Quality Checklists	P:\INTRANET\QAQC\DQChecklists
Training Database	P:\QAQC\QA_DOCUM\TRAINING\DATABASE\TrainApp.mdb
Training Plans	P:\INTRANET\QAQC\TRAINING\FORMS
DOC Templates	P:\QAQC\TRAINING\Template_IDC
MDL Summaries	P:\QAQC\MDLs\Client Copies Scanned MDL Summaries-LOCKED
Method Development Form	P:\INTRANET\QAQC\SOPS\Method Development.doc
Certificates and Accreditations	P:\INTRANET\QAQC\CAS Rochester Certs
Certification Master Table	P:\QAQC\QA_DOCUM\CERT\Certification Master.xls
SOP Tracking List	P:\QAQC\QA_DOCUM\SOP\2010toc.xls
PT Tracking List	P:\QAQC\QA_DOCUM\PE\Tracking\PT tracking master.xls
PE Study Schedule	P:\QAQC\QA_DOCUM\PE\PESCHED.XLS
MDL Schedule	P:\QAQC\MDLs\MDL Schedule 2010.xls
NCAR Tracking	H:\NCAR TRACKING\NCAR Assignment and Tracking.xls
Organization Charts	Available through Corporate Intranet
Resumes	Available through Corporate Human Resources
Equipment List	P:\QAQC\QA_DOCUM\Qam\EquipList10012012.xls
Data Qualifiers	H:\FORMS\QUALIF_ routine.DOC
Preventive Maintenance Table	P:\QAQC\QA_DOCUM\Qam\QAM 20\PM_TBL.XLS
PT Reports	P:\QAQC\QA_DOCUM\PE\Results

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ALS Analytical Job Descriptions

Analyst I

Entry level analyst position within the laboratory. Employee performs routine tasks in the lab under close supervision or by following detailed instructions. Progressively learning methods and procedures commonly used. Entry level skills performed at this level include titrations, gravimetric, and volumetric measurements, and routine small instrument use. Duties performed are routine in nature with a limited number of alternatives available. Work is closely supervised and reviewed.

Analyst II

Analyst at this position is progressively developing a proficiency performing a variety of analyses including instrumental and wet chemistry techniques. He/she has a mastery of the basic laboratory skills and has the ability to work with moderate supervision following project assignment. Able to identify problems and take corrective action on own work within the range of alternatives available.

Analyst III

Analyst at this position is progressively developing a proficiency performing a variety of analysPosition requires a complete level of knowledge and understanding in a specific application of laboratory principles and practices. An analyst at this level should be proficient in applicable scientific procedures and techniques to independently conduct tests or experiments for scientific projects as assigned and provide initial analyses of results for the supervisor.
Performs non-routine assignments of substantial variety and complexity under general supervisory direction. Receives objectives and technical advice from supervisor of project scientist. Compiles data and computes results on a variety of scientific procedures and techniques according to standard operation procedures. May assist in the training of junior analysts and technical assistants.es including instrumental and wet chemistry techniques. He/she has a mastery of the basic laboratory skills and has the ability to work with moderate supervision following project assignment. Able to identify problems and take corrective action on own work within the range of alternatives available.

Senior Analyst

Position requires an advanced level of knowledge and understanding of vocational field containing recognized formal principles and practices, complete knowledge in multiple fields, or full competence in a specialized skill or field encompassing the major business function of the Company. Examples of such skill areas would include gas chromatography, mass spectrometry, emissions spectrometry, AA, TOC, and TOX.
Position may direct work of other analyst, as lead analyst on an on-going basis, or as a project analyst on a project basis.
Performs non-routine and complex technical assignments involving responsibility for planning and conducting a complete project of limited scope or a portion of a larger and more diverse project.
Requires well-developed interpersonal skills in training junior analysts and assisting scientists with assigned tasks.

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Scientist I

As an entry-level scientist, the focus is on developing basic laboratory skills, learning routine tests, and using some instrumentation. Progressively learning and utilizing entry level applications of specialized methods, techniques, and instrumentation, including AA, IPC, and GC. Performs competently with entry-level scientific instrumentation and methods and is responsible for data interpretation, quality control, and reporting of own work. May prepare, or assist in preparing, standard operating procedures, and specifications for process and test. Handles routine maintenance and troubleshooting of instrumentation. Develops quality assurance skills, supervisory responsibilities, technical report writing, and project managements skills. May assist in training of analysts and technical assistants, and instruct lower level staff on routine project set-ups. Will assist the supervisor and/or senior scientists in setting up more complex procedures.
Requires moderately close supervision by experienced staff.

Scientist II

Performs work requiring the application of a specialized field of chemical analysis and ingenuity in the independent evaluation, selection, and adaptation of standard methods and techniques. Progressively learning and utilizing intermediate applications of specialized methods techniques. Performs competently with entry-level scientific instrumentation and methods and is responsible for data interpretation, quality control, and reporting of own work. Prepares standard operating procedures and specifications for process and test. Handles routine maintenance and troubleshooting of instrumentation.
Progressively developing quality assurance and project management skills, becoming involved with more complex analytical systems, technical report writing, and possible client interface. May assist in training of analyst and technical assistants, and instruct lower level staff on more complex project set-ups. Will assist the supervisor and/or senior scientists in setting up more complex procedures.
Works independently with only moderate supervision by experienced staff.

Scientist III

Performs work requiring the application of a specialized field of chemical analysis and ingenuity in the independent evaluation, selection, and adaptation of standard methods and techniques. Progressively learning and utilizing intermediate applications of specialized methods techniques. Performs competentlyPerforms work requiring the application of a specialized field of chemical analysis and ingenuity in the independent evaluation, selection, and adaptation of standard methods and techniques. May have expertise in several areas of analytical chemistry or have specific skills in a highly specialized, technical operation, such as GC/MS or metals analysis. Performs competently with intermediate to advanced interments and methods and is responsible for data interpretation, quality control and reporting of own work. Prepares standard operating procedures and specifications for process and test. Handles routine maintenance and troubleshooting of instrumentation.
Progressively developing quality assurance skills, supervisory responsibilities, and project management skills, becoming involved with more complex analytical systems, technical report writing, and client interface. May assist in training of analysts and technical assistants, and instruct lower level staff on more complex project set-ups. Will assist the supervisor and/or senior scientists in setting up more complex procedures.

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May serve as a team leader, or back up supervisor, overseeing three to eight employees. As such, will be responsible for ensuring conformance to company policies and applicable laws and regulations. Responsibilities may include interviewing, selecting and training employees; planning, assigning and directing work; evaluating performance; rewarding and disciplining employees; and addressing complaints and resolving problems. May be asked to perform other duties of a similar nature or level of responsibility.
Works independently, with only moderate supervision by experienced staff. with entry-level scientific instrumentation and methods and is responsible for data interpretation, quality control, and reporting of own work. Prepares standard operating procedures and specifications for process and test. Handles routine maintenance and troubleshooting of instrumentation.
Progressively developing quality assurance and project management skills, becoming involved with more complex analytical systems, technical report writing, and possible client interface. May assist in training of analyst and technical assistants, and instruct lower level staff on more complex project set-ups. Will assist the supervisor and/or senior scientists in setting up more complex procedures.
Works independently with only moderate supervision by experienced staff.

Scientist IV

Typically viewed as the department or laboratory technical specialist for particular area of expertise. At this level, the laboratory scientist's career path begins to fork in two directions. Those exhibiting both the desire and ability for management will enter the management track, while those whose strength and interests lie more in the scientific realm will follow this one. There may, however, be lateral movement between the two tracks.
A senior level scientist performs work requiring the application of a specialized field of chemical analysis and ingenuity in the independent evaluation, selection, and adaptation of standard methods and techniques. Performs competently with complex instruments and methods and is responsible for data interpretation, quality control and reporting of own work. Plans, conducts, and supervises (as a lead) complex analyses requiring advanced instrumentation such as IPC/MS, GC/MS, and GC. Handles routine and advanced maintenance and troubleshooting of instrumentation.
Works comfortably with complex analytical systems, technical report writing, and client interface. Assists in training of staff scientist, analysts and technical assistants, and instructing entry level staff on more complex project set ups. Will assist the supervisor and/or other senior scientists in setting up more complex procedures. Serves as technical advisor for teams and projects. May be asked to perform other duties of a similar nature or level of responsibility. May present formal technical training seminars to both clients and staff.
Works independently, under little supervision.

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Project Manager

A project manager is an individual who works with customers to determine their analytical needs, coordinates with ALS laboratory and administrative staff to ensure that these needs are understood, and ensures that the service ALS provides adequately meets these defined needs.

1. Client Responsibilities
   - Establish a working relationship with client.
   - Identify clients analytical needs and how the lab can address these needs.
   - Plan analytical program to meet these needs.
   - Keep client informed of progress of work.
   - Report findings and results back to client.
   - Communicate client concerns/issues to lab management.
   - Keep client informed of new developments and lab services.
   - Provides quotations and job specifications for specific work.
2. Project Responsibilities
   - Work with client and lab to define project specifications.
   - Communicate project schedule to lab.
   - Work with Sample Management to ensure proper type and number containers are provided.
   - Review incoming work to ensure work requests are properly specified according to project requirements.
   - Track as required projects through the lab keeping client and lab personnel appraised of progress.
   - Prepare, review, and approve invoices for specific work orders.
3. Reporting and QA/QC Responsibilities
   - Ensure consistent reporting formats for clients.
   - Review reported data against historical results for consistency.
   - Responsible for meeting QA objectives for specified projects.
   - Approves certified analytical reports.
   - Brings problems or issues relative to work to the QA Coordinator, Lab Operations, or Lab Management for study and resolution.
   - At times may be involved with QAP development.
   - May participate in specific marketing activities (i.e., trade show booths), if appropriate.
   - Identifies and communicates to management on new marketing opportunities and other issues.
   - Works closely with SMO, Lab Operations, QA/QC, and administrative staff to keep everyone informed as appropriate on client issues and projects.

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Business Development Manager

Responsible for supporting the marketing efforts of a region's upper management, sales force, and technical staff. Accountable for the quality and timeliness of all work produced and for coordinating client development efforts with other branch offices. Establishes and maintains contact with smaller clients to market the company's services. Creates client awareness of company services and their applications. Develops and maintains a staff client orientation through training and team-building exercises. Conducts local market research, coordinates and recommends marketing strategies, identifies target markets, and is responsible for consolidating marketing plans into the branch business development plan. Budgets and controls annual business development expenditures while reviewing and approving branch activities and budgets to minimize redundancy and waste.
Prepares and updates an accurate Business Portfolio Analysis and Client Market Profile by branch. Coordinates and assists in developing strategic and tactical marketing plans for the region as well as for other local operations. Prepares standardized market information collection, distribution and utilization formats, and procedures for regional marketing staff use. Also conducts market analysis.

Quality Assurance Program Manager

Accountable for the conduct of the Quality Assurance (QA) program for a branch laboratory. Is generally responsible for all ranch laboratory QA activities and maintaining QA related documents. Accountable for obtaining an maintaining certification and accreditations and maintaining laboratory proficiency testing programs. Responsible for the overall coordination of the laboratory QA program and for ensuring that quality objectives established by management, certification programs, and project plans are met. Responsible for Quality Assurance functions including the Quality Assurance Manual, documentation of certifications, documenting standard operating procedures, and maintaining proficiency testing records. Oversees balance calibration and sample storage temperature control Maintains certification/accreditations for regulatory agencies and client certification or approval programs. Acts as primary point of contact during laboratory audits and coordinates the audit schedule with laboratory and audit staff. Provides audit responses and initiates any changes in procedures resulting from an audit. Coordinates the analysis of proficiency testing samples required for certification/accreditation programs. Reports and reviews results of these analyses. Conducts informal audits and makes recommendations for corrective action. Provides technical assistance to laboratory staff on QA/QC issues, project feasibility, and methods interpretation/development. Receives operation supervision from the Laboratory Director; may receive general administrative supervision and guidance from the Quality Assurance Manager USA.

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Section Supervisor

Accountable for timely performance and quality of work assigned, and may be responsible for the work of a small department, including profit and loss responsibility for the unit. Under minimal direction, plans and manages all activities relating to specific laboratory operations or may operate within a key functional area such as client services. Assist in identifying project opportunities, developing proposals, and developing and maintaining client relationships. Manages administration and project schedules, provides technical consultation services to project teams, government agencies, and clients. Responsible for quality control of laboratory work including final review of all reports for specific area of responsibility or as required. Assures that work is being performed using appropriate technology. Attends trade shows and gives marketing and client presentations as required. Encourages and directs development and application of state-of-the-art methodologies and techniques.

Personnel responsibilities include coordination of unit workloads, conducting employee performance reviews, recommending personnel changes, additions, and participation in recruiting process. Marketing responsibilities may include attending trade shows and professional conferences, authoring technical papers, and contacting existing clients and new clients to market company's capabilities.

Has high level role in data evaluation and report responsibility. Supervises, trains and develops scientists, supervisors, analysts, and technician assistants. Monitors work load and project flow through self or assigned team leaders. Monitors adherence to corporate safety plans and policies. High level client and regulatory agency contact. Participation in internal and external meetings involving project strategy and major technical issues. Monitors and reviews budget and schedule status of projects with supervisors. High financial responsibility for profit and loss considerations. Works with regional senior management in short- and long-range planning, e.g., staff requirements, primary areas of technical development, marketing program. May be asked to perform other duties of a similar nature or level of responsibility.

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Laboratory Director

Accountable for the growth and profitability of a medium-sized branch office. Is generally responsible for all branch office staff, client relations, and marketing. Accountable for the quality and timeliness of all work produced and for coordinating work efforts with other branch offices.
Responsible for all operations within assigned region, including personnel, scheduling, coordination of daily project field and office activities. Supervised operations normally include SMO, facilities, administration, laboratory operations, and related activities. Maintains close working relationships with clients and staff and plays a key role in conflict resolution.
Directs and monitors the activities of the branch office through the appropriate supervisors, technical and administrative managers. Formulates and recommends to the Regional Regional Managers and/or President policies, procedures, plans and programs for the branch office that are commensurate with the overall objective of the region. Formulates and recommends to the Regional Regional Managers and/or President an annual operating budget for the branch office and conducts operations within approved budget limits.
Reviews and approves organizational and key staffing assignments within the branch office. Directs periodic status reviews of major projects to ensure that technical and quality standards are being met and that the performance is within budget and schedule. Participates, as required, in project and management reviews of proposals, reports, and client contract negotiations, including final pricing of proposals. Provides counsel and information about the project's feasibility.
Responsible for branch office programs and procedures, including staff planning and development, personnel administration, and compliance with corporate policies and procedures. Stays abreast of technological developments and trends which could lead to new applications or markets, Responsible for maintaining proper and timely controls over all branch office work, ensuring that billability targets and overall profitability goals are met. Maintains good client relations and actively pursues expansion of new clients and business lines in conjunction with regional and corporate marketing goals.
Receives operational supervision from the Regional Managers and/or President; may receive general administrative supervision and guidance from the regional CAO.

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APPENDIX B
ORGANIZATIONAL CHART AND RESUMES OF KEY PERSONNEL

Please note that the Appendices provide current information at the time of the revision, but are updated only upon annual review. Please contact the laboratory for up-to-date information.

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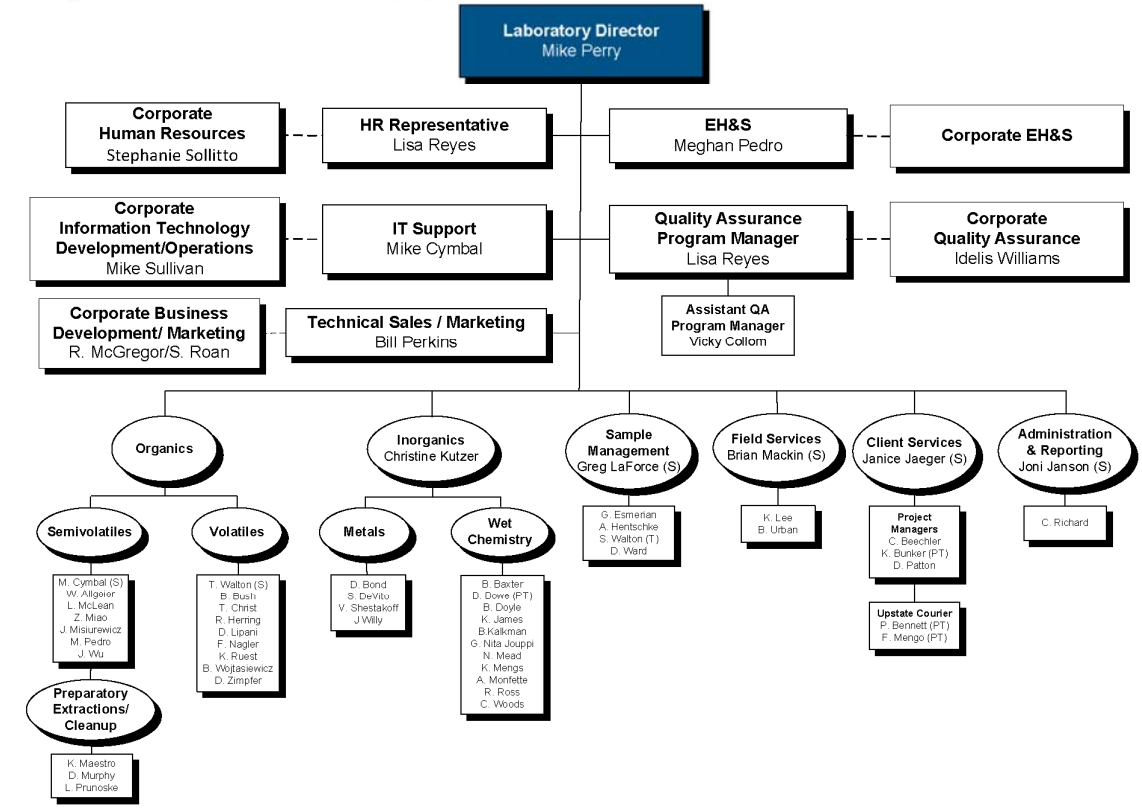
ALS Environmental

Rochester, New York Laboratory
July 26, 2012



Revised 7/26/2012

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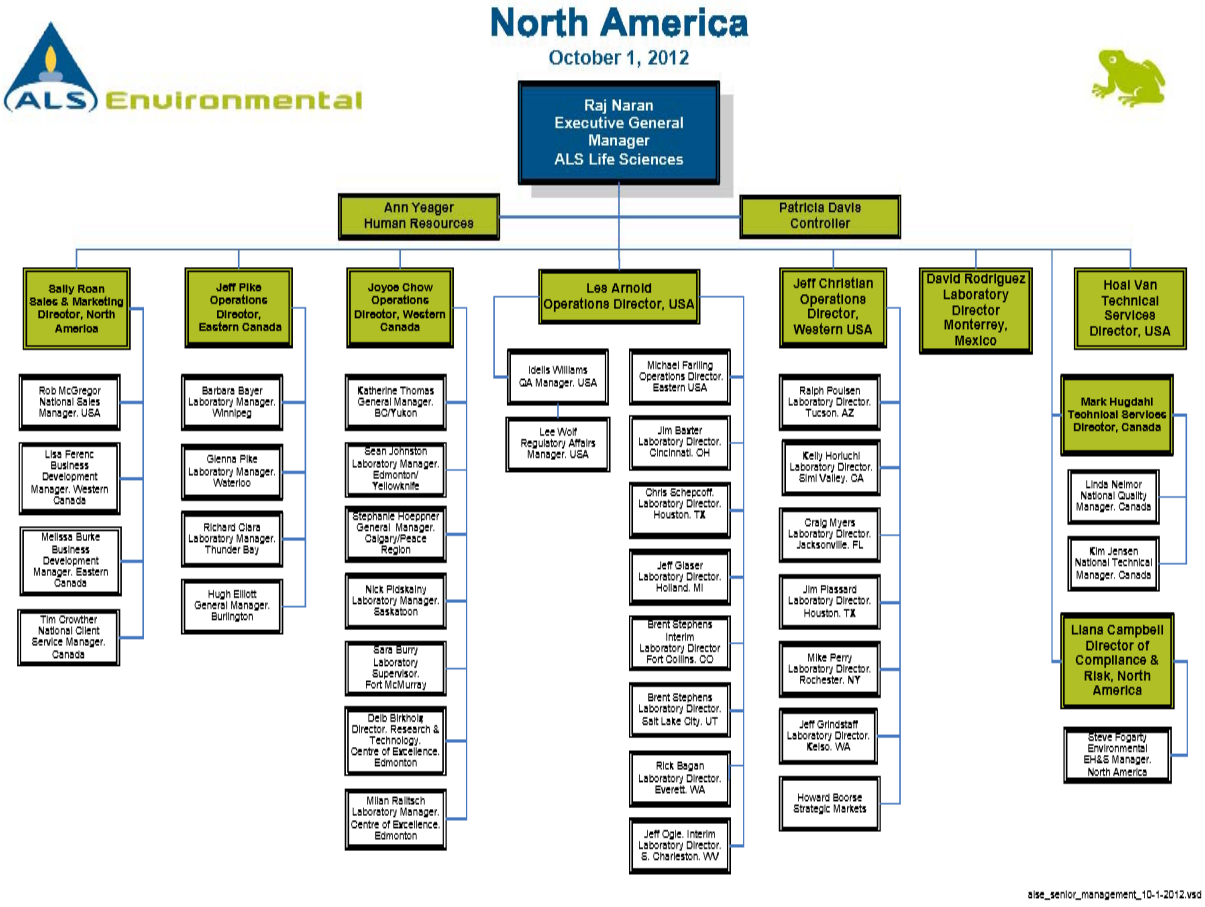

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MICHAEL K. PERRY

1565 Jefferson Rd., Bldg 300 Ste. 360, Rochester, NY 14623 585.288.5380

Current Position	**LABORATORY DIRECTOR AND TECHNICAL DIRECTOR** – 2011 to Present
Responsibilities	Primary responsibilities include management of all laboratory departments, scheduling, productivity, reporting and evaluation of analytical methodologies, project planning and Quality Assurance/Quality Control protocols. In addition, other responsibilities include direct responsibility for contracts and consultants relating to the EPA SITE program, ACOE remediation program and the technical interface for the New York State ASP CLP program and other large national based clients. **Documentation of Demonstration of Capabilities is available for review.**
Experience	**Laboratory Director,** *Columbia Analytical Services, Rochester, New York*, 1996-2011. Responsibilities as above. **Project Chemist,** *General Testing Corporation, Rochester, New York*, 1995-1996. In addition to the duties of Laboratory Director listed below, responsibilities expanded to include the supervision of four teams of Project Chemists. Production management was shifted to the Laboratory Supervisors in order to increase client contact. Directly responsible for contracts and consultants relating to the EPA SITE program, ACOE remediation program and the New York State ASP CLP program. **Laboratory Director,** *General Testing Corporation, Rochester, New York*, 1985-1995. Primary responsibilities included management of all laboratory departments, scheduling, productivity, reporting and evaluation of analytical methodologies and Quality Assurance/Quality Control protocols. **Instrument Manager,** *General Testing Corporation, Rochester, New York*, 1979-1985. Responsibilities included operation and maintenance of all laboratory instruments and supervision of personnel associated with the instrumentation laboratory. Analyses included metals, volatile organics, pesticides/PCBs, and semi-volatile organics. **Senior Quality Assurance Technician,** *Coca-Cola Corporation, Atlanta, Georgia*, 1976-1979. Responsible for analysis of raw materials and finished product using both wet chemistry and instrumentation techniques. **Laboratory Technician,** *Penwalt Pharmaceutical Company, Rochester, New York*, 1975. Worked in the Quality Control Department.
Education	**Coursework toward MS, Chemistry,** *Rochester Institute of Technology, Rochester, New York*, 1983-1986 **GC/MS,** *ACS Short Course*, 1986 **Effective Management of Chemical Analysis Laboratories**, *ACS Short Course*, 1985 **BS, Chemistry,** *Georgia State University, Atlanta, Georgia*, 1979 **AAS, Chemistry,** *State University of New York at Alfred, Alfred, New York*, 1975
Affiliations	American Chemical Society

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LISA M. REYES

1565 Jefferson Rd, Bldg 300, Suite 360, Rochester, NY 14623 (585) 2285380

Current Position Responsibilities

QUALITY ASSURANCE/QUALITY CONTROL PROGRAM MANAGER – 2011 to Present

Responsible for the overall coordination of the laboratory QA program and for ensuring implementation and compliance with established quality objectives and quality systems at all times. Responsible for Quality Assurance functions including the Quality Assurance Manual, certifications, documenting standard operating procedures, and maintaining performance evaluation records. Oversees balance calibration and sample storage temperature control. Maintains certifications/accreditations for regulatory agencies and client certifications or approval programs. Acts as primary point of contact during laboratory audits. Provides audit responses and initiates any changes in procedures resulting from an audit. Ensures continuous process improvement through the use of control charts, performance evaluation samples and preventive action. Conducts internal audits and makes recommendations for corrective action and improving effective quality assurance and quality control. Ensures that all personnel understand their contributions to the quality system and that communication takes place at all levels within the laboratory regarding the effectiveness of the quality system, and evaluating the effectiveness of training.

Provides technical assistance to laboratory staff on QA/QC issues, project feasibility, and methods interpretation/development.

Documentation of Demonstration of Capabilities is available for review.

Experience

Quality Assurance Program Manager, *Columbia Analytical Services, Rochester, New York, 1997-2011.* Responsibilities as above.

Environmental Chemist, *TreaTek-CRA Company/Conestoga-Rovers & Associates, Niagara Falls, New York,* 1992-1997. Data quality, assessments and validations of ASP, CLP, and SW-846 organic and inorganic analytical data. Liaison with analytical contract laboratories, CRA field personnel, and state and federal agencies. Prepared QAPPs, laboratory bidding documents, and contracts. Also responsible for performance of laboratory audits

Manager of Quality Management Office, *Huntingdon Analytical Services, Middleport, New York,* 1989-1992. Manager of QA for Environmental, Agrochemical, Asbestos, and Engineering Soil laboratories. Responsible for in-house QA/QC programs, inspections, and instrument maintenance. Also responsible for employee safety and hazardous waste training, as well as manifesting hazardous waste. Routinely performed inorganic analyses, and reviewed analytical data, reports, and CLP packages.

Research Assistant, *Research Foundation, State University of New York College at Brockport, Brockport, New York,* 1986-1989. Performed routine sampling of surface water and lakes. Also did inorganic analyses on water and soil matrices. Assisted in graduate projects dealing with fish, plankton, water chemistry, and crayfish.

Education

CLP Inorganic Data Validation, *US EPA Region II, Westchester Community, Westchester, New York,* 1993.
CLP Organic Data Validation, *US EPA Region II, Westchester Community, Westchester, New York,* 1992.
BS, Biology, *State University of New York at Brockport, Brockport, New York,* 1988

Affiliations

American Chemical Society

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JANICE M. JAEGER

1565 Jefferson Rd, Bldg 300, Suite 360,Rochester, NY 14623 (585) 288-5380

Current Position Responsibilities

CLIENT SERVICES MANAGER I, 2011-Present

Responsible for the supervision of Project Managers. Assist clients to determine what analyses are required. Oversee projects from quote initiation to final report submission. Act as liaison between client requirements and laboratory capabilities for projects. Update clients on progress if their project and answer any questions they may have. Respond promptly to client requests and develop new client contacts within and outside of our current client base.

Documentation of Demonstration of Capabilities is available for review.

Experience

Client Services Manager I, *Columbia Analytical Services, Rochester, NY.* 2004-2011. Responsibilities as above.

Project Manager III, *Columbia Analytical Services, Rochester, NY.* 1996-2004. Assist clients to determine what analyses are required. Responsibilities primarily as above without the supervisory role.

Customer Service Representative/Sample Receiving, *General Testing Corporation, Rochester, New York,* 1989-1996. Primary responsibilities included client services as listed above. Also responsible for sample receipt, log in and distribution as well as bottle preparation.

Surgical Assistant, *Penfield Veterinary Hospital Rochester, New York,* 1984-1989. Primary responsibilities included preparation of instruments, surgical area, and animal for surgery. Also responsible for monitoring the animal before and after surgery.

Education

BA, Pre-Veterinary Medicine and Pre-Professional Zoology (double Major), *Ohio Wesleyan University, Delaware, Ohio,* 1983.

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CHRISTINE M. KUTZER

ALS Environmental

1565 Jefferson Rd, Bldg 300, Ste. 360, Rochester, NY 14623 585.288.5380

Current Position	**TECHNICAL MANAGER II, INORGANICS LABORATORY** – 2011 to Present
Responsibilities	Plans and manages all activities in the Inorganics Department, including Metals and General Chemistry. Responsible for coordinating the workload and scheduling employees' daily activities. Assist in the operation, troubleshooting, and maintenance of instrumentation. Responsible for scheduling samples. Accountable for analytical data entry, analytical data approval and High Level metals package generation through MARRS. **Documentation of Demonstration of Capabilities is available for review.**
Experience	**Technical Manager II, Inorganics Laboratory,** *Columbia Analytical Services, Inc., Rochester, New York*, 2004-2011. Duties as above. **Technical Manager II, Metals and Organics Prep Laboratories,** *Columbia Analytical Services, Inc., Rochester, New York*, 2002-2004. Duties as above for Metals Department. Responsible for coordinating the workload and scheduling employees' daily activities and troubleshooting in the organics preparation laboratory. **Technical Manager I, Metals Laboratory,** *Columbia Analytical Services, Inc., Rochester, New York,* 1996-2002. Duties as above for Metals Department. **Analyst III,** *Columbia Analytical Services, Rochester, New York*, 1996. Responsible for instrument troubleshooting and maintenance, digestion of samples, and TCLP extractions. Also responsible for data entry, approval, and package review. **Chemist,** *General Testing Corporation, Rochester, New York*, 1992-1996. Duties were as listed above.
Education	**BS, Chemistry,** *St. Bonaventure University, Olean, New York*, 1992

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MICHAEL W. CYMBAL

ALS Environmental

1565 Jefferson Rd, Bldg 300, Ste.3650, Rochester, NY 14623 585.288.5380

Current Position	**TECHNICAL MANAGER I -** Information Technology and Extractable Department Supervisor 2011 to Present
Responsibilities	Responsible for computer systems (Novel Lan, Starlims) and instrument analysis of software. Also responsible for client spreadsheets and disk deliverables, computer maintenance and upgrades. Responsible for the oversight of the extractables department including extactions and instrumental analysis (HPLC, GC, and GC/MS). **Documentation of Demonstration of Capabilities is available for review.**
Experience	**Technical Manager I** - *Columbia Analytical Services, Inc., Rochester, New York, 1998-2011 (Information Technology) and 2004-2011 (Extractables Supervisor).* Duties as above. **Systems Analyst III,** *Columbia Analytical Services, Inc., Rochester, New York,* 1997-1998. Duties primarily as above. **Systems Analyst I,** *Columbia Analytical Services, Inc., Rochester, New York,* 1996-1997. Duties primarily as above. **Computer Administration,** *General Testing Corporation, Rochester, New York,* 1995-1996. Oversaw computer systems (Novel Lan, StarLIMS, Seven Reporting Systems) and created client spreadsheets and disk deliverables. **Analyst,** *General Testing Corporation, Rochester, New York,* 1990-1995. Responsible for Organic Analyses (Volatile and Semi-Volatile Pesticides) for GC and GC/MS. Also responsible for Instrument Maintenance and Sample Preparation.
Education	**BS, Chemistry,** *Robert's Wesleyan College, Rochester, New York,* 1990.

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THOMAS WALTON

ALS Environmental

1565 Jefferson Rd., Bldg 300, Ste. 360, Rochester, NY 14623 585.288.5380

Current Position	**TECHNICAL MANAGER I, GC/VOA LABORATORY –** 2011 to Present
Responsibilities	Responsible for the daily operations of the GC/MS laboratory, including the scheduling of department analyses, instrument calibration, and troubleshooting/maintenance activities. Accountable for personnel training, data approval, quality program support. **Documentation of Demonstration of Capabilities is available for review.**
Experience	**Technical Manager I, GC/VOA Laboratory,** *Columbia Analytical Services, Rochester, New York.* 2009-2011. Responsibilities as above. **Scientist IV,** *Columbia Analytical Services, Rochester, New York*. 2006-2009. Responsible for GC/MS analysis of air for presence of volatile organic compounds, data reduction and preparation of data for reporting. Also responsible for instrument maintenance as needed. **Chemist**, *Eastman Kodak Company, Rochester, New York*, 1989-2005. Analytical Chemist supporting environmental and industrial hygiene testing, equipment and process monitoring; method development, and quality control; and experience with EPA methods TO-15, 8015, 8260, and 8270.
Education	**BS, Chemistry,** *Suny at Cortland, Cortland, New York*, 1985.

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MEGHAN D. PEDRO

ALS Environmental

1565 Jefferson Rd., Bldg 300, Ste. 360, Rochester, NY 14623 585.288.5380

Current Position	**SCIENTIST III –** 2011 to Present **Environmental Health and Safety Program Manager** – 2009 to Present
Responsibilities	Supervision of the organics prep lab. Analysis of, and generation of reports, pesticides/PCBs, herbicides, and other miscellaneous analyses/extractions using GC/ECD. Prepares standards, surrogates and spikes. Administration of the laboratory health and safety policies, including formulation and implementation, supervision of new employee safety training, review of accidents, incidents and prevention plans, and the conducting of departmental safety inspections.
	Documentation of Demonstration of Capabilities is available for review.
Experience	**Scientist III,** *Columbia Analytical Services, Inc., Rochester, NY*, 2004-2011. Responsibilities as above. **Scientist II,** *Columbia Analytical Services, Inc., Rochester, NY*, 2003-2004. Responsibilities were primarily as above without the supervisory role. Analysis of, and generation of reports, pesticides/PCBs, herbicides, and other miscellaneous analyses/extractions using GC/ECD. Prepares standards, surrogates and spikes. **Scientist I,** *Columbia Analytical Services, Inc., Rochester, NY*, 2002-2003. Analysis of, and generation of reports for, pesticides/PCBs, herbicides, and other miscellaneous analyses/extractions using GC/ECD. Prepares standards, surrogates and spikes. **Senior Analyst,** *Columbia Analytical Services, Inc., Rochester, New York*, 2001-2002. Extraction, concentration, and clean-up of water, soil and oil samples for Semi-VOA compounds using EPA methodologies. Prior work history is not relevant to laboratory position.
Education	**BS, Chemistry,** *Nazareth College, Rochester, New York*, 2000.

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APPENDIX C
MAJOR ANALYTICAL EQUIPMENT

Please note that the Appendices provide current information at the time of the revision, but are updated only upon annual review. Please contact the laboratory for up-to-date information.

Please also note that many SOPs reference this Appendix (C) for control limits. These limits are now found in the Data Quality Objectives Table, as referenced in the ALS/Rochester QA Program Documents Table in Appendix A.

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ALS Environmental
Rochester, NY

EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
MASS SPECTROMETERS - VOAs					
GC/MS #5 (R-MS-05)	Gas Chromatograph	HP 5890II	3121A35679	VOAs	1991
	Mass Spec Detector	HP 5971	3118A02532		
	AutoSampler	Archon	12727		
	Concentrator	Tekmar 3000	98125008		
	Computer Workstation	Gateway P5-133	5360356		
	Computer Workstation	Dell Optiplex GX280	5M7KM71		
	Analytical Software Gateway	Enviroquant Chemstation G1032C v.c.01.00			
	Analytical Software Dell	Enviroquant Chemstation E.01.00.237			
GC/MS #6 (R-MS-06)	Gas Chromatograph	HP 6890	US00023178	VOAs	1998
	Mass Spec Detector	HP 5973	US82311143		
	AutoSampler	Archon			
	Concentrator	EST Encon	261043003		
	Computer Workstation	Gateway GP6-400	0013029323		
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00			
GC/MS #7 (R-MS-07)	Gas Chromatograph	HP 5890II	3235A43994	VOAs	2001
	Mass Spec Detector	HP 5971	323A03964		
	AutoSampler	Archon	13589		
	Concentrator	Tekmar 2000	91267022		
	Computer Workstation	Compaq DeskPro	6124FR4ZD257		
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00			

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ALS Environmental
Rochester, NY

EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
GC/MS #8 (R-MS-08)	Gas Chromatograph	HP 5890II	3126A36850	VOAs	2004
	Mass Spec Detector	HP 5972	3435A01975		
	AutoSampler	EST Centurion	CENT145061104		
	Concentrator	EST Encon	374062504		
	Computer Workstation	Compaq DeskPro	6946CJM7M878		
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00			
GC/MS #9 (R-MS-09)	Gas Chromatograph	HP 6890	US00029263	VOAs in air TO-15	2004
	Mass Spec Detector	HP 5973	US91922619		
	AutoSampler	Enteck 7016CA	00156		
	Concentrator	Enteck 7100	0088		
	Computer Workstation	HP Kayak XA	92181198		
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00 Enteck Smart Lab 2000 v3.32			
GC/MS #10 (R-MS-10)	Gas Chromatograph	Agilent 6890N	CN10633045	VOAs	2006
	Mass Spec Detector	Agilent 5975B	US62723782		
	Purge and Trap	EST-Varian Archon	14702		
	Concentrator	EST Encon	ELEC-523103006E PATH-523103006P		
	Computer Workstation	Dell E520	8PT52C1		
	Analytical Software	Chemstation	D.03.00.552		
GC/MS #11 (R-MS-11)	Instrument	EST Markelov+R[46]C HS9000	HS137042108	VOAs	2008
	Gas Chromatograph	Agilent 6890N	US00033857		
	Mass Spec Detector	Agilent 5973	US94212218		
	Concentrator				
	Computer Workstation	HP Kayak xA	FR94720557		
	Analytical Software	HP Enviroquant 61701BA	B.0100		

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ALS Environmental
Rochester, NY

EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
GC/MS #12 (R-MS-12)	Gas Chromatograph	Agilent 6890	US00026365	VOAs	2008
	Mass Spec Detector	Agilent 5973	US71191002		
	Purge & Trap	Archon	15104		
	Concentrator	EST Encon	Elec-444071905E Path-444071905P		
	Computer Workstation	Dell	B78K571		
	Analytical Software	Chemstation	W6G86-222ZT-YK65P-N82JA		
GC/MS #13 (R-MS-13)	Gas Chromatograph	Agilent 7890A	CN10945114	VOAs in Air	2010
	Mass Spec Detector	Agilent 5975C	US94333887		
	Autosampler	Entech 7016CA	1262		
	PreConcentrator	Entech 7100A	1533		
	Computer Workstation	IBM 8212KUE	LKTAK9B		
	Analytical Software	Enviroquant Chemstation Core Software Software Upgrade Entech Smartlab v4.17b	USK0104163 91701EA		
Digital Display 1-Channel	Mass Flow Controller Digital Display	MKS Instruments 247C	92290101A	VOAs	2006
Digital Display 4-Channel		MKS Instruments 246B	94200203A	VOAs	2006
Flow Controller #1	Mass Flow Controllers	Model 1359C-10000SK	0258C10583442	VOAs	2006
Flow Controller #2		Model 1359C-00200SK	0258C10598442	VOAs	2006
Flow Controller #3		Model 1359C-000205SK	0258C15231304	VOAs	2006
Flow Controller #4		Model 1359C-00010SK	0258C10581442	VOAs	2006
R-Conditioner-01	Molecular Dry Pump Control	Entech 3100A	1507	Canister Cleaning System	2011
	Oven A	Quincy Lab Bench Series Model 31-350ER	B33ER-01150		
	OvenB	Quincy Lab Bench Series Model 31-350ER	B33ER-01145		
	Gas Chromatograph	SRI-8610C	N1813		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
SRI 8610C GC/FID #40 (R-GC-40)	Computer Workstation	Gateway GP6-400	0011809646	TO-3 VOAs in AIR	2009
	Analytical Software	Peak Simple v.3.78	N553W		
	Hydrogen Generator	Chrysalis II Hydrogen 100	TNM060615566		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
MASS SPECTROMETERS -SVOAs					
GC/MS 5973A (R-MS-51)	Gas Chromatograph	HP 6890	US00024148	SemiVOAs/CLP	1998
	Mass Spec Detector	HP 5973	US82311266		
	AutoSampler	HP 7683	CN23021382		
	Injector	Agilent 7683	US10301831		
	Computer Workstation	Gateway GP7-600	17904248		
	Analytical Software	HP Chemstation B.02.05 EnviroQuant G1701BA v.B.01.00			
GC/MS 5973B (R-MS-52)	Gas Chromatograph	HP 6890	US00029105	SemiVOAs/CLP	1999
	Mass Spec Detector	HP 5973	US91911849		
	AutoSampler	HP7683	CN60738562		
	Injector	HP7683	CN23126455		
	Computer Workstation	HP Kayak XA6/400	US92280466		
	Analytical Software	HP Chemstation B.02.05 EnviroQuant G1701BA v.B.01.00			
GC/MS 5973C (R-MS-53)	Gas Chromatograph	Agilent 6890N (G1530N)	US10232036	SemiVOAs	2002
	Mass Spec Detector	Agilent 5973 (G2578A)	US21853642		
	AutoSampler	Agilent 7683 (G2614A)	US00307019		
	Injector	Agilent 7683 (G2613A) Agilent LVI being installed	US81501041		
	Computer Workstation	Gateway P7-450	13645026		
	Analytical Software	HP Chemstation Enviroquant G1701 v.D.00.00.38			

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
GC/MS 5973D (R-MS-54)	Gas Chromatograph	HP6890	US00025479	SemiVOAs	2008
	Mass Spec Detector	HP5973	DE82320565		
	AutoSampler	HP7683	CN74245816		
	Injector	HP7683	CN74143962		
	Computer Workstation	IBM Think Center	LKH2F83		
	Analytical Software	Chemstation G1701DA			
GC/MS 5975E (R-MS-56)	Gas Chromatograph	7890A	CN10391141	SemiVOAs	2010
	Mass Spec Detector	HP5975C	US1037615		
	AutoSampler	HP7693	CN10340022		
	Injector	HP7693	CN10340059		
	Computer Workstation	IBM Think Center	MXL0340NKM		
	Analytical Software	Chemstation G1701EA			

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
GAS CHROMATOGRAPHS - EXTRACTABLES					
HP5890(II)-B (R-GC-52)	Gas Chromatograph	HP 5890	2728A14298	Petroleum Hydrocarbons	1988
	Detector	FID	(integrated)		
	Autosampler	HP7673	3417A35264		
	Injector	HP7673	CN34222775		
	Controller	HP7673	CN00005087		
	Computer Workstation	HP KAYAK XA	US8345093		
	Analytical Software	HPChemstation B.02.05 EnviroQuant G1701BA v.B.01.00			
HP6890- D (R-GC-54)	Gas Chromatograph	HP 6890	22174	Pest/PCB/8011	1998
	Detector	Dual ECD			
	Injector	HP7683	US93408790		
	Autosampler	G2614A	US81800809		
	Computer Workstation	DELL	7BQRS71		
	Analytical Software	Enviroquant MSD Chemstation D.01.02.16 15 June 2001			
HP5890(II)- F (R-GC-55)	Gas Chromatograph	HP 5890II	2950A26574	Prop 65	1989
	Detector	Dual ECD			
	Autosampler	18596B	3032A22303		
	Injector	HP7673	3205A29661		
	Computer Workstation	HP Vectra XA 5/233	US81450241		
	Analytical Software	HP Chemstation v.B.02.05 EnviroQuant G1701BA v.B.01.00			
6890N- G (R-GC-58)	Gas Chromatograph	Agilent 6890N	US10520018	Herb/PCB	2005
	Detector	Micro ECD			
	Injector	Agilent G2913A	CN51624717		
	Autosampler	Agilent G2614A	CN51032422		
	Computer Workstation	DELL	7BQRS71		
	Analytical Software	Enviroquant MSD Chemstation D.01.02.16 15 June 2001			

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
HP5890(II)-H (R-GC-57)	Gas Chromatograph	HP 5890II	3336A56596	Alcohols/ WAPA	2005
	Detector	FID	(integrated)		
	Autosampler	18596C	US22508151		
	Injector	Agilent 6890			
	Controller	G1512A			
	Computer Workstation	HP KAYAK XA	US8345093		
	Analytical Software	HP Chemstation B.02.05 EnviroQuant G1701BA v.B.01.00			
6890N- I (R-GC-59)	Gas Chromatograph	Agilent 6890N	US10552066	Petroleum Hydrocarbons	2008
	Detector	FID			
	Injector	Agilent G2913A_7683B	CN60931630		
	Autosampler	Agilent G2614A	US92005373		
	Computer Workstation	DELL	818W761		
	Analytical Software	Chemstation D.02.00.275			
HP6890-J (R-GC-60)	Gas Chromatograph	Agilent 6890	US00039730	Method 18	2008
	Detector	FID			
	Injector	7683 Tower	de82400931		
	Autosampler	Agilent G2613A_7683	US04910055		
	Computer Workstation	Windows XP			
	Analytical Software	Agilent Chemstation 1701 H V2.00			
HP6890-K (R-GC-61)	Gas Chromatograph	Agilent 6890	US00008526	8015B	2008
	Detector	FID			
	Injector	7673 Tower	US72102123		
	Controller	G1512A	US72002014		
	Computer Workstation	Windows XP			
	Analytical Software	Agilent Chemstation 1701 A U2.00			

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
HP5890(II)-L (R-GC-56)	Gas Chromatograph	HP 5890II	2950A27718	Herb/PCB	1989
	Detector	Dual ECD			
	Autosampler	18596C	US3400814		
	Injector	Agilent 6890	CN22321966		
	Computer Workstation	HP Vectra XA 5/233	US81450241		
	Analytical Software	HP Chemstation v.B.02.05 EnviroQuant G1701BA v.B.01.00			
7890-M (R-GC-62)	Gas Chromatograph	Agilent 7890	CN12161177	Pesticides	2013
	Detector	Dual ECD			
	Injector	Agilent 7693	CN12120018		
	Tray	Agilent 7693	CN11450020		
	Computer Workstation	HP with Windows 7			
	Analytical Software	G1701ea 2.02			

EXTRACTABLES SUPPORT EQUIPMENT

GPC	GPC	OI Analytical AP2000	A122330318	Cleanups	2002
RapidVap #1	Nitrogen Evaporation System	LabConco RapidVap	11296345E	Concentrations	2001
RapidVap #2	Nitrogen Evaporation System	LabConco RapidVap	20998065F	Concentrations	2002
RapidVap #3	Nitrogen Evaporation System	LabConco RapidVap	70975713	Concentrations	2007
N-EVAP	Organomation N-EVAP	Model 112	7531	Concentrations	

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
Hot Orbital Shaker		Armalab OR200	3560	Extractions	2004
Automated Soxhlet #1	Automated Soxhlet	Gerhardt SOX416	1/8465080006	Extractions	2008
Automated Soxhlet #2	Automated Soxhlet	Gerhardt SOX416	1/8465080007	Extractions	2008
Automated Soxhlet #3	Automated Soxhlet	Gerhardt SOX416	1/8465090004	Extractions	2009
Automated Soxhlet #4	Automated Soxhlet	Gerhardt SOX416	1/8465090005	Extractions	2009
Autoshaker#1	Lab-Line Extraction Mixer	Model 6000	0904-3735	Extractions	2004
Autoshaker#2	Lab-Line Extraction Mixer	Model 6000	0904-3736	Extractions	2004
Autoshaker#3	Lab-Line Extraction Mixer	Model 6000	0904-3737	Extractions	2004
SPE-DEX 4790#1	Solid Phase Extractor	Horizon	05-0593	Extractions	2005
SPE-DEX 4790#2	Solid Phase Extractor	Horizon	05-0595	Extractions	2005
SPE-DEX 4790#3	Solid Phase Extractor	Horizon	05-0594	Extractions	2005
Tekmar 500		TM-500	7460E	Sonication	
Tekmar 600		TM-600	13232	Sonication	
VibraCell #1		VC375	15144E	Sonication	
VibraCell#2		VC505	37629G	Sonication	

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
GAS CHROMATOGRAPHS - VOLATILES					
V2 (R-GC-02)	Gas Chromatograph	Varian 3300	4130	Alcohols/Gases	1999
	Detector	FID	(integrated)		
	Computer Workstation	Gateway 2000	0009092536		
	Analytical Software	Varian System Control v.4.51	D57543610		
V3 (R-GC-03)	Gas Chromatograph	Varian 3400	5442	VOAs	1999
	PID Controller	OIA 5200	A240213		
	PID Detector	OI 4430			
	ELCD Detector	OI 5220	C515520175		
	ELCD Controller	OI 5300	C449553665		
	AutoSampler	Varian Archon	13316		
	Concentrator	Tekmar 3000	98124003		
	Computer Workstation	Gateway 2000	10221502		
	Analytical Software	Varian System Control v.4.51	D57543610		
V4 (R-GC-04)	Gas Chromatograph	Varian 3400	15248	VOAs	2001
	PID Detector	OI 4436	OI1000		
	PID Controller	OI 5200	A218047		
	ELCD Detector	OI 5220	C515520175		
	ELCD Controller	OI 5300	C449553665		
	AutoSampler	Archon	13596		
	Concentrator	Encon	130122900 E/P		
	Computer Workstation	GP6-233	9767125		
	Analytical Software	Varian System Control v.4.5.2	D57543610		
HP1 (R-GC-05)	Gas Chromatograph	HP5890II	3121A35575	VOAs	2001
	PID Detector	OIA 4430	31030		
	FID Detector	(integrated)	-		
	AutoSampler	Tekmar 2016	89220008		
	Concentrator	Tekmar 2000	89013002		
	Sample Heater	Tekmar	91065008		
	Computer Workstation	Gateway GP5-233	9352344		
	Analytical Software	Varian System Control v.4.5.2	00159-1908-cd1-22bd		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
T6 (R-GC-06)	Gas Chromatograph	Varian 3400	4143	VOAs/VPH/GRO	1998
	PID Detector	OI 4430	OI1006		
	FID Detector	Integrated	-		
	AutoSampler	Varian	12050		
	Concentrator	Tekmar 3100	US01225010		
	Computer Workstation	Gateway GP5-233	9352344		
	Analytical Software	Varian System Control v.4.5.2	00159-1a08-cd1-22bd		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
HPLC					
HPLC02 (LC/MS) (R-HPLC-02)	Binary Pump	Agilent 1100	DE11108496	Perchlorate	2005
	Column Thermostat	Agilent 1100	DE11120893		
	Wellplate Autosampler	Agilent 1100	DE11300879		
	Sample Thermostat	Agilent 1100	DE82207519		
	MSD	Agilent G1946D	US12411208		
	Computer Workstation	HP Vectra	US12475439		
	Analytical Software	Chemstation for HPLC Rev.A.10.02			
HPLC03 (R-HPLC-03)	Binary Pumps	Shimadzu LCD10ADVP	1(A) C20963851348US 2(B) C20963851344US	Metabolic Acids Hydroquinone Tolytriazole PAHs	2005
	UV/VIS Detector	Shimadzu SPD10AVVP	C21004050470US		
	Fluorescence Detector	Waters 470	470-00067		
	Electrochemical Detector	BAS LC4C/CC5	LC-4C 7014		
	AutoSampler	Shimadzu SIL10ADVP	C21053850511US		
	System Controller	Shimadzu SCL10AVP	C21013851302US		
	Degasser	Shimadzu DGU 14A	101076		
	Temperature Control Module	Waters	TCM-001304		
	Computer Workstation				
	Analytical Software				
HPLC04 (R-HPLC-04)	Solvent Delivery System	HP1050	3019A00475	Formaldehyde UV-MISC	2007
	Variable Wavelength UV Detector	HP1050	3225J01126		
	Scanning Fluorescence Detector	HP1046A			
	AutoSampler	HP1050	LR47359C		
	Quaternary Pump	HP1050			
	Column Thermostat	HP1050			
	Analytical Software	Chemstation for HPLC Rev A.09.0E1206	Data Acquisition and Instrument Control		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
HPLC05 (R-HPLC-05)	Degasser	Degasser G1322A	JP 7305035	Metabolic Acids/client specific	2007
	Binary Pump	Agilent 1100/G1312A	US70600653		
	Diode Array Detector	Agilent 1100/G1315B	DE11112376		
	AutoSampler	Agilent 1100/G1313A ALS	DE72003859		
	Analytical Software	Chemstation for HPLC Rev A 09.0S1206	Data Acquisition and Instrument Control		
HPLC06 (R-HPLC-06)	Detector	Agilent 1100/G1315A	US74901960	Explosives	2011
	Degasser	Agilent 1100/G1322A	JP73010194		
	AutoSampler	Agilent 1100/G1313A	US80603194		
	Quaternary Pump	Agilent 1100/G1310A	DE33206020		
	Temperature Control Module	Agilent 1100/G1316A	US54000565		
	Analytical Software	Chemstation for HPLC Rev A.09.03[1417]	Data Acquisition and Instrument Control		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
METALS					
FIMS (R-CVAA-01)	CVAA-FIMS	Perkin Elmer	1258	Mercury	1997
	Computer Workstation	Soyata			
	Analytical Software	PE AA WinLab for Windows v.2.50			
4100ZL #2 (R-GFAA-01)	AA	Perkin Elmer AA 4100ZL	6245	Furnace Metals	1998
	Computer Workstation	Gateway GP6-400			
	Analytical Software	PE AA WinLab for Windows v.2.50			
Leeman Hydra AFG+ (R-CVAF-01)	CVAF	Leeman Hydra AFG+	112-00067-1	Low Level Mercury (Method 1631)	2004
	Computer Workstation	Dell Dimension 2400	35180912881		
	Analytical Software	WinHg Runner 1.5 CT Rev0.286	-		
ICP #3 (R-ICP-AES-03)	Instrument	Perkin Elmer 5300DV	077N5112802	Metals	2006
	Computer Workstation	Dell Optiplex GX620			
	Analytical Software	PE ICP WinLab v.3.1			
ICP #4 (R-ICP-AES-04)	Instrument	Perkin Elmer 5300DV	077N6052202	Metals	2010
	Computer Workstation	Dell Optiplex GX620			
	Analytical Software	PE ICP WinLab v.3.1			
ICPMS (R-ICP-MS-01)	SCIEX ICP/MS	Perkin Elmer Elan 9000	PO370203	Metals	2002
	Autosampler	PE AS93Plus			
	Computer Workstation	Dell Optiplex GX150			
	Analytical Software	ELAN v.2.4			

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
HOTBLOCKS - METALS					
Hotblock #1		Environmental Express		Metals Digestions	2001
Hotblock #2		Environmental Express		Metals Digestions	2001
Hotblock #3		Environmental Express		Metals Digestions	2005
Hotblock #4		Environmental Express		Metals Digestions	2005
Hotblock #5		Environmental Express		Metals Digestions	
Hotblock #6		Environmental Express		Metals Digestions	
ModBlock A		CPI		Metals Digestions	2003
ModBlock B		CPI		Metals Digestions	2003

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
GENERAL CHEMISTRY					
TOC#1 (R-TOC-01)	TOC Analyzer	OI Model 1010	J245710349	TOC - waters	2003
	Autosampler	OI Model 1051	B247751184		
	Computer Workstation	Gateway GP6-300	10709094		
	Analytical Software	OI WinTOC for 1010 v.01 Rev 225	-		
TOC#2 (R-TOC-02)	TOC Analyzer	Dohrman DC190	9507646	TOC - soils	2001
	Boat Sampler	Dohrman 183 s/s1	9507610		
Lachat 8000 (R-FIA-01)	Flow Injection System	Lachat 8000		Chloride, TKN, NO2/NO3, NH3, Alkalinity, Hardness, Phosphorus, Silica, Cr6+	1999
	Colorimeter	Lachat	A83000-1286		
	Pump	Lachat	A82000-525		
	Autosampler	Lachat	A81010-168		
	Computer Workstation	Gateway GP6-233	9767124		
	Analytical Software	Omnion FIA v.2	-		
Lachat 8500 (R-FIA-05)	Flow Injection System	Lachat 8500		Chloride, TKN, NO2/NO3, NH3, Alkalinity, Hardness, Phosphorus, Silica, Cr6+	2011
	Colorimeter		110100001295		
	Amperometric Detector	BASi CC-5e	5966		
	Cell	BASi CC-3D	11314		
	Pump	14951	0595996-2		
	Autosampler	ASX-260	021109A260		
	Computer Workstation	Dell Optiplex 780			
	Analytical Software	Omnion FIA v.3.0	-		
Technicon #2 (R-FIA-04)	Flow Injection System	Technicon		Phenol	Pre-1982
	Colorimeter	Technicon	20060911		
	Pump	Technicon			
	Chart Recorder	Technicon	41685B		
	Autosampler	Technicon	681-Rest worn off		
	Module	Technicon	83035		
AquaKem (R-Discrete-01)	Instrument	AquaKem 200	A0419913	Nitrite, Ammonia, Phosphate, Chloride, Hexavalent Chromium, Cyanide	2005
	Computer Workstation	Sell SX280	3KSDF1J		
	Analytical Software	6.5.AQ1 rc4			

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
IC#3 (R-IC-03)	Ion Chromatograph	Metrohm 861 Advanced Compact IC		Anions	2005
	Basic Chromatography Module	Metrohm	861-02114		
	Pump	Metrohm	62824100s20		
	Conductivity Detector	Metrohm	integrated		
	Autosampler	Metrohm	838-04105		
	Computer Workstation	Dell OptiPlex GX520	6VRC581		
	Analytical Software	IC NET 2.3 SR2	A.701.0016		
IC # 4 (R-IC-04)	Ion Chromatograph	Dionex 500DX		ANIONS	2007
	Basic Chromatography Module	LC20-1	97110393		
	Gradient Pump	GP40-1	97110534		
	Conductivity Detector	ED40-1	97110074		
	Autosampler	AS40-1	97110671		
	Computer Workstation	Gateway 2000 GP6-266	10239250		
	Analytical Software	Peaknet 5.21	192-994-1564		
IC # 5 (R-IC-05)	Ion Chromatograph	Dionex ICS-1000	7090145	Cr6+ ANIONS	2007
	Gradient Pump	GP40			
	Conductivity Detector	DS6	7081071		
	Autosampler	AS40	7090325		
	Computer Workstation	Dell Optiplex 745	1441DAA99		
	Analytical Software	Chromeleon 6.80	56276		

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
IC # 6 (R-IC-06)	Ion Chromatograph	DX-120	10169	ANIONS	2008
	Conductivity Detector	DS4-1	10133		
	Autosampler	AS40	4070066		
	Computer Workstation	Dell Optiplex GX110	5ZBVK01		
	Analytical Software	Peaknet 5.11	147-994-3278		
IC # 7 (R-IC-07)	Ion Chromatograph	DX500		ANIONS	2008
	Basic Chromatography Module	LC20	99050321		
	Gradient Pump	GP50	99050419		
	Conductivity Detector	CD20	99050289		
	Autosampler	AS40	99011702		
	Computer Workstation	Dell Optiplex GX110	5ZBVK01		
	Analytical Software	Peaknet 5.11	147-994-3278		
IC #8 (R-IC-08)	Ion Chromatograph	Dionex ICS-2100	12030901	Cr6+	2012
	Heated Conductivity Cell	DS6	12030664		
	Reagent Pump	AXP	20045075		
	Variable Wavelength Detector		12031294		
	Autosampler	AS-AP	12031171		
	Computer Workstation	Dell Optiplex 790	15105322945		
	Analytical Software	Chromeleon 7.0	151838		
Isoperibol Calorimeter (R-Calorimeter-02)	Isoperibol Calorimeter	Parr 6300	27187	BTU, Combustion Prep	2004
Autoclave	Tutternauer	3870m	2801669	Micro/TPO4	2011

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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
Midi A	Midi Cyanide Distillation System	BSL Co	none	Cyanide/Phenol/ Sulfide Distillation	1997
Midi B	Midi Cyanide Distillation System	BSL Co	none	Cyanide/Phenol/ Sulfide Distillation	1997
Midi C	Midi Cyanide Distillation System			Cyanide/Phenol/ Sulfide Distillation	2004
Bullwinkle (R-pH-02)	pH Meter	Orion SA520	2305	pH	1990
Rocky (R-pH-02)	pH Meter	Orion 720A	5012		1992
	pH Electrode	Orion 915600			
	Fluoride Electrode	Orion 9409			
	Reference Electrode	Orion 90-01-00			
SympHony (R-pH-05)	pH/Conductivity Meter	SympHony SB80PC	D00582	ph/Conductivity	2008
Turbidimeter (R-Turbidimeter-02)	Turbidimeter	HF Scientific Micro 100	609246	Turbidity	2000
MR 21 (R-UV-VIS-01)	Spectro-photometer	Milton Roy Spectronic 21	1225601	COD, MBAS, Cr6+, Ferrous Iron	1989
Perkin Elmer Lambda 3A (R-UV-VIS-04)	Spectro-photometer	Perkin Elmer Lambda 3A		Hydrogen Peroxide, UV254	

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ALS Environmental
Rochester, NY

EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
DO Meter #1 (R-DOMeter-01)	Dissolved Oxygen Meter	YSI Model 58	07M100226	DO, BOD	
DO Meter #2 (R-DOMeter-02)	Dissolved Oxygen Meter	YSI Model 58	06J2457	DO, BOD	
Open Cup (R-Flash-01)	Open Cup Flashpoint Tester	Koehler Instru.Co. Model 420	none	Ignitability - solids	1989
Closed Cup (R-Flash-02)	Closed Cup Flashpoint Tester	Boekel Model 152800	none	Ignitability - liquids	1993
Aquameter (R-KF-01)	Aquameter	Beckman KF4B	101414	% Water	
Density Meter (R-Density-01)	Metler Toledo	DE40	MPJ17625	Density	2007

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ALS Environmental
Rochester, NY

EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
Autotitrator (R-Titrator-01)	Robotic Titrosampler	Metrohm 855		Photoprocessing Samples	2007
	Pump Unit	Metrohm 772			
	Dosing Interface	Metrohm 846			
	Dosino	(7) Metrohm 800			
	Computer Workstation	Dell Optiplex 745			
	Analytical Software				
TKN Digestion Blocks	Technicon	Technicon block	206	TKN digest	<1997
		Omega CN 2110 Temperature Controller	-		
	AIM600	AI Scientific Pty Ltd AIM600	4726A12136	TKN digest	2007
Fluorometer (R-Fluorometer-01)	Fluorometer	Turner Designs Trilogy 7200-000	720000843	Chlorphyll a	2012
	Chlorophyll a Module	Turner 7200-040	-		
R-Sieve-01	Tyler-RO Tap	RX-29	10-2155	Grain Size	2010
Vacuum Pumps		Gast DOL-101-AA	787	1664	
		Gast DOA-P704-AA		1664	
		Gast 0522-U31-G18DX	687	General Filtration	
R-Balance-01	**Top Loading Balances**	American Scientific DTL2500-1	20466	Wetchem	<1997
R-Balance-03		Mettler Toledo PB602-S	1118331281	Metals	<2002
R-Balance-04		Cole Parmer Symmetry	ED1200	SMO	2009
R-Balance-05		Mettler Toledo PB602-S	1125322050	Extractables	2004
R-Balance-06		Fisher XL 500	7384	Metals	<1997
R-Balance-07		Ohaus Adventure Pro AV412	8026261026	Volatiles	2005
R-Balance-14		Ohaus ScoutPro SP6001	7/31340865	SMO (soil lab)	2010
R-Balance-02	**Analytical Balances**	Mettler AE240	F96727	Wetchem	1996 used
R-Balance-08		Fisher XA200	8887	Volatiles	1990
R-Balance-09		Mettler AE160	D25222	Wetchem	2008 used
R-Balance-10		Mettler AE200	J29745	Wetchem	2008 used
R-Balance-11		Mettler AG204	120330501	Wetchem	2001
R-Balance-13		Mettler AE160	D40689	Extractables	2008 used

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ALS Environmental
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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
R-Oven-Metal-01	Thermo Scientific	Model 6528	604341-206	Tissue Prep	2008
R-Oven-01	Fischer		601	180	<1997
R-Oven-02	Precision	Model 18		104	<2000
R-Oven-03	Precision	Model 18		104	<2005
R-Oven-04	National Appliance Co	Model 620	PSR5	180	<2000
	Barnstead/ Thermolyne Sybron Type 19200	Model OV19225	228930910988	40	2010 used
	VWR	1370FM	601403		2011
Kiln	Skutt Automatic Kiln	Model KM-1218-3	001168	Glassware/Sodium sulfate purification	2011
Muffle Furnace	Thermolyne	F48025-60	150440201110801	Wetchem	2011

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ALS Environmental
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EQUIPMENT LIST

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Analyses Performed	Year Acquired
C-1	**Sample Cooler**	Bally Engineered Structures, Inc.	VOA	Sample Storage	
C-2	**Sample Cooler**	American Cooler Technologies		Sample Storage	2011
BOD Incubator	**Incubator**	Shultz		BOD Closet	
R-4	**Reagent Fridge**	Revco Scientific	TY90605E	WC Reagents	
R-5	**Standards Fridge**	General Motors	CAS03991	WC Standards	
R-6	**Micro Fridge**	General Motors	CAS03992	Micro Reagents	
R-7	**Fridge (Mini)**	GE		Wetchem	
R-8	**Standards Fridge**	NuCool	28VS201001-006630	FID Standards	2010
R-9	**Sample Fridge**	Jordon Scientific	S7649999E	Extractables	2011
F-2	**Extract Freezer**	Baxter Cryo-Fridge	CAS06056	Extractables	
Freezer 5	**Sample Freezer**	Maytag	12377439GV	SMO Sample Storage	
F-6	**Extract Freezer**	GE	SH175743	Extractables	
F-7	**Standards Freezer**	GE	FL171960	Extractables	
F-08	**Standard Freezer**	Signature	23429-1	VOA Standards	
Freezer 9	**Sample Freezer**	GE	MS145661	VOA Sample Storage	
F-10	**Tissue Storage**	Labline		SMO Sample Storage	

Note that the computers listed with the instruments are dedicated to that instrument for data aquisition, but the data files are saved to a lab-wide network and data may be accessed by any computer with the correct software - provided the user is authorized to do so.

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APPENDIX D
DATA QUALIFIERS AND ACRONYMS

Please note that the Appendices provide current information at the time of the revision, but are updated only upon annual review. Please contact the laboratory for up-to-date information.

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ALS Environmental

REPORT QUALIFIERS

U	Analyte was analyzed for but not detected. The sample quantitation limit has been corrected for dilution and for percent moisture, unless otherwise noted in the case narrative.
J	Estimated value due to either being a Tentatively Identified Compound (TIC) or that the concentration is between the MRL and the MDL. Concentrations are not verified within the linear range of the calibration. For DoD: concentration >40% difference between two GC columns (pesticides/Arclors).
B	Analyte was also detected in the associated method blank at a concentration that may have contributed to the sample result.
E	Inorganics- Concentration is estimated due to the serial dilution was outside control limits.
E	Organics- Concentration has exceeded the calibration range for that specific analysis.
D	Concentration is a result of a dilution, typically a secondary analysis of the sample due to exceeding the calibration range or that a surrogate has been diluted out of the sample and cannot be assessed.
*	Indicates that a quality control parameter has exceeded laboratory limits. Under the "Notes" column of the Form I, this qualifier denotes analysis was performed out of Holding Time.
H	Analysis was performed out of hold time for tests that have an "immediate" hold time criteria.
#	Spike was diluted out.
+	Correlation coefficient for MSA is <0.995.
N	Inorganics- Matrix spike recovery was outside laboratory limits.
N	Organics- Presumptive evidence of a compound (reported as a TIC) based on the MS library search.
S	Concentration has been determined using Method of Standard Additions (MSA).
W	Post-Digestion Spike recovery is outside control limits and the sample absorbance is <50% of the spike absorbance.
P	Concentration >40% (25% for CLP) difference between the two GC columns.
C	Confirmed by GC/MS
Q	DoD reports: indicates a pesticide/Aroclor is not confirmed (≥100% Difference between two GC columns).
X	See Case Narrative for discussion.

ACCREDITED IN ACCORDANCE WITH nelac

Rochester Lab ID # for State Certifications[1]

NELAP Accredited	Maine ID #NY0032	New Hampshire ID # 294100 A/B
Connecticut ID # PH0556	Nebraska Accredited	
Delaware Accredited	Nevada ID # NY-00032	North Carolina #676
DoD ELAP #65817	New Jersey ID # NY004	Pennsylvania ID# 68-786
Florida ID # E87674	New York ID # 10145	Rhode Island ID # 158
Illinois ID #200047		Virginia #460167

[1] Analyses were performed according to our laboratory's NELAP-approved quality assurance program and any applicable state or agency requirements. The test results meet requirements of the current NELAP/TNI standards or state or agency requirements, where applicable, except as noted in the laboratory case narrative provided. For a specific list of accredited analytes, refer to http://alsglobal.com/environmental/laboratories/rochester-environmental-lab.aspx

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ALS Environmental

REPORT QUALIFIERS

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B	Analyte was also detected in the associated method blank at a concentration that may have contributed to the sample result.
E	Inorganics- Concentration is estimated due to the serial dilution was outside control limits.
E	Organics- Concentration has exceeded the calibration range for that specific analysis.
D	Concentration is a result of a dilution, typically a secondary analysis of the sample due to exceeding the calibration range or that a surrogate has been diluted out of the sample and cannot be assessed.
*	Indicates that a quality control parameter has exceeded laboratory limits. Under the "Notes" column of the Form I, this qualifier denotes analysis was performed out of Holding Time.
H	Analysis was performed out of hold time for tests that have an "immediate" hold time criteria.
#	Spike was diluted out.
+	Correlation coefficient for MSA is <0.995.
N	Inorganics- Matrix spike recovery was outside laboratory limits.
N	Organics- Presumptive evidence of a compound (reported as a TIC) based on the MS library search.
S	Concentration has been determined using Method of Standard Additions (MSA).
W	Post-Digestion Spike recovery is outside control limits and the sample absorbance is <50% of the spike absorbance.
P	Concentration >40% (25% for CLP) difference between the two GC columns.
C	Confirmed by GC/MS
Q	DoD reports: indicates a pesticide/Aroclor is not confirmed (≥100% Difference between two GC columns).
X	See Case Narrative for discussion.

ACCREDITED IN ACCORDANCE WITH nelac

CAS/Rochester Lab ID # for Massachusetts Certification
M-NY032

Analyses were conducted in accordance with Massachusetts Department of Environmental Protection certification standards, except as noted in the laboratory case narrative provided. A copy of the current Department issued parameter list is included in this report.

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Laboratory Acronyms

The following is a list of laboratory acronyms commonly used in environmental testing:

ACRONYM	DEFINITION
AA	Atomic Absorption Spectrometry (aka AAS) instrument used to measure concentration of metals in samples
ACS	American Chemical Society
APG	Analytical Products Groups (manufacturer of PE Samples)
ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
BFB	4-Bromofluorobenzene
BNA	Base Neutral Acid organic compounds (aka SOC or SVOCs)
BOD	Biochemical Oxygen Demand
BTEX/BETX	Benzene, Toluene, Ethylbenzene, Xylenes
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service Registry Number
CCB	Continuing Calibration Blank sample
CCC	Continuing Calibration Check sample
CCV	Continuing Calibration Verification sample
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
CLP	Contract Laboratory Program (through USEPA)
COC	Chain-of-Custody
COD	Chemical Oxygen Demand

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DCM	Dichloromethane (aka Methylene Chloride)
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology (state or federal)
DOH	Department of Health
EPA	U. S. Environmental Protection Agency (aka USEPA)
EPCRA	Emergency Planning & Community Right-to-Know Act
ERA	Environmental Resource Associates
ELAP	Environmental Laboratory Accreditation Program
FAA	Flame Atomic Absorption Spectrophotometry
FDA	Food & Drug Administration
FIA	Flow Injection Analysis
FID	Flame Ionization Detector
FIFRA	Federal Insecticide, Fungicide & Rodenticide Act
FR	Federal Register
GAO	General Accounting Office
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption Spectrometry
HECD/ELCE	Hall Electrolytic Conductivity Detector
HP	Hewlett-Packard (mfg. GC instruments)
HPLC	High Pressure Liquid Chromatography
IC	Ion Chromatography
ICB	Initial Calibration Blank sample
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectrometry (aka ICPAES)
ICP-MS	Inductively Coupled Plasma Mass Spectrometry

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ICV	Initial Calibration Verification sample
IFB	Invitation for Bid
IR	Infrared Spectrophotometer
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LUFT	Leaking Underground Fuel Tank
MB	Method Blank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
MS	Matrix Spike
NA	Not Applicable
NAN	Not Analyzed
NAS	National Academy of Sciences
NC	Not Calculated
NCASI	National Council for Air and Stream Improvement (for the Paper Industry)
NCI	National Cancer Institute
ND	Not Detected (at or above MRL)
NIH	National Institute of Health
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPD	Nitrogen Phosphorus Detector
NPDES	National Pollutant Discharge Elimination System
NSF	National Science Foundation

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NTIS	National Technical Information System
NTP	National Toxicology Program
ORB	Original Record Book (aka raw data books)
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PE	Performance Evaluation sample
PID	Photoionization Detector
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
RAS	Routine Analytical Services (contracts through USEPA)
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RPD	Relative Percent Difference
SAS	Special Analytical Services (contracts through USEPA)
SIE	Selective Ion Electrode
SIM	Selected Ion Monitoring
SMO	Sample Management Office (aka Sample Receiving)
SOC	Semi-Volatile Organic Compounds
SOQ	Statement of Qualifications
SOW	Statement of Work
SVOAs	Semi-Volatile Organic Analytes
SVOCs	Semi-Volatile Organic Compounds
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TOC	Total Organic Carbon (test to determine organic content)
TOX	Total Organic Halides (test to determine organic halide content)
TPH	Total Petroleum Hydrocarbons

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tr	Trace level in the concentration of an analyte that is less than the PQL but greater than or equal to the MDL
TSCA	Toxic Substances Control Act
UST	Underground Storage Tank
UV	Ultraviolet Spectrophotometer
VOA	Volatile Organic Analyte
VOC	Volatile Organic Compounds
WP	Water Pollution
WS	Water Supply
UNITS	
mg/kg	Milligrams per Kilogram (same as ppm)
mg/L	Milligrams per Liter (same as ppm)
ug/L	Micrograms per liter (same as ppb)
ppb	Parts Per Billion
ppm	Parts Per Million

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APPENDIX E
PREVENTIVE MAINTENANCE PROCEDURES

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Preventive Maintenance Procedures

Instrument	Activity	Laboratory or Vendor Performed	Frequency
Refrigerators and Coolers	Record temperatures	Laboratory	Daily
	Clean coils	Vendor	As needed
	Check coolant	Vendor	As needed or if temperature outside limit
Fume Hoods	Face velocity measured	Laboratory	Quarterly
	Sash operation	Laboratory	As needed
Ovens	Clean	Laboratory	As needed or if temperature outside limit
Incubators	Record temperatures	Laboratory	Daily, morning and evening
Water Baths	Wash with disinfectant solution	Laboratory	When water is murky, dirty, or growth appears
Autoclave	Check temperature	Laboratory	Every month
	Clean	Laboratory	When mold or growth appears
Top Loading Balances	Check calibration	Laboratory	Before every use
	Check alignment	Laboratory	Before every use
	Cleaning, calibration, adjustment, and spec compliance	Vendor	Annually
	Repair	Vendor	As needed
Analytical Balances	Check alignment	Laboratory	Before every use
	Check calibration	Laboratory	Before every use
	Clean pans and compartment	Laboratory	After every use
	Cleaning, calibration, adjustment, and spec compliance	Vendor	Annually
	Repair	Vendor	As needed
Dissolved Oxygen Meter	Change membrane	Laboratory	When fluctuations occur
pH probes	Condition probe	Laboratory	When fluctuations occur
UV-visible Spectrophotometer	Wavelength check	Vendor	Every 6 Months

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Preventive Maintenance Procedures

Instrument	Activity	Laboratory or Vendor Performed	Frequency
Discrete Analyzer	Review Water Check	Laboratory	Daily
	Empty Waste Bin	Laboratory	Daily
	Fill Diluent with fresh DI	Laboratory	Daily
	Check Waste Container	Laboratory	Daily
	Print or save results to file	Laboratory	Daily
	Clear Daily Files	Laboratory	Daily
	Empty Liquid Waste	Laboratory	Weekly
	Clean wash wells and tubing	Laboratory	Weekly
	Clean off any chemical residue	Laboratory	Weekly
	Check syringe tip	Laboratory	Weekly
	Run Dichromate test at 480nm	Laboratory	Weekly
	Restore adjustments from disk	Laboratory	Monthly
	Save database to CD	Laboratory	Monthly
	Print then delete messages	Laboratory	Monthly
	Print water check	Laboratory	Monthly
	Clean and lube incubator rod	Laboratory	Monthly
	Clean and lube fetched rod	Laboratory	Monthly
Total Organic Carbon Analyzers	Check IR zero	Laboratory	Weekly
	Check digestion/condensation vessels	Laboratory	Each use
	Clean digestion chamber	Laboratory	Every 2000 hours, or as needed
	Clean permeation tube	Laboratory	Every 2000 hours, or as needed
	Clean six-port valves	Laboratory	Every 200 - 2000 hours, or as needed
	Clean sample pump	Laboratory	Every 200 - 2000 hours, or as needed
	Clean carbon scrubber	Laboratory	Every 200 - 2000 hours, or as needed
	Clean IR cell	Laboratory	Every 2000 - 4000 hours, or as needed
Flow Injection Analyzer	Check valve flares	Laboratory	Quarterly
	Check valve ports	Vendor	As needed
	Check pump tubing	Laboratory	Daily
	Check flow cell flares	Laboratory	Quarterly
	Change bulb	Laboratory	As needed
	Check manifold tubing	Laboratory	Every six months
	Check T's and connectors	Laboratory	Every six months
Ion Chromatograph	Change column bed supports	Laboratory	Monthly or as needed
	Clean column	Laboratory	Monthly or as needed
	Change column	Laboratory	Every six months or as needed
	Change tubing	Laboratory	Annually or as needed
	Eluent pump	Laboratory	Annually

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Preventive Maintenance Procedures

Instrument	Activity	Laboratory or Vendor Performed	Frequency
Atomic Absorption Spectro-photometers - CVAA	Check gases	Laboratory	Daily
	Check aspiration tubing	Laboratory	Daily
	Empty waste container	Laboratory	Weekly
Atomic Absorption Spectro-photometers - GFAA	Check gases	Laboratory	Daily
	Check argon dewar	Laboratory	Daily, or as needed
	Change graphite tube	Laboratory	Daily, or as needed
	Clean furnace windows	Laboratory	Monthly or as needed
ICP-AES	Check argon dewar	Laboratory	Daily
	Replace peristaltic pump tubing	Laboratory	Daily, or as needed
	Empty waste container	Laboratory	Daily, or as needed
	torch	Laboratory	Every two weeks, or as needed
	Replace water filter	Laboratory	Quarterly, or as needed
	Replace or vacuum air filters	Laboratory	Monthly, or as needed
ICP-MS	Check argon dewar	Laboratory	Daily
	Replace peristaltic pump tubing	Laboratory	Daily, or as needed
	Empty waste container	Laboratory	Daily, or as needed
	Clean nebulizer, spray chamber, and torch	Laboratory	Every two weeks, or as needed
	Clean Cone	Laboratory	As needed
	Check air filters	Laboratory	Annually or as needed
	Check rotary pump oil	Laboratory	Quarterly, or as needed
	Clean ion lens stack	Laboratory	Annually or as needed

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Preventive Maintenance Procedures

Instrument	Activity	Laboratory or Vendor Performed	Frequency
Chromatographs	Clean and repack column	Laboratory	As needed
	Backflush valves	Laboratory	As needed
Gas Chromatographs, Semivolatiles	Check gas supplies	Laboratory	Daily, replace when pressure reaches 250 psi
	Change in-line filters	Laboratory	Quarterly or after 30 tanks of gas
	Change injection port liner	Laboratory	Daily or as needed
	Clip first foot of capillary column	Laboratory	As needed
	Change guard column	Laboratory	As needed
	Replace analytical column	Laboratory	As needed when peak resolution fails
	Check system for gas leaks	Laboratory	After changing columns
	Clean FID	Laboratory	As needed
	Leak test ECD	Laboratory	Annually
Gas Chromatograph/Mass Spectrometers, Semivolatiles	Check gas supplies	Laboratory	Daily, replace when pressure reaches 50 psi
	Change in-line filters	Laboratory	Quarterly or after 30 tanks of gas
	Change septum	Laboratory	Daily
	Change injection port liner	Laboratory	Weekly or as needed
	Clip first foot of capillary column	Laboratory	As needed
	Change guard column	Laboratory	As needed
	Replace analytical column	Laboratory	As needed when peak resolution fails
	Clean jet separator	Laboratory	As needed
	Clean source	Laboratory	As needed when tuning problems
	Change pump oil	Laboratory	Every six months
	Oil wick	Laboratory	Every six months

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Preventive Maintenance Procedures

Instrument	Activity	Laboratory or Vendor Performed	Frequency
Purge and Trap Concentrators	Change trap	Laboratory	As needed
	Change transfer lines	Laboratory	As needed
	Clean purge vessel	Laboratory	As needed
Gas Chromatographs, Volatiles	Check gas supplies	Laboratory	Daily, replace when pressure reaches 200 psi
	Change in-line filters	Laboratory	When indicator changes color
	Change septum	Laboratory	As needed
	Clip first foot of capillary column	Laboratory	As needed
	Change guard column	Laboratory	As needed
	Replace analytical column	Laboratory	As needed when peak resolution fails
	Check system for gas leaks	Laboratory	After changing columns or as needed
	Replenish ELCD solvents	Laboratory	Weekly
	Clean PID lamp	Laboratory	As needed
	Clean FID	Laboratory	As needed
	Change ion exchange resin	Laboratory	As needed
	Replace nickel tubing	Laboratory	As needed
Gas Chromatograph/Mass Spectrometers, Volatiles	Check gas supplies	Laboratory	Weekly, replace when pressure reaches 200 psi
	Change in-line filters	Laboratory	When indicator changes color
	Change septum	Laboratory	Daily, depending on use and component recovery
	Clip first foot of capillary column	Laboratory	As needed
	Change guard column	Laboratory	As needed
	Replace analytical column	Laboratory	As needed when peak resolution fails
	Clean jet separator	Laboratory	As needed
	Clean source	Laboratory	As needed when tuning problems
	Change pump oil	Laboratory	Annually
HPLC	Check gas supplies	Laboratory	Daily, replace when pressure reaches 200 psi
	Change guard column	Laboratory	As needed
	Change analytical column	Laboratory	As needed
	Change inlet filters	Laboratory	As needed
TCLP/SPLP Extractors	Monitor Room Temperature	Laboratory	Daily
	Monitor RPM of Rotators	Laboratory	Bi-weekly
	Grease fittings	Laboratory	As needed
	O-ring replacement	Laboratory	As needed

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APPENDIX F
LABORATORY SOP LIST

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STANDARD OPERATING PROCEDURES AND CONTROLLED DOCUMENTS

SOP NAME	FILE NAME
CORPORATE:	
CHECKING NEW LOTS OF CHEM. FOR CONTAMINATION	ADM-CTMN
DETM. OF STATISICAL CONTROL LIMITS	ADM-CTRL_LIM
DATA RECALL	ADM-DATARECALL
PREP OF ELECTRONIC-DATA FOR ORGANIC ANALYSES FOR E-DATA AUDITS	ADM-E_DATA
HANDLING CUSTOMER FEEDBACK	ADM-FDBK
CORRECTIVE ACTION	ADM-CA
QUALIFYING SUBCONTRACT LABS	CE-QA004
MANUAL INTEGRATION POLICY	CE-QA002
INTERNAL AUDITS	CE-QA001
TRAINING	CE-QA003
QUALIFYING SUBCONTRACT LABS	CE-QA004
LABORATORY MANAGEMENT REVIEW	CE-QA005
LABORATORY ETHICS and DATA INTEGRITY	CE-GEN001
RECORDS MANAGEMENT	CE-GEN003
PREVENTIVE ACTION	CE-GEN004
DOCUMENT CONTROL	CE-GEN005
PROFICIENCY TESTING SAMPLE ANALYSIS	CE-QA006
MAKING ENTRIES ONTO ANALYTICAL RECORDS	CE-QA007
PROCUREMENT AND CONTROL OF LAB SERVICES AND SUPPLIES	CE-GEN007
PREPARATION OF SOPs	ADM-SOP
SIGNIFICANT FIGURES	ADM-SIG.FIG
METHOD DEVELOPMENT, INVESTIGATION, and TRANSFER	ADM-MDEV
DETERMINATION OF METHOD DETECTION LIMIT	ADM-MDL
TAPE BACKUP AND TAPE ARCHIVING	ADM-TAPEBU
ESTIMATION OF UNCERTAINTY OF MEASUREMENTS	ADM-UNCERT

LOCAL:	
QUALITY ASSURANCE MANUAL	QAM
ANALYTICAL BATCHES AND SEQUENCES	ADM-BATCH
CONFIRMATION OF ORGANIC ANALYTE IDENTIFICATION AND QUANTITATION	ADM-CONFIRM
MECHANICAL VOLUME DISPENSING DEVICES, VOLUMETRIC AND NON-VOLUMETRIC LABWARE	ADM-PCAL
INITIAL CALIBRATION	ADM-ICAL
PREPARING SAMPLE DILUTIONS	ADM-DIL
GENERATION OF ELECTRONIC DATA DELIVERABLES USING EDDGE	ADM-EDD
LABORATORY DATA REVIEW PROCESS	ADM-DREV
PROJECT CHEMIST DUTIES AND REPORT REVIEW	ADM-PCR
REPORT GENERATION	ADM-RG
DATA ARCHIVING	ADM-ARCH
DAILY BALANCE CALIB. AND TEMP. CHECKS	ADM-DALYCK
PH MEASUREMENTS FOR SUPPORT OF OTHER METHODS - CALIBRATION, USE, AND DOCUMENTATION	ADM-PhSUPPORT
SAMPLE PREPARATION, COMPOSITING, AND SUBSAMPLING	ADM-SPLPREP
CARBON DIOXIDE BY CALCULATION	ADM-4500 CO2 D
TOTAL HARDNESS BY CALCULATION	GEN-2340B
LANGELIER INDEX CALCULATION	ADM-2230B
UNIONIZED SULFIDE BY CALCULATION	ADM-H2SCALC
FIELD SAMPLING	FLD-SAMPLE
FIELD CHLORINE RESIDUAL	FLD-4500Cl-G
TEMPERATURE - FIELD	FLD-2550B
OXYGEN - FIELD	FLD-4500-OG
BOTTLE PREPARATION, PACKING, AND SHIPPING	SMO-BPS

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STANDARD OPERATING PROCEDURES AND CONTROLLED DOCUMENTS

SOP NAME	FILE NAME
SAMPLE RECEIVING	SMO-GEN
INTERNAL CHAINS OF CUSTODY	SMO-ICOC
SAMPLE DISPOSAL	SMO-SPLDIS
pH IN WATER AND AQUEOUS WASTE	GEN-9040B/SM4500H+B
TURBIDITY	SMO-180.1
SETTEABLE SOLIDS	GEN-160.5
CONDUCTIVITY IN WATER	GEN-120.1
CORROSIVITY	GEN-9045C
COLOR	GEN-110.2
MULTI-INCREMENTAL SAMPLING (MIS)	SMO-MIS
REACTIVITY BY OBSERVATION	GEN-ReactObs
PAINT FILTER TEST	SMO-9095
PASSIVE DIFFUSION BAGS	SMO-PDB
REDOX	GEN-REDOX
TISSUE SAMPLE PREPARATION	SMO-TISP
WKI PREPARATION	SMO-WKI
JAPANESE INDUSTRIAL STANDARD DESICCATOR METHOD FOR FORMALDEHYDE IN WALLPAPER	GEN-JISA6921
ALKALINITY, TOTAL	GEN-2320B
ALKALINITY FOR PHOTOPROCESSING SAMPLES	GEN-ALK-CARE
AMMONIA	GEN-350.1
ASH, DETERMINATION OF	GEN-ASH
BIOCHEMICAL OXYGEN DEMAND	GEN-5210B
BOMB CALORIMETRY PREP AND HEAT OF COMBUSTION	GEN-BOMB
BROMIDE BY AUTOMATED TITRATOR	GEN-BROMIDE-CARE
CATION EXCHANGE CAPACITY OF SOILS USING SODIUM ACETATE	GEN-9081
CHEMICAL OXYGEN DEMAND-Soils	GEN-CODS
CHEMICAL OXYGEN DEMAND-Waters	GEN-410.4
CHLORIDE	GEN-4500ClE
CHLORINE DEMAND	GEN-409A
CHLORINE RESIDUAL	GEN-4500ClF
CHLOROPHYLL A BY COLORIMETRY	GEN-10200H
CHLOROPHYLL A BY FLUOROMETRY	GEN-CHLPHA
CHLORINE IN OIL BY CHLOR-D-TECT Q KIT	GEN-9077
COLILERT AND VERIFICATION OF E.COLI IN MUG CULTURES	GEN-9223B
CYANIDE, AMENABLE TO CHLORINE	GEN-4500 CN G
CYANIDE, MIDI DISTILLATION	GEN-9012
CYANIDE, TOTAL AMPEROMETRIC	GEN-D7842
CYANIDE, FREE AMPEROMETRIC	GEN-D7237
CYANIDE, ILM05.3	GEN-ILM5.3CN
CYANIDE, WEAK ACID DISSOCIABLE	GEN-WADCN
DENSITY BY OSCILLATING CELL METER	GEN-D4052
CORROSION DEPOSIT SAMPLE ANALYSIS	GEN-DEPOSITS
DENSITY OR SPECIFIC GRAVITY BY WEIGHT PER GALLON CUP	GEN-D1475Cup
DISSOLVED OXYGEN	GEN-4500OG
ETHYLENE GLYCOL	GEN-89-9
FERROUS IRON	GEN-3500Fe
FIXER TITRATION OF PHOTOPROCESSING SAMPLES FOR HYPO INDEX AND THIOSULFATE	GEN-FIXER-TITR-CARE
HARDNESS, TOTAL	GEN-2340C
ALKALINE DIGESTION FOR HEXAVALENT CHROMIUM IN SOIL	GEN-3060A
COLORIMETRIC DETERMINATION OF HEXAVALENT CHROMIUM IN SOIL	GEN-7196A
HEXAVALENT CHROMIUM BY IC	GEN-7199
HEXAVALENT CHROMIUM - WATERS	GEN-CR+6

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STANDARD OPERATING PROCEDURES AND CONTROLLED DOCUMENTS

SOP NAME	FILE NAME
HYDROGEN PEROXIDE BY MANUAL COLORIMETRY WITH TITANIUM(IV)SULFATI	GEN-HP
HYDROGEN PEROXIDE IN AIR IMPINGERS BY MANUAL COLORIMETRY WITH TITANIUM	GEN-OSHAVI6
HYPO (FIXER) CONTAMINATION IN PHOTOPROCESSING SAMPLES	GEN-HYPO-CARE
IGNITABILITY - CLOSED CUP	GEN-CCIGN
IGNITABILITY - OPEN CUP	GEN-OCIGN
IN-LAB FILTRATION	GEN-FILTER
ION CHROMATOGRAPHY, DETERMINATION OF ANIONS BY	GEN-300.0
LIPIDS, PERCENT	GEN-LIPID
NITRATE AND NITRITE	GEN-353.2
NITROGEN, TOTAL KJELDAHL	GEN-351.2
ODOR	GEN-2150B
OIL AND GREASE HEXANE EXTRACTION	GEN-1664A
PERCENT WATER BY KARL FISCHER	GEN-%W
PHENOLICS, TOTAL	GEN-420.4/9066
PHOSPHORUS, ORTHC	GEN- OPO4
PHOSPHORUS, TOTAL	GEN-365.1
PIPELINE SOIL SAMPLE ANALYSIS	GEN-PIPELINE
REACTIVITY, SULFIDE AND CYANIDE	GEN-RS/RCN
SILICA	GEN-I-2700-85
SILICON, GRAVIMETRIC	GEN-SILICON
SOLIDS, PERCENT	GEN-DWPS
SOLIDS, TOTAL	GEN-2540B
SOLIDS, TOTAL DISSOLVED	GEN-2540C
SOLIDS, TOTAL SUSPENDED	GEN-2540D
SOLIDS, VOLATILE AND FIXED (TOTAL, DISSOLVED, and SUSPENDED)	GEN-160.4
SOLIDS, PERCENT VOLATILE	GEN-2540G
SULFIDE, ACID SOLUBLE	GEN-9030B/9034
SULFIDE, ACID VOLATILE	GEN-AVS/SEM
SULFIDE, TOTAL AND DISSOLVED IN WATERS	GEN-4500S2F
SULFITE	GEN-4500SO3B
SULFURIC ACID BY METHOD 8	GEN-8
SURFACTANTS (MBAS)	GEN-5540C
THIOCYANATE	GEN-4500 CN M
THIOSULFATE BY TITRETS	GEN-S2O3
TMA and TMAH IN SORBENT TUBES AND WATER USNG IC	GEN-TMA(H)
TOTAL ORGANIC CARBON OR TIC B Y LLOYD KAHN/9060	GEN-TOCLK/9060
TOTAL ORGANIC CARBON-WATERS	GEN-5310C/9060
TOTAL INORGANIC CARBON - WATERS	GEN-TICW
UV-ABSORBING CONSTITUENTS	GEN-5910B
PARTICLE SIZE	GEN-D422
SPECIFIC GRAVITY OF SOIL	GEN-SPGRAV
BULK DENSITY FOR ELUTRIATE PREPARATION	GEN-E1109
ELUTRIATE PREPARATION	GEN-ELUTRIATE
WET CHEMISTRY GLASSWARE CLEANING	GEN-GC
DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP	MET-200.7/6010B
DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP-MS	MET-6020A
DETERMINATION OF METALS ANG TRACE ELEMENTS BY ICP-MS BY ILM05.3	MET-ILM05.3MS
DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP BY ILM05.3	MET-ILM5.3AES
DETERMINATION OF TRACE METALS BY GFAA	MET-GFAA
MERCURY IN WATER BY COLD VAPOR ATOMIC ABSORPTION SPEC	MET-7470A/245.1
MERCURY IN SOLID OR SEMISOLID BY COLD VAPOR ATOMIC ABSORPTION SPEC	MET-7471B/245.5
MERCURY IN WATER BY OXIDATION, P&T, AND CVAFS	MET-1631
MERCURY IN WATER BY COLD VAPOR ATOMIC ABSORPTION SPEC.CLI	MET-HgILM-W

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STANDARD OPERATING PROCEDURES AND CONTROLLED DOCUMENTS

SOP NAME	FILE NAME
MERCURY IN SOLID OR SEMISOLID BY COLD VAPOR ATOMIC ABSORPTION SPEC	MET-HgILM-S
METALS DIGESTION, WATERS FOR ICP	MET-3010A
METALS DIGESTION, WATERS FOR GFAA ANALYSIS	MET-3020A
METALS DIGESTION, SOIL, SEDIMENT, SLUDGE FOR ICP AND GFAA ANALYSIS	MET-3050B
CLOSED VESSEL OIL DIGESTION	MET-3051M
SPLP EXTRACTION FOR METALS AND SEMIVOLATILES	MET-SPLP
SPLP ZHE EXTRACTION	MET-SPLPZHE
SULFUR FOR ION CHROMATOGRAPHY	MET-ICS
METALS AND SEMIVOLATILES TCLP EXTRACTION (METHOD 1311)	MET-TCLP
ZERO HEADSPACE EXTRACTION (EPA METHOD 1311)	MET-TZHE
SAMPLE PREPARATION OF BIOLOGICAL TISSUE FOR METALS ANALYSIS	MET-TDIG
CLP DIGESTION TECHNIQUES FOR WATERS AND SOILS	MET-CLPDIG
METALS GLASSWARE CLEANING	MET-GC
VOLATILE SCREENING	VOC-SCREEN
VOA STORAGE BLANKS	VOC-BLAN
PURGEABLE VOLATILES BY GC	VOC-601/602
MINERIAL SPIRITS	VOC-8015MS
ANALYSIS OF WATER, SOLIDS, AND SOLUBLE WASTES FOR TOTAL PETROLEUM HYDROCARBONS AS GASOLINE RANGE ORGANICS	VOC-8015GRO
AROMATIC AND HALOGENATED VOCS BY GC	VOC-8021B
MIXED GASES BY RSK-175M	VOC-8015/RSK175
CLOSED SYSTEM PURGE AND TRAP	VOC-5035
DRINKING WATER VOLATILES BY GC/MS	VOC-524.2
PURGEABLE VOLATILES BY GC/MS	VOC-624
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-8260
CLP VOLATILE ORGANICS COMPOUNDS BY GC/MS SOW OLM04.3/95.1	VOC-CLP4.3
LOW CONC WATER FOR VOCS BY OLC02.1 AND OLC03.2 SOW	VOC-OLC
VOCs IN AIR COLLECTED IN CANs AND GAS COLLECTION BAGS BY GC/MS	VOC-TO-15
1,4-DIOXANE IN PERSONAL CARE PRODUCTS BY HEADSPACE GC/MS	VOC-p-Dioxane
DETERMINATION OF POLYAROMATIC HYDROCARBONS BY HPLC	HPLC-8310
DETERMINATION OF CARBONYL COMPOUNDS BY HPLC	HPLC-8315A
ACRYL COMPOUNDS BY HPLC	HPLC-8316
NITROAROMATICS AND NITRAMINES (EXPLOSIVES) BY HPLC	HPLC-8330
ANALYSIS OF WATER SAMPLES FOR METABOLIC ACIDS	HPLC-METACIDS
PERCHLORATE IN WATER, SOIL, SOLID WASTE USING HPLC/ESI/MS	HPLC-6850
DETERMINATION OF HYDROQUINONE BY HPLC/ECD FOR "Client'	HPLC-"Client"Hyd
SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510C
AUTOMATED SOXHLET EXTRACTION	EXT-3541
ULTRASONIC EXTRACTION	EXT-3550B
WASTE DILUTION	EXT-3580A
ADDITION OF SPIKES AND SURROGATES	EXT-SAS
PREPARATION OF ANHYDROUS SODIUM SULFATE	EXT-SUL
CONCENTRATION OF EXTRACTS	EXT-CONC
FLORISIL CLEANUP	EXT-3620B
SILICA GEL CLEANUP	EXT-3630
GEL PERMEATION CLEANUP	EXT-3640A
SULFUR CLEANUP	EXT-3660B
SULFURIC ACID CLEANUP OF PCB EXTRACTS	EXT-3665A
CARBON CLEANUP	EXT-CARCU
ORGANIC EXTRACTIONS GLASSWARE CLEANING	EXT-GC
DIAZOMETHANE PREPARATION	EXT-DIAZ
GASEOUS ORGANIC COMPOUNDS ON MEDIA BY GC/FID	SOC-18

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STANDARD OPERATING PROCEDURES AND CONTROLLED DOCUMENTS

SOP NAME	FILE NAME
PETROLEUM PRODUCTS IN WATER (HYDROCARBON SCAN)-NYSDOH Mt	SOC-310-13
1,2 DIBROMO-3-CHLOROPROPANE & 1,2-DIBROMOETHANE IN WATEF	SOC-504/8011
1,4-DIOXANE IN WATER BY SPE AND GC/MS SIM	SOC-522
PCBs BY GC/MS	SOC-680
NONHALOGENATED ORGANICS BY GC/FID	SOC-8015B
PETROLEUM HYDROCARBONS AS DIESEL IN WATERS, SOILS, AND WASTE INCLUDING MODS FOR MAINE AND CONNECTICUT	SOC-8015B DRO
ORGANOCHLORINE PESTICIDES AND PCBs IN WATERS AND SOILS	SOC-8081A
PCBs IN WATERS and SOILS	SOC-8082
CHLORINATED HERBICIDES	SOC-8151A
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SOC-8270
EXTENDED POLYCYCLIC AROMATIC HYDROCARBONS (PARENT AND ALKYL HOMOLOGS) BY GC/MS SELECTIVE ION MONITORING	SOC-8270alkPAH
1,3-DICHLORO-2-PROPANOL AND 3-CHLORO-1,2-PROPANEDIOL IN PAPEF	SOC-PROP65

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APPENDIX G

CERTIFICATIONS, ACCREDITATIONS, AND PRIMARY NELAP ACCREDITED METHODS

Please note that the Appendices provide current information at the time of the revision, but are updated only upon annual review. Please contact the laboratory for up-to-date information.

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ALS/Rochester Certifications/Accreditations/Contracts

Federal, National, and International Programs

- NELAP Accreditation, since January 2001.
  Primary Accreditation with New York (see below).
  Secondary Accreditation with Florida, New Jersey, New Hampshire, Pennsylvania, Virginia and Illinois (see below).
- United States Department of Defense Environmental Laboratory Accreditation Program (DOD-ELAP) since January 2010.
- ISO/IEC 17025:2005 since January 2010.

State and Local Programs

- State of Connecticut, Department of Health Services, Approved Public Health Laboratory.
  Certified Laboratory for Potable Water, Waste Water, Solid Waste and Soil.
  Examination for Inorganic Chemicals and Organic Chemicals. Registration No. PH-0556.
  Exp. 10/30/2013.
- State of Delaware, Department of Natural Resources and Environmental Control. Approved for Delaware Hazardous Substance Cleanup Act.
- State of Florida, Department of Health.
  Drinking water, Wastewater, Solid Hazardous Waste. Certification No. E87674. Expires 06/30/2013.
- State of Illinois, Environmental Protection Agency.
  Inorganic and Organic Hazardous and Solid Waste. Certification No. 200047. Expires 11/17/2012.
- State of Maine, Department of Health and Human Services.
  Drinking Water, Wastewater, and Solid Waste. Certification No.NY0032. Expires 11/12/2013.
- The Commonwealth of Massachusetts, Department of Environmental Protection.
  Non-Potable Water. Certification No. M-NY032. Exp. 06/30/2013.
- State of Nevada, Department of Conservation and Natural Resources, Division of Environmental Protection.
  Non-Potable Water and Solid and Hazardous Waste. Lab ID number NY-00032. Expires 7/31/2013.
- State of New Jersey, Department of Environmental Protection
  State Certified Environmental Laboratory for Drinking Water, Waste Water, and Solid Waste.
  Certification No. NY004. Exp. 06/30/2013.
- State of New York, Department of Health, Environmental Laboratory Approval Program.
  Potable Water, Air, Non-Potable Water, and Solid and Hazardous Waste.
  Certification No. 10145. Exp. 04/01/2013.
- State of New Hampshire, Department of Environmental Services
  Non-Potable Water, Drinking Water, Solid Waste. Certification No. 294102. Exp. 10/14/2012.
- State of North Carolina, Department of the Environment and Natural Resources, Division of Water Quality
  Wastewater, Ground water. Certificate 676. Expires 12/31/12.

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ALS/Rochester Certifications/Accreditations/Contracts

- Pennsylvania Department of Environmental Protection.
  Non-Potable Water. Lab ID No. 68-00786. Expires 6/30/2013.

- State of Rhode Island, Department of Health
  Approved for Surface Water, WasteWater, and Sewage. License No. 158. Exp. 12/30/2012.

- Virginia Department of General Services Division of Consolidated Laboratory Services.
  Drinking Water, Non-potable Water, and Solid and Chemical Materials. ID# 460167. Exp. 6/14/2013.

Unregulated State Programs

- State of Georgia Environmental Protection Division
  Reciprocal Approval for Non-Potable/Environmental Waters and Wastes.

- State of Indiana Hazardous Waste Division
  Reciprocal Approval for Non-Potable/Environmental Waters and Wastes.

- State of Michigan - Reciprocal Approval for Non-Potable/Environmental Waters and Wastes.

- State of Mississippi - Reciprocal Approval for Non-Potable/Environmental Waters and Wastes.

- State of Maryland - Reciprocal Approval for Non-Potable/Environmental Waters and Wastes.

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2013
Issued April 1, 2012

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES AIR AND EMISSIONS
All approved analytes are listed below:

Acrylates	
Acrylonitrile	EPA TO-15
Ethyl acrylate	EPA TO-15
Methyl methacrylate	EPA TO-15
Chlorinated Hydrocarbons	
1,2,4-Trichlorobenzene	EPA TO-15
Hexachlorobutadiene	EPA TO-15
Miscellaneous Air	
Sulfuric Acid	40 CFR 60 Method 8
Purgeable Aromatics	
1,2,4-Trimethylbenzene	EPA TO-15
1,2-Dichlorobenzene	EPA TO-15
1,3,5-Trimethylbenzene	EPA TO-15
1,3-Dichlorobenzene	EPA TO-15
1,4-Dichlorobenzene	EPA TO-15
Benzene	EPA TO-15
Chlorobenzene	EPA TO-15
Ethyl benzene	EPA TO-15
m/p-Xylenes	EPA TO-15
o-Xylene	EPA TO-15
Styrene	EPA TO-15
Toluene	EPA TO-15
Total Xylenes	EPA TO-15
Purgeable Halocarbons	
1,1,1-Trichloroethane	EPA TO-15
Purgeable Halocarbons	
1,1,2,2-Tetrachloroethane	EPA TO-15
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA TO-15
1,1,2-Trichloroethane	EPA TO-15
1,1-Dichloroethane	EPA TO-15
1,1-Dichloroethene	EPA TO-15
1,2-Dibromoethane	EPA TO-15
1,2-Dichloroethane	EPA TO-15
1,2-Dichloropropane	EPA TO-15
Bromodichloromethane	EPA TO-15
Bromoform	EPA TO-15
Bromomethane	EPA TO-15
Carbon tetrachloride	EPA TO-15
Chloroethane	EPA TO-15
Chloroform	EPA TO-15
Chloromethane	EPA TO-15
cis-1,2-Dichloroethene	EPA TO-15
cis-1,3-Dichloropropene	EPA TO-15
Dibromochloromethane	EPA TO-15
Dichlorodifluoromethane	EPA TO-15
Methylene chloride	EPA TO-15
Tetrachloroethene	EPA TO-15
trans-1,2-Dichloroethene	EPA TO-15
trans-1,3-Dichloropropene	EPA TO-15
Trichloroethene	EPA TO-15
Trichlorofluoromethane	EPA TO-15

Serial No.: 45980

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MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES AIR AND EMISSIONS
All approved analytes are listed below:

Purgeable Halocarbons	
Vinyl chloride	EPA TO-15
Volatile Chlorinated Organics	
Benzyl chloride	EPA TO-15
Volatile Organics	
1,2-Dichlorotetrafluoroethane	EPA TO-15
1,3-Butadiene	EPA TO-15
2,2,4-Trimethylpentane	EPA TO-15
2-Butanone (Methylethyl ketone)	EPA TO-15
4-Methyl-2-Pentanone	EPA TO-15
Acetone	EPA TO-15
Carbon Disulfide	EPA TO-15
Cyclohexane	EPA TO-15
Hexane	EPA TO-15
Methyl iodide	EPA TO-15
Methyl tert-butyl ether	EPA TO-15
n-Heptane	EPA TO-15
Vinyl acetate	EPA TO-15

Serial No.: 45980

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ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Bacteriology	
Coliform, Total / E. coli (Qualitative)	SM 18-21 9223B (97) (Colilert)
Drinking Water Metals I	
Arsenic, Total	EPA 200.8 Rev. 5.4
	SM 18-19, 21 3113B (99 & 04)
Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
	SM 18-19, 21 3113B (99 & 04)
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
	SM 18-19, 21 3113B (99 & 04)
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II	
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Drinking Water Metals III	
Sodium, Total	EPA 200.7 Rev. 4.4
Drinking Water Miscellaneous	
Organic Carbon, Total	SM 18-21 5310C (00)
Turbidity	EPA 180.1 Rev. 2.0
UV 254	SM 19-21 5910B
Drinking Water Non-Metals	
Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
	SM 18-21 4500-Cl- E (97)
Color	SM 18-21 2120B (01)
Cyanide	EPA 335.4 Rev. 1.0
Fluoride, Total	EPA 300.0 Rev. 2.1
Nitrate (as N)	EPA 300.0 Rev. 2.1
	EPA 353.2 Rev. 2.0
Nitrite (as N)	EPA 300.0 Rev. 2.1
	EPA 353.2 Rev. 2.0

Serial No.: 45976

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2013
Issued April 1, 2012

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Non-Metals	
Orthophosphate (as P)	EPA 365.1 Rev. 2.0
Silica, Dissolved	SM 18-19 4500-Si F
	USGS I-2700-85
Solids, Total Dissolved	SM 18-21 2540C (97)
Specific Conductance	EPA 120.1 Rev. 1982
Sulfate (as SO4)	EPA 300.0 Rev. 2.1
Drinking Water Trihalomethanes	
Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2
Fuel Additives	
Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2
Microextractibles	
1,2-Dibromo-3-chloropropane	EPA 504.1
1,2-Dibromoethane	EPA 504.1
Volatile Aromatics	
1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2

Volatile Aromatics	
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
sec-Butylbenzene	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2
Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2

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Page 2 of 3

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All approved analytes are listed below:

Volatile Halocarbons

1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

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ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Acrylates	
Acrolein (Propenal)	EPA 624
	EPA 8260B
	EPA 8260C
Acrylonitrile	EPA 624
	EPA 8260B
	EPA 8260C
Ethyl methacrylate	EPA 8260B
	EPA 8260C
Methyl acrylonitrile	EPA 8260B
	EPA 8260C
Methyl methacrylate	EPA 8260B
	EPA 8260C
Amines	
1,2-Diphenylhydrazine	EPA 8270C
	EPA 8270D
1,4-Phenylenediamine	EPA 8270C
	EPA 8270D
1-Naphthylamine	EPA 8270C
	EPA 8270D
2-Naphthylamine	EPA 8270C
	EPA 8270D
2-Nitroaniline	EPA 8270C
	EPA 8270D
3-Nitroaniline	EPA 8270C
	EPA 8270D
Amines	
4-Chloroaniline	EPA 8270C
	EPA 8270D
4-Nitroaniline	EPA 8270C
	EPA 8270D
5-Nitro-o-toluidine	EPA 8270C
	EPA 8270D
Aniline	EPA 8270C
	EPA 8270D
Carbazole	EPA 8270C
	EPA 8270D
Diphenylamine	EPA 8270C
	EPA 8270D
Methapyrilene	EPA 8270C
	EPA 8270D
Pronamide	EPA 8270C
	EPA 8270D
Propionitrile	EPA 8260B
	EPA 8260C
Pyridine	EPA 625
	EPA 8270C
	EPA 8270D
Benzidines	
3,3'-Dichlorobenzidine	EPA 625
	EPA 8270C
	EPA 8270D

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Benzidines	
3,3'-Dimethylbenzidine	EPA 8270C
	EPA 8270D
Benzidine	EPA 625
	EPA 8270C
	EPA 8270D
Chlorinated Hydrocarbon Pesticides	
4,4'-DDD	EPA 608
	EPA 8081A
	EPA 8081B
4,4'-DDE	EPA 608
	EPA 8081A
	EPA 8081B
4,4'-DDT	EPA 608
	EPA 8081A
	EPA 8081B
Aldrin	EPA 608
	EPA 8081A
	EPA 8081B
alpha-BHC	EPA 608
	EPA 8081A
	EPA 8081B
alpha-Chlordane	EPA 8081A
	EPA 8081B
beta-BHC	EPA 608
	EPA 8081A
Chlorinated Hydrocarbon Pesticides	
beta-BHC	EPA 8081B
Chlordane Total	EPA 608
	EPA 8081A
	EPA 8081B
Chlorobenzilate	EPA 8270C
	EPA 8270D
delta-BHC	EPA 608
	EPA 8081A
	EPA 8081B
Dialiate	EPA 8270C
	EPA 8270D
Dieldrin	EPA 608
	EPA 8081A
	EPA 8081B
Endosulfan I	EPA 608
	EPA 8081A
	EPA 8081B
Endosulfan II	EPA 608
	EPA 8081A
	EPA 8081B
Endosulfan sulfate	EPA 608
	EPA 8081A
	EPA 8081B
Endrin	EPA 608
	EPA 8081A

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Chlorinated Hydrocarbon Pesticides	
Endrin	EPA 8081B
Endrin aldehyde	EPA 608
	EPA 8081A
	EPA 8081B
Endrin Ketone	EPA 8081A
	EPA 8081B
gamma-Chlordane	EPA 8081A
	EPA 8081B
Heptachlor	EPA 608
	EPA 8081A
	EPA 8081B
Heptachlor epoxide	EPA 608
	EPA 8081A
	EPA 8081B
Isodrin	EPA 8270C
	EPA 8270D
Kepone	EPA 8081A
	EPA 8081B
Lindane	EPA 608
	EPA 8081A
	EPA 8081B
Methoxychlor	EPA 608
	EPA 8081A
	EPA 8081B
PCNB	EPA 8270C

Chlorinated Hydrocarbon Pesticides	
PCNB	EPA 8270D
Toxaphene	EPA 608
	EPA 8081A
	EPA 8081B
Chlorinated Hydrocarbons	
1,2,3-Trichlorobenzene	EPA 8260B
	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270C
	EPA 8270D
1,2,4-Trichlorobenzene	EPA 625
	EPA 8270C
	EPA 8270D
2-Chloronaphthalene	EPA 625
	EPA 8270C
	EPA 8270D
Hexachlorobenzene	EPA 625
	EPA 8081A
	EPA 8081B
	EPA 8270C
	EPA 8270D
Hexachlorobutadiene	EPA 625
	EPA 8270C
	EPA 8270D
Hexachlorocyclopentadiene	EPA 625
	EPA 8270C

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Chlorinated Hydrocarbons		**Dissolved Gases**	
Hexachlorocyclopentadiene	EPA 8270D	Acetylene	RSK-175
Hexachloroethane	EPA 625	Ethane	RSK-175
	EPA 8270C	Ethene (Ethylene)	RSK-175
	EPA 8270D	Methane	RSK-175
Hexachloropropene	EPA 8270C	Propane	RSK-175
	EPA 8270D	**Fuel Oxygenates**	
Pentachlorobenzene	EPA 8270C	Di-isopropyl ether	EPA 8015 B
	EPA 8270D		EPA 8015C
Chlorophenoxy Acid Pesticides			EPA 8260B
2,4,5-T	EPA 1978 p.115		EPA 8260C
	EPA 8151A	Ethanol	EPA 8015 B
2,4,5-TP (Silvex)	EPA 1978 p.115		EPA 8015C
	EPA 8151A	Methyl tert-butyl ether	EPA 8021B
2,4-D	EPA 1978 p.115		EPA 8260B
	EPA 8151A		EPA 8260C
Dicamba	EPA 1978 p.115	tert-amyl methyl ether (TAME)	EPA 8260B
	EPA 8151A		EPA 8260C
Dinoseb	EPA 8151A	tert-butyl alcohol	EPA 8260B
	EPA 8270C		EPA 8260C
	EPA 8270D	tert-butyl ethyl ether (ETBE)	EPA 8260B
Demand			EPA 8260C
Biochemical Oxygen Demand	SM 18-21 5210B (01)	**Haloethers**	
Carbonaceous BOD	SM 18-21 5210B (01)	4-Bromophenylphenyl ether	EPA 625
Chemical Oxygen Demand	EPA 410.4 Rev. 2.0		EPA 8270C
			EPA 8270D

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Haloethers	
4-Chlorophenylphenyl ether	EPA 625
	EPA 8270C
	EPA 8270D
Bis (2-chloroisopropyl) ether	EPA 625
	EPA 8270C
	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 625
	EPA 8270C
	EPA 8270D
Bis(2-chloroethyl)ether	EPA 625
	EPA 8270C
	EPA 8270D
Low Level Polynuclear Aromatics	
Acenaphthene	EPA 610
	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Acenaphthylene	EPA 610
	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Anthracene	EPA 610
	EPA 8270C

Low Level Polynuclear Aromatics	
Anthracene	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Benzo(a)anthracene	EPA 610
	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Benzo(a)pyrene	EPA 610
	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Benzo(b)fluoranthene	EPA 610
	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Benzo(g,h,i)peryiene	EPA 610
	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
	EPA 8310
Benzo(k)fluoranthene	EPA 610
	EPA 8270C

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Low Level Polynuclear Aromatics		**Low Level Polynuclear Aromatics**	
Benzo(k)fluoranthene	EPA 8270D	Indeno(1,2,3-cd)pyrene	EPA 8270D
	EPA 8270D SIM		EPA 8270D SIM
	EPA 8310		EPA 8310
Chrysene	EPA 610	Naphthalene	EPA 610
	EPA 8270C		EPA 8270C
	EPA 8270D		EPA 8270D
	EPA 8270D SIM		EPA 8270D SIM
	EPA 8310		EPA 8310
Dibenzo(a,h)anthracene	EPA 610	Phenanthrene	EPA 610
	EPA 8270C		EPA 8270C
	EPA 8270D		EPA 8270D
	EPA 8270D SIM		EPA 8270D SIM
	EPA 8310		EPA 8310
Fluoranthene	EPA 610	Pyrene	EPA 610
	EPA 8270C		EPA 8270C
	EPA 8270D		EPA 8270D
	EPA 8270D SIM		EPA 8270D SIM
	EPA 8310		EPA 8310
Fluorene	EPA 610	**Mineral**	
	EPA 8270C	Alkalinity	SM 18-21 2320B (97)
	EPA 8270D	Calcium Hardness	EPA 200.7 Rev. 4.4
	EPA 8270D SIM		SM 18-21 2340B (97)
	EPA 8310	Chloride	EPA 300.0 Rev. 2.1
Indeno(1,2,3-cd)pyrene	EPA 610		EPA 9056A
	EPA 8270C		SM 18-21 4500-Cl- E (97)

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Mineral	
Fluoride, Total	EPA 300.0 Rev. 2.1
	EPA 9056A
Hardness, Total	EPA 200.7 Rev. 4.4
	SM 18-21 2340B (97)
	SM 18-21 2340C (97)
Sulfate (as SO4)	EPA 300.0 Rev. 2.1
	EPA 9056A
Nitroaromatics and Isophorone	
1,3,5-Trinitrobenzene	EPA 8270C
	EPA 8270D
	EPA 8330B
1,3-Dinitrobenzene	EPA 8270C
	EPA 8270D
	EPA 8330B
1,4-Naphthoquinone	EPA 8270C
	EPA 8270D
2,4,6-Trinitrotoluene	EPA 8330B
2,4-Dinitrotoluene	EPA 625
	EPA 8270C
	EPA 8270D
	EPA 8330B
2,6-Dinitrotoluene	EPA 625
	EPA 8270C
	EPA 8270D
	EPA 8330B
Nitroaromatics and Isophorone	
2-Amino-4,6-dinitrotoluene	EPA 8330B
2-Nitrotoluene	EPA 8330B
3,5-Dinitroaniline	EPA 8330B
3-Nitrotoluene	EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 8330B
4-Nitrotoluene	EPA 8330B
Hexahydro-1,3,5-trinitro-1,3,5-triazine	EPA 8330B
Isophorone	EPA 625
	EPA 8270C
	EPA 8270D
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330B
Nitrobenzene	EPA 625
	EPA 8270C
	EPA 8270D
	EPA 8330B
Nitroglycerine	EPA 8330B
Nitroquinoline-1-oxide	EPA 8270D
Octahydro-tetranitro-tetrazocine	EPA 8330B
Pentaerythritol tetranitrate	EPA 8330B
Nitrosoamines	
N-Nitrosodiethylamine	EPA 8270C
	EPA 8270D
N-Nitrosodimethylamine	EPA 625
	EPA 8270C
	EPA 8270D

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Nitrosoamines	
N-Nitrosodi-n-butylamine	EPA 8270C
	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625
	EPA 8270C
	EPA 8270D
N-Nitrosodiphenylamine	EPA 625
	EPA 8270C
	EPA 8270D
N-nitrosomethylethylamine	EPA 8270D
N-nitrosomorpholine	EPA 8270D
N-nitrosopiperidine	EPA 8270C
	EPA 8270D
N-Nitrosopyrrolidine	EPA 8270C
	EPA 8270D
Nutrient	
Ammonia (as N)	EPA 350.1 Rev. 2.0
Kjeldahl Nitrogen, Total	EPA 351.2 Rev. 2.0
Nitrate (as N)	EPA 300.0 Rev. 2.1
	EPA 353.2 Rev. 2.0
	EPA 9056A
Nitrite (as N)	EPA 300.0 Rev. 2.1
	EPA 353.2 Rev. 2.0
	EPA 9056A
Orthophosphate (as P)	EPA 365.1 Rev. 2.0
Phosphorus, Total	EPA 365.1 Rev. 2.0

Organophosphate Pesticides	
Atrazine	EPA 8270C
	EPA 8270D
Dimethoate	EPA 8270C
	EPA 8270D
Disulfoton	EPA 8270C
	EPA 8270D
Parathion ethyl	EPA 8270C
	EPA 8270D
Parathion methyl	EPA 8270C
	EPA 8270D
Phorate	EPA 8270C
	EPA 8270D
Thionazin	EPA 8270D
Phthalate Esters	
Benzyl butyl phthalate	EPA 625
	EPA 8270C
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 625
	EPA 8270C
	EPA 8270D
Diethyl phthalate	EPA 625
	EPA 8270C
	EPA 8270D
Dimethyl phthalate	EPA 625
	EPA 8270C

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Page 8 of 22

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2013
Issued April 02, 2012
Revised June 21, 2012

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category

ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Phthalate Esters		**Polychlorinated Biphenyls**	
Dimethyl phthalate	EPA 8270D	PCB-1254	EPA 8082A
Di-n-butyl phthalate	EPA 625	PCB-1260	EPA 608
	EPA 8270C		EPA 8082
	EPA 8270D		EPA 8082A
Di-n-octyl phthalate	EPA 625	PCB-1262	EPA 8082
	EPA 8270C		EPA 8082A
	EPA 8270D	PCB-1268	EPA 8082
Polychlorinated Biphenyls			EPA 8082A
PCB-1016	EPA 608	**Polynuclear Aromatics**	
	EPA 8082	2-Acetylaminofluorene	EPA 8270D
	EPA 8082A	3-Methylcholanthrene	EPA 8270C
PCB-1221	EPA 608		EPA 8270D
	EPA 8082	7,12-Dimethylbenzyl (a) anthracene	EPA 8270C
	EPA 8082A		EPA 8270D
PCB-1232	EPA 608	Acenaphthene	EPA 625
	EPA 8082		EPA 8270C
	EPA 8082A		EPA 8270D
PCB-1242	EPA 608	Acenaphthylene	EPA 625
	EPA 8082		EPA 8270C
	EPA 8082A		EPA 8270D
PCB-1248	EPA 608	Anthracene	EPA 625
	EPA 8082		EPA 8270C
	EPA 8082A		EPA 8270D
PCB-1254	EPA 608	Benzo(a)anthracene	EPA 625
	EPA 8082		EPA 8270C

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Page 9 of 22

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Polynuclear Aromatics	
Benzo(a)anthracene	EPA 8270D
Benzo(a)pyrene	EPA 625
	EPA 8270C
	EPA 8270D
Benzo(b)fluoranthene	EPA 625
	EPA 8270C
	EPA 8270D
Benzo(ghi)perylene	EPA 625
	EPA 8270C
	EPA 8270D
Benzo(k)fluoranthene	EPA 625
	EPA 8270C
	EPA 8270D
Chrysene	EPA 625
	EPA 8270C
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 625
	EPA 8270C
	EPA 8270D
Fluoranthene	EPA 625
	EPA 8270C
	EPA 8270D
Fluorene	EPA 625
	EPA 8270C
	EPA 8270D

Polynuclear Aromatics	
Indeno(1,2,3-cd)pyrene	EPA 625
	EPA 8270C
	EPA 8270D
Naphthalene	EPA 625
	EPA 8270C
	EPA 8270D
Phenanthrene	EPA 625
	EPA 8270C
	EPA 8270D
Pyrene	EPA 625
	EPA 8270C
	EPA 8270D
Priority Pollutant Phenols	
2,3,4,6 Tetrachlorophenol	EPA 8270C
	EPA 8270D
2,4,5-Trichlorophenol	EPA 625
	EPA 8270C
	EPA 8270D
2,4,6-Trichlorophenol	EPA 625
	EPA 8270C
	EPA 8270D
2,4-Dichlorophenol	EPA 625
	EPA 8270C
	EPA 8270D
2,4-Dimethylphenol	EPA 625

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Page 10 of 22

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Priority Pollutant Phenols	
2,4-Dimethylphenol	EPA 8270C
	EPA 8270D
2,4-Dinitrophenol	EPA 625
	EPA 8270C
	EPA 8270D
2,6-Dichlorophenol	EPA 8270C
	EPA 8270D
2-Chlorophenol	EPA 625
	EPA 8270C
	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625
	EPA 8270C
	EPA 8270D
2-Methylphenol	EPA 8270C
	EPA 8270D
2-Nitrophenol	EPA 625
	EPA 8270C
	EPA 8270D
3-Methylphenol	EPA 8270C
	EPA 8270D
4-Chloro-3-methylphenol	EPA 625
	EPA 8270C
	EPA 8270D
4-Methylphenol	EPA 8270C
	EPA 8270D

Priority Pollutant Phenols	
4-Nitrophenol	EPA 625
	EPA 8270C
	EPA 8270D
Cresols, Total	EPA 8270C
	EPA 8270D
Pentachlorophenol	EPA 625
	EPA 8151A
	EPA 8270C
	EPA 8270D
Phenol	EPA 625
	EPA 8270C
	EPA 8270D
Residue	
Settleable Solids	SM 18-21 2540 F (97)
Solids, Total	SM 18-21 2540B (97)
Solids, Total Dissolved	SM 18-21 2540C (97)
Solids, Total Suspended	SM 18-21 2540D (97)
Semi-Volatile Organics	
1,1'-Biphenyl	EPA 8270C
	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270C
	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270C
	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270C

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Semi-Volatile Organics	
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270C
	EPA 8270D
2-Picoline	EPA 8270D
4-Amino biphenyl	EPA 8270C
	EPA 8270D
Acetophenone	EPA 8270C
	EPA 8270D
Benzaldehyde	EPA 8270C
	EPA 8270D
Benzoic Acid	EPA 8270C
	EPA 8270D
Benzyl alcohol	EPA 8270C
	EPA 8270D
Caprolactam	EPA 8270C
	EPA 8270D
Dibenzofuran	EPA 8270C
	EPA 8270D
Ethyl methanesulfonate	EPA 8270C
	EPA 8270D
Isosafrole	EPA 8270C
	EPA 8270D
Methyl methanesulfonate	EPA 8270C
	EPA 8270D
O,O,O-Triethyl phosphorothioate	EPA 8270C

Semi-Volatile Organics	
O,O,O-Triethyl phosphorothioate	EPA 8270D
p-Dimethylaminoazobenzene	EPA 8270C
	EPA 8270D
Phenacetin	EPA 8270C
	EPA 8270D
Safrole	EPA 8270C
	EPA 8270D
Volatile Aromatics	
1,2,4-Trichlorobenzene, Volatile	EPA 8260B
	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
1,2-Dichlorobenzene	EPA 601
	EPA 602
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
1,3-Dichlorobenzene	EPA 601
	EPA 602
	EPA 624

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Volatile Aromatics		Volatile Aromatics	
1,3-Dichlorobenzene	EPA 8021B	Ethyl benzene	EPA 8021B
	EPA 8260B		EPA 8260B
	EPA 8260C		EPA 8260C
1,4-Dichlorobenzene	EPA 601	Isopropylbenzene	EPA 8021B
	EPA 602		EPA 8260B
	EPA 624		EPA 8260C
	EPA 8021B	Naphthalene, Volatile	EPA 8260B
	EPA 8260B		EPA 8260C
	EPA 8260C	n-Butylbenzene	EPA 8021B
2-Chlorotoluene	EPA 8260C		EPA 8260B
4-Chlorotoluene	EPA 8260C		EPA 8260C
Benzene	EPA 602	n-Propylbenzene	EPA 8021B
	EPA 624		EPA 8260B
	EPA 8021B		EPA 8260C
	EPA 8260B	p-Isopropyltoluene (P-Cymene)	EPA 8021B
	EPA 8260C		EPA 8260B
Bromobenzene	EPA 8260B		EPA 8260C
	EPA 8260C	sec-Butylbenzene	EPA 8021B
Chlorobenzene	EPA 601		EPA 8260B
	EPA 624		EPA 8260C
	EPA 8021B	Styrene	EPA 624
	EPA 8260B		EPA 8260B
	EPA 8260C		EPA 8260C
Ethyl benzene	EPA 602	tert-Butylbenzene	EPA 8260C
	EPA 624	Toluene	EPA 602

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Volatile Aromatics	
Toluene	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Total Xylenes	EPA 602
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Volatile Chlorinated Organics	
Benzyl chloride	EPA 8260B
	EPA 8260C
Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 8260B
	EPA 8260C
1,1,1-Trichloroethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Volatile Halocarbons	
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260B
	EPA 8260C
1,1,2-Trichloroethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,1-Dichloroethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,1-Dichloroethene	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,1-Dichloropropene	EPA 8260B
	EPA 8260C
1,2,3-Trichloropropane	EPA 8260B
	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8011
	EPA 8260B
	EPA 8260C
1,2-Dibromoethane	EPA 8011

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Volatile Halocarbons	
1,2-Dibromoethane	EPA 8260B
	EPA 8260C
1,2-Dichloro-1,1,2-Trifluoroethane	EPA 8260C
1,2-Dichloroethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,2-Dichloropropane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
1,3-Dichloropropane	EPA 8260B
	EPA 8260C
2,2-Dichloropropane	EPA 8260B
	EPA 8260C
2-Chloro-1,3-butadiene (Chloroprene)	EPA 8260B
	EPA 8260C
2-Chloroethylvinyl ether	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
3-Chloropropene (Allyl chloride)	EPA 8260B

Volatile Halocarbons	
3-Chloropropene (Allyl chloride)	EPA 8260C
Bromochloromethane	EPA 8260B
	EPA 8260C
Bromodichloromethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Bromoform	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Bromomethane	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Carbon tetrachloride	EPA 601
	EPA 624
	EPA 8021B
	EPA 8260B
	EPA 8260C
Chloroethane	EPA 601
	EPA 624

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Volatile Halocarbons		Volatile Halocarbons	
Chloroethane	EPA 8021B	Dibromochloromethane	EPA 8260B
	EPA 8260B		EPA 8260C
	EPA 8260C	Dibromomethane	EPA 8260B
Chloroform	EPA 601		EPA 8260C
	EPA 624	Dichlorodifluoromethane	EPA 601
	EPA 8021B		EPA 624
	EPA 8260B		EPA 8021B
	EPA 8260C		EPA 8260B
Chloromethane	EPA 601		EPA 8260C
	EPA 624	Hexachlorobutadiene, Volatile	EPA 8260B
	EPA 8021B		EPA 8260C
	EPA 8260B	Methyl iodide	EPA 8260B
	EPA 8260C		EPA 8260C
cis-1,2-Dichloroethene	EPA 624	Methylene chloride	EPA 601
	EPA 8021B		EPA 624
	EPA 8260B		EPA 8021B
	EPA 8260C		EPA 8260B
cis-1,3-Dichloropropene	EPA 601		EPA 8260C
	EPA 624	Tetrachloroethene	EPA 601
	EPA 8021B		EPA 624
	EPA 8260B		EPA 8021B
	EPA 8260C		EPA 8260B
Dibromochloromethane	EPA 601		EPA 8260C
	EPA 624	trans-1,2-Dichloroethene	EPA 601
	EPA 8021B		EPA 624

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Page 16 of 22

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Volatile Halocarbons		Volatiles Organics	
trans-1,2-Dichloroethene	EPA 8021B	1,4-Dioxane	EPA 8260B
	EPA 8260B		EPA 8260C
	EPA 8260C	2-Butanone (Methylethyl ketone)	EPA 8260B
trans-1,3-Dichloropropene	EPA 601		EPA 8260C
	EPA 624	2-Hexanone	EPA 8260B
	EPA 8021B		EPA 8260C
	EPA 8260B	2-Nitropropane	EPA 8260B
	EPA 8260C		EPA 8260C
trans-1,4-Dichloro-2-butene	EPA 8260B	4-Methyl-2-Pentanone	EPA 8260B
	EPA 8260C		EPA 8260C
Trichloroethene	EPA 601	Acetone	EPA 8260B
	EPA 624		EPA 8260C
	EPA 8021B	Acetonitrile	EPA 8260B
	EPA 8260B		EPA 8260C
	EPA 8260C	Carbon Disulfide	EPA 8260B
Trichlorofluoromethane	EPA 601		EPA 8260C
	EPA 624	Cyclohexane	EPA 8260B
	EPA 8021B		EPA 8260C
	EPA 8260B	Di-ethyl ether	EPA 8260B
	EPA 8260C		EPA 8260C
Vinyl chloride	EPA 601	Ethyl Acetate	EPA 8015 B
	EPA 624		EPA 8015C
	EPA 8021B		EPA 8260B
	EPA 8260B		EPA 8260C
	EPA 8260C	Ethylene Glycol	EPA 8015C

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Volatiles Organics		**Wastewater Metals I**	
Isobutyl alcohol	EPA 8015 B	Barium, Total	EPA 6020A
	EPA 8015C	Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 8260B		EPA 200.8 Rev. 5.4
	EPA 8260C		EPA 6010B
Isopropanol	EPA 8260B		EPA 6010C
	EPA 8260C		EPA 6020
Methyl acetate	EPA 8260B		EPA 6020A
	EPA 8260C	Calcium, Total	EPA 200.7 Rev. 4.4
Methyl cyclohexane	EPA 8260B		EPA 6010B
	EPA 8260C		EPA 6010C
	EPA 8270D	Chromium, Total	EPA 200.7 Rev. 4.4
n-Butanol	EPA 8260B		EPA 200.8 Rev. 5.4
	EPA 8260C		EPA 6010B
o-Toluidine	EPA 8260B		EPA 6010C
	EPA 8260C		EPA 6020
	EPA 8270C		EPA 6020A
	EPA 8270D	Copper, Total	EPA 200.7 Rev. 4.4
Vinyl acetate	EPA 8260B		EPA 200.8 Rev. 5.4
	EPA 8260C		EPA 6010B
Wastewater Metals I			EPA 6010C
Barium, Total	EPA 200.7 Rev. 4.4		EPA 6020
	EPA 200.8 Rev. 5.4		EPA 6020A
	EPA 6010B	Iron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C		EPA 6010B
	EPA 6020		EPA 6010C

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Page 18 of 22

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2013
Issued April 02, 2012
Revised June 21, 2012

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category

ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Wastewater Metals I		**Wastewater Metals I**	
Lead, Total	EPA 200.7 Rev. 4.4	Potassium, Total	EPA 6010C
	EPA 200.8 Rev. 5.4	Silver, Total	EPA 200.7 Rev. 4.4
	EPA 6010B		EPA 200.8 Rev. 5.4
	EPA 6010C		EPA 6010B
	EPA 6020		EPA 6010C
	EPA 6020A		EPA 6020
	EPA 7010		EPA 6020A
	SM 18-19, 21 3113B (99 & 04)	Sodium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4		EPA 6010B
	EPA 6010B		EPA 6010C
	EPA 6010C	Strontium, Total	EPA 200.7 Rev. 4.4
Manganese, Total	EPA 200.7 Rev. 4.4		EPA 6010B
	EPA 200.8 Rev. 5.4		EPA 6010C
	EPA 6010B	**Wastewater Metals II**	
	EPA 6010C	Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 6020		EPA 6010B
	EPA 6020A		EPA 6010C
Nickel, Total	EPA 200.7 Rev. 4.4	Antimony, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4		EPA 200.8 Rev. 5.4
	EPA 6010B		EPA 6010B
	EPA 6010C		EPA 6010C
	EPA 6020		EPA 6020
	EPA 6020A		EPA 6020A
Potassium, Total	EPA 200.7 Rev. 4.4	Arsenic, Total	EPA 200.7 Rev. 4.4
	EPA 6010B		EPA 200.8 Rev. 5.4

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Page 19 of 22

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Wastewater Metals II		**Wastewater Metals II**	
Arsenic, Total	EPA 6010B	Selenium, Total	EPA 6020
	EPA 6010C		EPA 6020A
	EPA 6020		EPA 7010
	EPA 6020A		SM 18-19, 21 3113B (99 & 04)
	EPA 7010	Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 7060A		EPA 200.8 Rev. 5.4
	SM 18-19, 21 3113B (99 & 04)		EPA 6010B
Beryllium, Total	EPA 200.7 Rev. 4.4		EPA 6010C
	EPA 200.8 Rev. 5.4		EPA 6020
	EPA 6010B		EPA 6020A
	EPA 6010C	Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 6020		EPA 200.8 Rev. 5.4
	EPA 6020A		EPA 6010B
Chromium VI	EPA 218.6 Rev. 3.3		EPA 6010C
	EPA 7196A		EPA 6020
	EPA 7199		EPA 6020A
	SM 18-19 3500-Cr D	**Wastewater Metals III**	
	SM 20-21 3500-Cr B (01)	Cobalt, Total	EPA 200.7 Rev. 4.4
Mercury, Low Level	EPA 1631E		EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0		EPA 6010B
	EPA 7470A		EPA 6010C
Selenium, Total	EPA 200.7 Rev. 4.4		EPA 6020
	EPA 200.8 Rev. 5.4		EPA 6020A
	EPA 6010B	Gold, Total	EPA 200.7 Rev. 4.4
	EPA 6010C	Molybdenum, Total	EPA 200.7 Rev. 4.4

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Page 20 of 22

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Wastewater Metals III		**Wastewater Miscellaneous**	
Molybdenum, Total	EPA 200.8 Rev. 5.4	Boron, Total	EPA 6010B
	EPA 6010B		EPA 6010C
	EPA 6010C	Bromide	EPA 300.0 Rev. 2.1
	EPA 6020		EPA 9056A
	EPA 6020A	Color	SM 18-21 2120B (01)
Palladium, Total	EPA 200.7 Rev. 4.4	Corrosivity	SM 18-19 2330
Thallium, Total	EPA 200.7 Rev. 4.4	Cyanide, Total	EPA 335.4 Rev. 1.0
	EPA 200.8 Rev. 5.4		EPA 9012A
	EPA 279.2 Rev. 1978		EPA 9012B
	EPA 6010B		SM 18-21 4500-CN E (99)
	EPA 6010C		SM 18-21 4500-CN G (99)
	EPA 6020	Formaldehyde	EPA 8315
	EPA 6020A	Oil & Grease Total Recoverable (HEM)	EPA 1664A
	EPA 7010	Organic Carbon, Total	EPA 9060
	SM 18-19, 21 3113B (99 & 04)		EPA 9060A
Tin, Total	EPA 200.7 Rev. 4.4		SM 18-21 5310C (00)
	EPA 6010B	Perchlorate	EPA 6850
	EPA 6010C	Phenols	EPA 420.4 Rev. 1.0
Titanium, Total	EPA 200.7 Rev. 4.4		EPA 9066
	EPA 6010B	Silica, Dissolved	USGS I-2700-85
	EPA 6010C	Specific Conductance	EPA 120.1 Rev. 1982
Uranium (Mass)	EPA 6020		EPA 9050
	EPA 6020A	Sulfide (as S)	EPA 9034
Wastewater Miscellaneous			SM 18 4500-S E
Boron, Total	EPA 200.7 Rev. 4.4		SM 19-21 4500-S F (00)

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Page 21 of 22

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Wastewater Miscellaneous	
Surfactant (MBAS)	SM 18-21 5540C (00)
Total Petroleum Hydrocarbons	EPA 1664A
Turbidity	EPA 180.1 Rev. 2.0
Sample Preparation Methods	
	EPA 3010A
	EPA 3020A
	EPA 3510C
	EPA 3520C
	EPA 3535A
	EPA 5030B
	EPA 9030B

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Page 22 of 22

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ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
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Acrylates	
Acrolein (Propenal)	EPA 8260B
	EPA 8260C
Acrylonitrile	EPA 8260B
	EPA 8260C
Ethyl methacrylate	EPA 8260B
	EPA 8260C
Methyl acrylonitrile	EPA 8260B
	EPA 8260C
Methyl methacrylate	EPA 8260B
	EPA 8260C
Amines	
1,2-Diphenylhydrazine	EPA 8270C
	EPA 8270D
1,4-Phenylenediamine	EPA 8270C
	EPA 8270D
1-Naphthylamine	EPA 8270C
	EPA 8270D
2-Naphthylamine	EPA 8270C
	EPA 8270D
2-Nitroaniline	EPA 8270C
	EPA 8270D
3-Nitroaniline	EPA 8270C
	EPA 8270D
4-Chloroaniline	EPA 8270C
	EPA 8270D
Amines	
4-Nitroaniline	EPA 8270C
	EPA 8270D
5-Chloro-2-methylaniline	EPA 8270C
	EPA 8270D
5-Nitro-o-toluidine	EPA 8270C
	EPA 8270D
Aniline	EPA 8270C
	EPA 8270D
Carbazole	EPA 8270C
	EPA 8270D
Diphenylamine	EPA 8270C
	EPA 8270D
Methapyrilene	EPA 8270C
	EPA 8270D
Pronamide	EPA 8270C
	EPA 8270D
Benzidines	
3,3'-Dichlorobenzidine	EPA 8270C
	EPA 8270D
3,3'-Dimethylbenzidine	EPA 8270C
	EPA 8270D
Benzidine	EPA 8270C
	EPA 8270D
Characteristic Testing	
Corrosivity	EPA 9045C

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Characteristic Testing	
Corrosivity	EPA 9045D
Free Liquids	EPA 9095A
	EPA 9095B
Ignitability	EPA 1010
	EPA 1010A
Reactivity	SW-846 Ch7 Sec. 7.3
Chlorinated Hydrocarbon Pesticides	
4,4'-DDD	EPA 8081A
	EPA 8081B
4,4'-DDE	EPA 8081A
	EPA 8081B
4,4'-DDT	EPA 8081A
	EPA 8081B
Aldrin	EPA 8081A
	EPA 8081B
alpha-BHC	EPA 8081A
	EPA 8081B
alpha-Chlordane	EPA 8081A
	EPA 8081B
Atrazine	EPA 8270C
	EPA 8270D
beta-BHC	EPA 8081A
	EPA 8081B
Chlordane Total	EPA 8081A
	EPA 8081B

Chlorinated Hydrocarbon Pesticides	
Chlorobenzilate	EPA 8270C
	EPA 8270D
delta-BHC	EPA 8081A
	EPA 8081B
Diallate	EPA 8270C
	EPA 8270D
Dieldrin	EPA 8081A
	EPA 8081B
Endosulfan I	EPA 8081A
	EPA 8081B
Endosulfan II	EPA 8081A
	EPA 8081B
Endosulfan sulfate	EPA 8081A
	EPA 8081B
Endrin	EPA 8081A
	EPA 8081B
Endrin aldehyde	EPA 8081A
	EPA 8081B
Endrin Ketone	EPA 8081A
	EPA 8081B
gamma-Chlordane	EPA 8081A
	EPA 8081B
Heptachlor	EPA 8081A
	EPA 8081B
Heptachlor epoxide	EPA 8081A

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Chlorinated Hydrocarbon Pesticides	
Heptachlor epoxide	EPA 8081B
Isodrin	EPA 8270D
Kepone	EPA 8081A
	EPA 8081B
Lindane	EPA 8081A
	EPA 8081B
Methoxychlor	EPA 8081A
	EPA 8081B
Pentachloronitrobenzene	EPA 8270C
	EPA 8270D
Toxaphene	EPA 8081A
	EPA 8081B
Chlorinated Hydrocarbons	
1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270C
	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270C
	EPA 8270D
1-Chloronaphthalene	EPA 8270C
	EPA 8270D
2-Chloronaphthalene	EPA 8270C
	EPA 8270D
Hexachlorobenzene	EPA 8270C
	EPA 8270D
Hexachlorobutadiene	EPA 8270C

Chlorinated Hydrocarbons	
Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270C
	EPA 8270D
Hexachloroethane	EPA 8270C
	EPA 8270D
Hexachlorophene	EPA 8270C
	EPA 8270D
Hexachloropropene	EPA 8270C
	EPA 8270D
Pentachlorobenzene	EPA 8270C
	EPA 8270D
Chlorophenoxy Acid Pesticides	
2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	EPA 8151A
Dinoseb	EPA 8270C
	EPA 8270D
Pentachlorophenol	EPA 8151A
Haloethers	
4-Bromophenylphenyl ether	EPA 8270C
	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270C
	EPA 8270D
Bis (2-chloroisopropyl) ether	EPA 8270C

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Page 3 of 16

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Haloethers	
Bis (2-chloroisopropyl) ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270C
	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270C
	EPA 8270D
Low Level Polynuclear Aromatic Hydrocarbons	
Acenaphthene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Acenaphthylene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Anthracene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Benzo(a)anthracene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Benzo(a)pyrene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Benzo(b)fluoranthene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Benzo(g,h,i)perylene	EPA 8270C

Low Level Polynuclear Aromatic Hydrocarbons	
Benzo(g,h,i)perylene	EPA 8270D
	EPA 8270D SIM
Benzo(k)fluoranthene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Chrysene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Dibenzo(a,h)anthracene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Fluoranthene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Fluorene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Indeno(1,2,3-cd)pyrene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Naphthalene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Phenanthrene	EPA 8270C
	EPA 8270D

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Page 4 of 16

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Low Level Polynuclear Aromatic Hydrocarbons	
Phenanthrene	EPA 8270D SIM
Pyrene	EPA 8270C
	EPA 8270D
	EPA 8270D SIM
Metals I	
Barium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Cadmium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Calcium, Total	EPA 6010B
	EPA 6010C
Chromium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Copper, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Iron, Total	EPA 6010B
	EPA 6010C
Metals I	
Lead, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
	EPA 7010
Magnesium, Total	EPA 6010B
	EPA 6010C
Manganese, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Nickel, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Potassium, Total	EPA 6010B
	EPA 6010C
Silver, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Sodium, Total	EPA 6010B
	EPA 6010C
Strontium, Total	EPA 6010B
	EPA 6010C

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Page 5 of 16

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Metals II	
Aluminum, Total	EPA 6010B
	EPA 6010C
Antimony, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Arsenic, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
	EPA 7010
	EPA 7060A
Beryllium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Chromium VI	EPA 7196A
	EPA 7199
Lithium, Total	EPA 6010B
	EPA 6010C
Mercury, Total	EPA 7471A
	EPA 7471B
Selenium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
Metals II	
Selenium, Total	EPA 6020A
	EPA 7010
Vanadium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Zinc, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Metals III	
Cobalt, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Molybdenum, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A
Silica, Dissolved	EPA 6010B
	EPA 6010C
Thallium, Total	EPA 6010B
	EPA 6010C
	EPA 6020
	EPA 6020A

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Page 6 of 16

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2013
Issued April 02, 2012
Revised June 21, 2012

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category

ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Metals III	
Thallium, Total	EPA 7010
Tin, Total	EPA 6010B
	EPA 6010C
Titanium, Total	EPA 6010C
Minerals	
Bromide	EPA 9056A
Chloride	EPA 9056A
Fluoride, Total	EPA 9056A
Sulfate (as SO4)	EPA 9056A
Miscellaneous	
Boron, Total	EPA 6010B
	EPA 6010C
Cyanide, Total	EPA 9012A
	EPA 9012B
Formaldehyde	EPA 8315
Organic Carbon, Total	Lloyd Kahn Method
Perchlorate	EPA 6850
Phenols	EPA 9066
Sulfide (as S)	EPA 9034
Nitroaromatics and Isophorone	
1,3,5-Trinitrobenzene	EPA 8270C
	EPA 8270D
	EPA 8330
	EPA 8330B
Nitroaromatics and Isophorone	
1,3-Dinitrobenzene	EPA 8270C
	EPA 8270D
	EPA 8330
	EPA 8330B
1,4-Naphthoquinone	EPA 8270C
	EPA 8270D
2,4,6-Trinitrotoluene	EPA 8330
	EPA 8330B
2,4-Dinitrotoluene	EPA 8270C
	EPA 8270D
	EPA 8330
	EPA 8330B
2,6-Dinitrotoluene	EPA 8270C
	EPA 8270D
	EPA 8330
	EPA 8330B
2-Amino-4,6-dinitrotoluene	EPA 8330
	EPA 8330B
2-Nitrotoluene	EPA 8330
	EPA 8330B
3,5-Dinitroaniline	EPA 8330B
3-Nitrotoluene	EPA 8330
	EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 8330
	EPA 8330B

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Page 7 of 16

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Nitroaromatics and Isophorone	
4-Dimethylaminoazobenzene	EPA 8270C
	EPA 8270D
4-Nitrotoluene	EPA 8330
	EPA 8330B
Hexahydro-1,3,5-trinitro-1,3,5-triazine	EPA 8330
	EPA 8330B
Isophorone	EPA 8270C
	EPA 8270D
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330
	EPA 8330B
Nitrobenzene	EPA 8270C
	EPA 8270D
	EPA 8330
	EPA 8330B
Nitroglycerine	EPA 8330B
Nitroquinoline-1-oxide	EPA 8270C
	EPA 8270D
Octahydro-tetranitro-tetrazocine	EPA 8330
	EPA 8330B
Pentaerythritol tetranitrate	EPA 8330B
Pyridine	EPA 8270C
	EPA 8270D
Nitrosoamines	
N-Nitrosodiethylamine	EPA 8270C
	EPA 8270D
Nitrosoamines	
N-Nitrosodimethylamine	EPA 8270C
	EPA 8270D
N-Nitrosodi-n-butylamine	EPA 8270C
	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270C
	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270C
	EPA 8270D
N-nitrosomethylethylamine	EPA 8270C
	EPA 8270D
N-nitrosomorpholine	EPA 8270C
	EPA 8270D
N-nitrosopiperidine	EPA 8270C
	EPA 8270D
N-Nitrosopyrrolidine	EPA 8270C
	EPA 8270D
Nutrients	
Nitrate (as N)	EPA 9056A
Nitrite (as N)	EPA 9056A
Organophosphate Pesticides	
Dimethoate	EPA 8270C
	EPA 8270D
Disulfoton	EPA 8270C
	EPA 8270D
Parathion ethyl	EPA 8270C

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Page 8 of 16

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Organophosphate Pesticides	
Parathion ethyl	EPA 8270D
Parathion methyl	EPA 8270C
	EPA 8270D
Phorate	EPA 8270C
	EPA 8270D
Sulfotepp	EPA 8270C
	EPA 8270D
Thionazin	EPA 8270C
	EPA 8270D
Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015 B
	EPA 8015C
Gasoline Range Organics	EPA 8015 B
	EPA 8015C
Phthalate Esters	
Benzyl butyl phthalate	EPA 8270C
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 8270C
	EPA 8270D
Diethyl phthalate	EPA 8270C
	EPA 8270D
Dimethyl phthalate	EPA 8270C
	EPA 8270D
Di-n-butyl phthalate	EPA 8270C
	EPA 8270D
Phthalate Esters	
Di-n-octyl phthalate	EPA 8270C
	EPA 8270D
Polychlorinated Biphenyls	
PCB-1016	EPA 8082
	EPA 8082A
PCB-1221	EPA 8082
	EPA 8082A
PCB-1232	EPA 8082
	EPA 8082A
PCB-1242	EPA 8082
	EPA 8082A
PCB-1248	EPA 8082
	EPA 8082A
PCB-1254	EPA 8082
	EPA 8082A
PCB-1260	EPA 8082
	EPA 8082A
PCB-1262	EPA 8082
	EPA 8082A
PCB-1268	EPA 8082
	EPA 8082A
Polynuclear Aromatic Hydrocarbons	
2-Acetylaminofluorene	EPA 8270D
3-Methylcholanthrene	EPA 8270C
	EPA 8270D

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Page 9 of 16

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Polynuclear Aromatic Hydrocarbons	
7,12-Dimethylbenzyl (a) anthracene	EPA 8270C
	EPA 8270D
Acenaphthene	EPA 8270C
	EPA 8270D
Acenaphthylene	EPA 8270C
	EPA 8270D
Anthracene	EPA 8270C
	EPA 8270D
Benzo(a)anthracene	EPA 8270C
	EPA 8270D
Benzo(a)pyrene	EPA 8270C
	EPA 8270D
Benzo(b)fluoranthene	EPA 8270C
	EPA 8270D
Benzo(ghi)perylene	EPA 8270C
	EPA 8270D
Benzo(k)fluoranthene	EPA 8270C
	EPA 8270D
Chrysene	EPA 8270C
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 8270C
	EPA 8270D
Fluoranthene	EPA 8270C
	EPA 8270D
Fluorene	EPA 8270C

Polynuclear Aromatic Hydrocarbons	
Fluorene	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270C
	EPA 8270D
Naphthalene	EPA 8270C
	EPA 8270D
Phenanthrene	EPA 8270C
	EPA 8270D
Pyrene	EPA 8270C
	EPA 8270D
Priority Pollutant Phenols	
2,3,4,6 Tetrachlorophenol	EPA 8270C
	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270C
	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270C
	EPA 8270D
2,4-Dichlorophenol	EPA 8270C
	EPA 8270D
2,4-Dimethylphenol	EPA 8270C
	EPA 8270D
2,4-Dinitrophenol	EPA 8270C
	EPA 8270D
2,6-Dichlorophenol	EPA 8270C
	EPA 8270D
2-Chlorophenol	EPA 8270C

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Page 10 of 16

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Priority Pollutant Phenols	
2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270C
	EPA 8270D
2-Methylphenol	EPA 8270C
	EPA 8270D
2-Nitrophenol	EPA 8270C
	EPA 8270D
3-Methylphenol	EPA 8270C
	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270C
	EPA 8270D
4-Methylphenol	EPA 8270C
	EPA 8270D
4-Nitrophenol	EPA 8270C
	EPA 8270D
Pentachlorophenol	EPA 8270C
	EPA 8270D
Phenol	EPA 8270C
	EPA 8270D
Semi-Volatile Organics	
1,1'-Biphenyl	EPA 8270C
	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270C
	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270C

Semi-Volatile Organics	
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270C
	EPA 8270D
2-Methylnaphthalene	EPA 8270C
	EPA 8270D
2-Picoline	EPA 8270D
4-Amino biphenyl	EPA 8270C
	EPA 8270D
Acetophenone	EPA 8270C
	EPA 8270D
Aramite	EPA 8270C
	EPA 8270D
Benzaldehyde	EPA 8270C
	EPA 8270D
Benzoic Acid	EPA 8270C
	EPA 8270D
Benzyl alcohol	EPA 8270C
	EPA 8270D
Caprolactam	EPA 8270C
	EPA 8270D
Dibenzofuran	EPA 8270C
	EPA 8270D
Ethyl methanesulfonate	EPA 8270C
	EPA 8270D
Isosafrole	EPA 8270C

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Page 11 of 18

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Semi-Volatile Organics	
Isosafrole	EPA 8270D
Methyl methanesulfonate	EPA 8270C
	EPA 8270D
O,O,O-Triethyl phosphorothioate	EPA 8270C
	EPA 8270D
Phenacetin	EPA 8270C
	EPA 8270D
Safrole	EPA 8270C
	EPA 8270D

Volatile Aromatics	
1,2,4-Trichlorobenzene, Volatile	EPA 8260B
	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
1,2-Dichlorobenzene	EPA 8260B
	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
1,3-Dichlorobenzene	EPA 8260B
	EPA 8260C
1,4-Dichlorobenzene	EPA 8260B
	EPA 8260C
2-Chlorotoluene	EPA 8260B

Volatile Aromatics	
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260B
	EPA 8260C
Benzene	EPA 8021B
	EPA 8260B
	EPA 8260C
Bromobenzene	EPA 8260B
	EPA 8260C
Chlorobenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
Ethyl benzene	EPA 8021B
	EPA 8260B
	EPA 8260C
Isopropylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
Naphthalene, Volatile	EPA 8260B
	EPA 8260C
n-Butylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
n-Propylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C

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Page 12 of 16

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Volatile Aromatics	
p-Isopropyltoluene (P-Cymene)	EPA 8021B
	EPA 8260B
	EPA 8260C
sec-Butylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
Styrene	EPA 8260B
	EPA 8260C
tert-Butylbenzene	EPA 8021B
	EPA 8260B
	EPA 8260C
Toluene	EPA 8021B
	EPA 8260B
	EPA 8260C
Total Xylenes	EPA 8021B
	EPA 8260B
	EPA 8260C
Volatile Chlorinated Organics	
Benzyl chloride	EPA 8260C
Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 8260B
	EPA 8260C
1,1,1-Trichloroethane	EPA 8260B
	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260B

Volatile Halocarbons	
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260B
	EPA 8260C
1,1,2-Trichloroethane	EPA 8260B
	EPA 8260C
1,1-Dichloroethane	EPA 8260B
	EPA 8260C
1,1-Dichloroethene	EPA 8260B
	EPA 8260C
1,1-Dichloropropene	EPA 8260B
	EPA 8260C
1,2,3-Trichloropropane	EPA 8260B
	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260B
	EPA 8260C
1,2-Dibromoethane	EPA 8260B
	EPA 8260C
1,2-Dichloroethane	EPA 8260B
	EPA 8260C
1,2-Dichloropropane	EPA 8260B
	EPA 8260C
1,3-Dichloropropane	EPA 8260B
	EPA 8260C
2,2-Dichloropropane	EPA 8260B
	EPA 8260C

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Page 13 of 16

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Volatile Halocarbons	
2-Chloro-1,3-butadiene (Chloroprene)	EPA 8260B
	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260B
	EPA 8260C
3-Chloropropene (Allyl chloride)	EPA 8260B
	EPA 8260C
Bromochloromethane	EPA 8260B
	EPA 8260C
Bromodichloromethane	EPA 8260B
	EPA 8260C
Bromoform	EPA 8260B
	EPA 8260C
Bromomethane	EPA 8260B
	EPA 8260C
Carbon tetrachloride	EPA 8260B
	EPA 8260C
Chloroethane	EPA 8260B
	EPA 8260C
Chloroform	EPA 8260B
	EPA 8260C
Chloromethane	EPA 8260B
	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260B
	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260B

Volatile Halocarbons	
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260B
	EPA 8260C
Dibromomethane	EPA 8260B
	EPA 8260C
Dichlorodifluoromethane	EPA 8260B
	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260B
	EPA 8260C
Methyl iodide	EPA 8260C
Methylene chloride	EPA 8260B
	EPA 8260C
Tetrachloroethene	EPA 8260B
	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260B
	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260B
	EPA 8260C
trans-1,4-Dichloro-2-butene	EPA 8260B
	EPA 8260C
Trichloroethene	EPA 8260B
	EPA 8260C
Trichlorofluoromethane	EPA 8260B
	EPA 8260C
Vinyl chloride	EPA 8260B

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Page 14 of 16

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Volatile Halocarbons	
Vinyl chloride	EPA 8260C
Volatile Organics	
1,4-Dioxane	EPA 8260B
	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260B
	EPA 8260C
2-Hexanone	EPA 8260B
	EPA 8260C
2-Nitropropane	EPA 8260B
	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260B
	EPA 8260C
Acetone	EPA 8260B
	EPA 8260C
Acetonitrile	EPA 8260B
	EPA 8260C
Carbon Disulfide	EPA 8260B
	EPA 8260C
Cyclohexane	EPA 8260B
	EPA 8260C
Di-ethyl ether	EPA 8260B
	EPA 8260C
Ethyl Acetate	EPA 8260B
	EPA 8260C
Ethylene Glycol	EPA 8015 B

Volatile Organics	
Ethylene Glycol	EPA 8015C
Isobutyl alcohol	EPA 8260B
	EPA 8260C
Isopropanol	EPA 8260B
	EPA 8260C
Methyl acetate	EPA 8260B
	EPA 8260C
Methyl cyclohexane	EPA 8260B
	EPA 8260C
Methyl tert-butyl ether	EPA 8021B
	EPA 8260B
	EPA 8260C
n-Butanol	EPA 8260B
	EPA 8260C
o-Toluidine	EPA 8260B
	EPA 8260C
	EPA 8270C
	EPA 8270D
Propionitrile	EPA 8260B
	EPA 8260C
tert-butyl alcohol	EPA 8260B
	EPA 8260C
Vinyl acetate	EPA 8260B
	EPA 8260C

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2013
Issued April 02, 2012
Revised June 21, 2012

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL PERRY
COLUMBIA ANALYTICAL SERVICES
1565 JEFFERSON ROAD BUILDING 300, SUITE 360
ROCHESTER, NY 14623

NY Lab Id No: 10145

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category

ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Sample Preparation Methods

EPA 1311
EPA 1312
EPA 3050B
EPA 3060A
EPA 3541
EPA 3550C
EPA 3580A
EPA 5030B
EPA 5035A-H
EPA 5035A-L
EPA 9030B

Serial No.: 47161

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ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Miscellaneous	
Lead in Dust Wipes	EPA 6010B
	EPA 6010C
Sample Preparation Methods	
	EPA 3050B

Serial No.: 47162

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Page 1 of 1

APPENDIX C

ALS ENVIRONMENTAL ANALYTICAL STANDARD OPERATING PROCEDURES (SOPS)

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ALS Environmental

DOCUMENT TITLE:	*VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)*
REFERENCED METHOD:	*TO-15*
SOP ID:	*VOC-TO-15*
REV. NUMBER:	*3*
EFFECTIVE DATE:	*10/2/2012*

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VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY

GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

SOPID:	VOC-TO-15	Rev. Number:	3	Effective Date:	10/2/2012

Approved By: Tom Walton Date: 9-18-2012
Department Supervisor – Tom Walton

Approved By: Lisa Reyes Date: 9/18/12
QA Manager – Lisa Reyes

Approved By: Michael Perry Date: 9/18/12
Technical Director – Michael Perry

Archival Date:		Doc Control ID#:	12-VOC-01 OK 9/19/12	Editor:	

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1. SCOPE AND APPLICATION

1.1. This SOP uses EPA Compendium Methods TO-15 and TO-14A to quantify a wide range of volatile organic compounds (VOCs) in gaseous matrices collected in gas collection bags (method modification) and specially prepared stainless steel canisters. This method typically applies to ambient concentrations of VOCs 0.5ppbv and above and typically requires VOC enrichment by concentrating up to one liter of a sample volume, with a virtually unlimited upper concentration range using dilutions from source level samples.

1.2. Table 2 lists compounds that can be determined by this procedure along with their method reporting limits (MRLs). The reported MRL may be adjusted higher; however, the capability of achieving lower MRLs for specific project requirements must be thoroughly demonstrated and documented. Additional compounds may be analyzed according to this procedure as described in the referenced methods as long as the requirements of this document are adhered to; however, if a compound is not listed in the TO-15 method, it should be reported as a modification. The number of samples that may be analyzed in a 24-hour period is about twenty. The number of sample results that may be reduced in an eight-hour day is approximately twenty.

1.3. This SOP references other SOPs for Canister Cleaning and Certification, Canister Pressurization, and Flow Controllers.

2. METHOD SUMMARY

2.1. The analytical method involves using a high-resolution gas chromatograph (GC) coupled to a mass spectrometer (MS). The GC/MS utilizes a linear quadrupole system, which allows for it to be operated by continuously scanning a wide range of mass to charge ratios (SCAN mode) or by Select Ion Monitoring mode (SIM), which consists of monitoring a small number of ions from a specified compound list. At this time, the laboratory only operates in SCAN mode.

2.2. An aliquot of an air sample is concentrated on a solid adsorbent trap (either cryogenically cooled glass beads or stronger adsorbents at higher temperatures) to collect the analytes of interest. To remove co-collected water vapor, the concentrated sample then goes through a water removal (dry purge) step, during which the sample is transferred to a second cryogenically cooled trap to remove carbon dioxide. The trap is heated and the VOCs are thermally desorbed onto a refocusing cold trap. The VOCs are then thermally desorbed onto the head of a capillary column once the cold trap is heated. The oven temperature (programmed) increases and the VOCs elute and are detected by the mass spectrometer. Mass spectra for individual peaks in the total ion chromatogram are examined with respect to the fragmentation pattern of ions corresponding to various VOCs including the intensity of primary and secondary ions. The fragmentation pattern is compared with stored spectra taken under

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similar conditions, in order to identify the compound. For any given compound, the intensity of the primary fragment is compared with the system response to the primary fragment for known amounts of the compound and this establishes the compound concentration that exists in the sample.

3. DEFINITIONS

3.1. Cryogen - A refrigerant used to obtain sub-ambient temperatures in the VOC concentrator and/or on front of the analytical column. Liquid nitrogen (cryogen) is used for this purpose and it has a boiling point of –195.8°C.

3.2. Gauge Pressure - Pressure measure with reference to the surrounding atmospheric pressure, usually expressed in units of psi. Zero gauge pressure is equal to atmospheric (barometric) pressure.

3.3. Canisters - specially prepared, leak-free, stainless steel pressure vessel (with valve) of desired volume (e.g., 6L)

3.4. Sample collection bags – Tedlar™ or equivalent

3.5. MS-SCAN - Mass spectrometric mode of operation in which the gas chromatograph (GC) is coupled to a mass spectrometer (MS) programmed to SCAN all ions repeatedly over a specified mass range.

3.6. Neat Stock Standard - A purchased, single component assayed reference material having a stated purity used to prepare working calibration standards.

3.7. Initial Calibration Verification (ICV) Standard - A solution prepared in the laboratory containing known concentration(s) of analytes of interest. The solution is prepared from neat stock standards and/or stock standards solutions which are from a different source then the standards used to prepare the working calibration standards to verify the calibration curve.

3.8. Continuing Calibration Verification (CCV) Standard - A working calibration standard which is analyzed at specific intervals in order to verify that the instrument continues to meet the calibration criteria.

3.9. Field Sample - A sample collected and delivered to the laboratory for analysis.

3.10. QA/QC Samples: Samples added to a sample preparation batch, or an analytical batch to provide quality assurance checks on the analysis.

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3.10.1. Laboratory Control Sample (LCS) – also called Audit Standard in TO-15 - a blank sample spiked with compounds representative of the target analytes. This is used to document laboratory performance.

3.10.2. Laboratory Duplicates (DUP)- Two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analyses of duplicate sample indicates precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

3.10.3. Method Blank (MB) - an analyte-free matrix (Zero-grade air) carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

3.11. Internal Standard Calibration - Compares the instrument responses from the target compound in the sample to the responses of specific standards (called internal standards – not expected to be found in the samples), which are added to the sample or sample preparation prior to analysis. The ratio of the peak area (or height) of the target compound in the sample or sample preparation is compared to a similar ratio derived for each calibration standard.

3.12. Surrogate - an organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process. Surrogate compounds are added to every blank, sample, LCS, and standard. These are used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in environmental media.

3.13. Dynamic Dilution – means of preparing calibration mixtures in which standard gases from pressurized cylinders are continuously blended with humidified zero air in a manifold so that a flowing stream of calibration mixture is available at the inlet of the analytical system.

3.14. Percent Drift or Difference (%D) - Used to compare two values, the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference).

3.15. % Relative Standard Deviation (%RSD): statistical measure of variation. Used in this method to measure the relative variation of initial calibration standards. Calculated by dividing the standard deviation of the individual calibration factors by the average calibration factor and multiplying by 100 to express as a percentage

3.16. Relative Percent Difference (RPD) – The absolute value of the difference of two values divided by the average of the same two values. Used to compare the precision of the analysis. The result is always a positive number.

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3.17. Batch - A group of samples, not to exceed 20 investigative samples. See ADM-BATCH for further discussion.

3.18. Method Detection Limit (MDL): a statistically derived value representing the lowest level of target analyte that may be measured by the instrument with 99% confidence that the value is greater than zero.

3.19. Limit of Quantitation (LOQ) / Reporting Limit – The minimum levels, concentrations, or quantities of a target that can be reported with a reliable degree of confidence.

4. INTERFERENCES

4.1. Summa Canisters - Canisters shall be stored in a contaminant free location and shall be capped tightly during shipment to prevent leakage and minimize any compromise of the sample. The pressure/vacuum is checked prior to shipment and upon receipt from the field. Any problems with the sample from the field are noted on the chain of custody and the Project Manager contacted. Canisters must be cleaned and certified to be free from target analytes before being shipped to the field for sample collection.

4.2. Analytical System - The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running humidified zero air blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with buna-N rubber components must be avoided.

4.3. Carbon Dioxide - Excessive levels of carbon dioxide present in a sample may interfere with analysis by freezing up the cryogenic trap. A smaller aliquot must be analyzed to eliminate this problem, or the sample should be analyzed using the higher temperature multi-adsorbent trapping technique which allows carbon dioxide to pass.

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4.4. Gas Collection Bags - This procedure covers the use of gas collection vessels such as Tedlar® or Mylar® bags. However, due to the nature of these types of bags it is not recommended that clients use this option for ambient air samples. Sample collection bags made out of ®Tedlar have contaminants that are inherent to the manufacturing process. The two main contaminants are phenol and N,N-Dimethylacetamide. However, this only becomes a problem when the concentration levels in the sample are low ppbv such as ambient air monitoring samples where more of the sample usually has to be concentrated and analyzed. To minimize the loss of sample integrity, a 72-hour hold time has been incorporated into the procedure.

4.5. Glassware - Interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware results in discrete artifacts and/or elevated baselines in the detector profiles should be minimized. All glassware associated with this method must be scrupulously cleaned to avoid possible contamination. The use of high purity water, reagents, and solvents helps to minimize these problems.

4.6. Contamination by carryover can occur when high level samples immediately precede samples containing significantly lower levels of contamination. Pay close attention to samples which follow high level samples. Re-analyze if contamination is suspected.

5. SAFETY

5.1. Chemicals, reagents and standards must be handled as described in the company safety policies, approved methods and in MSDSs where available. Refer to the Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.2. Each compound, mixture of compounds, standards, and surrogates, as well as samples, should be treated as a potential health hazard. Exposure to these chemicals should be reduced to the lowest level possible through the use of gloves (to minimize absorption through the skin) and hoods (to minimize inhalation). Refer to the laboratory's Environmental, Health and Safety Manual as it makes reference to the safe handling of chemicals, MSDS location, and the laboratory waste management plan for the safe disposal of chemicals and samples.

5.3. Material Safety Data Sheets (MSDS) - The analyst should consult MSDS for compounds being handled in the course of this procedure, and be familiar with proper safety precautions to be followed when handling hazardous chemicals. Care should be taken when handling standard material in a neat or highly concentrated form.

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5.4. Liquid Nitrogen - Liquid nitrogen can cause serious tissue damage (frostbite) with only a few seconds of contact. The valves on the cryogen dewars should be opened slowly so leaky fittings can be identified. Neoprene or leather gloves should be worn when turning valves and handling tubing and fittings that have been in contact with the cryogen.

5.5. Protective Clothing - Personal protective clothing (safety glasses, gloves and lab coat) are required when preparing standards and handling standard material in neat form.

5.6. Pressurized Gases - The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp when not in use. Sources of flammable gases (i.e. pressurized hydrogen) should be clearly labeled.

5.7. Syringes - The proper use of syringes should be part of employee training for this SOP. Care should be taken to avoid personal injury as a result or improper handling techniques.

5.8. Burns - Caution must be exercised when working around the canister cleaning system because of the potential for burns.

5.9. Pump Oil - contact with used oil from the vacuum pumps should be avoided since it becomes contaminated during normal use with toxic organic residues from the summa canisters. Latex gloves must be worn when working with used pump oil that must be disposed of as hazardous waste in accordance with the appropriate regulations.

5.10. Refer to the Safety Manual for further discussion of general safety procedures and information.

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6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Project Managers obtain sampling information from clients and communicate that information to the air lab via LIMS. Much time and effort is invested to clean and prepare canisters for sampling. Advance notice may be needed to have canisters ready for shipping and sampling. Canisters are cleaned and certified according to Sections 11 and 12.

6.2. Air samples are collected in the field and delivered to the laboratory and shall be collected in either a specially prepared, leak-free, stainless steel pressure vessel (with valve) of desired volume (e.g., 6L) or a sample collection bag. Canister samples may either be grab or time integrated using a variable flow controller utilizing the canister vacuum to draw the sample. Sampling should be performed by experienced personnel. Sampling instructions for canisters are sent to the sampler with the canisters (see Attachment B). Flow controllers are calibrated according to Attachment D. Bags require the use of an upstream pump or a "lung machine."

6.3. There are no special preservation requirements for either canisters or bags. However, bags should be stored in appropriately labeled boxes or by hanging them from clips to prevent puncture or other deterioration. Canisters are pressurized by the lab when they are received from the field (see Section 11). Canisters should be stored on the appropriate shelves until they are to be analyzed.

6.4. Sample collection bags must be analyzed within 72 hours from confirmed time of sampling. Canisters do not have specific holding times; however, samples received by the laboratory shall be analyzed within 30 days of sampling or sooner if project specific requirements dictate.

6.5. Optional: Sample volume from a tedlar bag may be injected into a certified clean canister to maintain sample integrity and extend holding time to 30 days from the original sample collection, if necessary. Canisters may also be used in making sample dilutions.

6.6. Cans and flow controllers are tracked in the LIMS by barcodes for current status (shipped, to be cleaned, to be analyzed, etc).

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7. APPARATUS AND EQUIPMENT

7.1. Instrument configurations:

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Year Acquired
GC/MS #9 (R-MS-09)	Gas Chromatograph	HP 6890	US00029263	2004
	Mass Spec Detector	HP 5973	US91922619	
	AutoSampler	Enteck 7016CA	00156	
	PreConcentrator	Enteck 7100	0088	
	Computer Workstation	HP Kayak XA	92181198	
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00 Enteck Smart Lab 2000 v3.32		
GC/MS #13 (R-MS-13)	Gas Chromatograph	Agilent 7890A	CN10945114	2010
	Mass Spec Detector	Agilent 5975C	US94333887	
	Autosampler	Entech 7016CA	1262	
	PreConcentrator	Entech 7100A	1533	
	Computer Workstation	IBM 8212KUE	LKTAK9B	
	Analytical Software	Enviroquant Chemstation Core Software Software Upgrade Entech Smartlab v4.17b	USK0104163 91701EA	

7.2. Gas Chromatograph (GC) - capable of temperature programming, with a column oven that may be cooled to subambient temperature at the start of the gas chromatographic run to result in the resolution of the VOCs.

7.3. Ionization Gauge Controller - Hewlett Packard 59864B Ionization Gauge Controller or equivalent.

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7.4. Analytical Column - The following column is currently in use. Alternative columns may be used as long as sufficient peak resolution and separation is achieved.

Column:

J&W DB-624Fused Silica Capillary Column
60m x 0.25mm ID
1.4 micron film thickness

7.5. Data Systems - IBM-compatible PC with Windows 95/98/NT/XP and Hewlett Packard Chemstation software including EnviroQuant with Extracted Ion Current Profile (EICP), NBS75K library or equivalent.

7.6. Canister Pressurization Station – Digital Vacuum/Pressure Gauge [0 to –30 inHg; 0-100 psig]

7.7. Canister Sampling Devices - Critical Orifices and Flow Controllers –either laboratory manufactured or purchased.

7.8. Digital Vacuum Gauge – Master: Ashcroft D1005PS series or equivalent - ¯30in Hg to 100psi calibrated annually. Others checked against the master.

7.9. Barometer – VWR Digital Barometer, NIST Traceable, altitude adjusted to agree with digital master gauge.

7.10. Gas Collection Devices –

- 6.0L Canisters: Summa Passivated Canisters, Restek Corporation Silco Canisters, Entech Silonite coated, or equivalent.
- Tedlar bags – 0.5L, 1L, 3L, 5L, 10L, 25L, and 40L (other sizes are available; however, the volumes that are listed encompass the majority of the bags supplied and the samples submitted to the laboratory.

7.11. Dynamic Dilution System - Custom assembled dilution system consisting of:

- MKS Instruments, 1359C series Mass Flow Controllers of various ranges
- MKS Instruments, 247C Digital Display
- Digital Vacuum/Pressure Gauge [0 to –30 inHg; 0-100 psig]
- Stainless Steel Humidification Vessel
- Miscellaneous regulators and valves

8. PREVENTIVE MAINTENANCE

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A maintenance log will be kept documenting maintenance performed on each analytical system. The serial numbers of each instrument shall be recorded, and each log entry must include a description of the maintenance performed and be initialed by the analyst performing or observing/authorizing maintenance by an outside contractor.

The instrument maintenance log must be kept current. An entry shall be made in the appropriate log every time maintenance is performed (no matter the extent). The entry in the log must include:

- the date of maintenance
- who did the maintenance
- description of the maintenance
- proof that the maintenance activity was successful.

A notation of a successful tune and continuing calibration or initial calibration and the file number that accompanies the data will serve as proof that the maintenance is complete and the instrument is in working order.

The extent of the maintenance is not important, however, it is important that a notation be included for each maintenance activity such as changing a column, tuning the instrument, changing the pump oil, cleaning the source, ordering a part. In addition, a notation should be made in the logbook stating that no samples were analyzed during the days that the instrument was down and no active maintenance was being conducted (i.e., where no other notation was made in the logbook for those days).

8.1. Concentrating Trap - Routine maintenance includes periodic solvent cleaning of the Silcosteel lines in the valve oven if contamination is suspected. Periodic replacement of the multi-sorbent or partial replacement of the trap is required if analyte specific deterioration is detected. After replacement the trap it should be baked for a minimum of 20 minutes (or until a clean blank is generated).

8.2. GC System

8.2.1. Column performance is monitored by observing both peak shapes and column bleed. Over time, the column will exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column.

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8.2.2. Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column-cutting tool. When removing any major portion of the column, which will affect the retention times and elution characteristics, a change in instrument conditions may be required to facilitate nominal analytical activity.

8.2.3. Performance can also be due to ineffective column ferrules, which should be replaced when a tight seal around the column is no longer possible. This can be detected with the use of a leak detector.

8.3. Mass Spectrometer - The Mass Selective Detector (MSD) ion source requires periodic cleaning to maintain proper performance. Symptoms of a dirty ion source include difficulty keeping the MSD in tune and fluctuating internal standard areas. The vacuum system should be serviced at a minimum of every twelve months, including changing the pump oil.

8.4. Instrument Tuning - The instrument is tuned with guidance from the procedure described in the HP Operations Manual, when necessary. The tune shall meet the tune criteria described in this document.

8.5. Syringes - All syringes are monitored by the analyst for wear. Parts are replaced as needed to insure all syringes remain gas tight.

8.6. Summa Canisters – cans are cleaned and certified. Canisters and flow controllers are tracked for status in the LIMS.

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9. STANDARDS, REAGENTS, EQUIPMENT, AND CONSUMABLE MATERIALS

9.1. Reagents and Equipment

9.1.1. UHP Grade Helium (99.999%)(GC carrier gas and preconcentrator purge/sweep gas)
9.1.2. Cryogen - Liquid nitrogen in 50 psi dewars (used to cool preconcentrator traps)
9.1.3. UHP/Zero Grade Air
9.1.4. UHP/Zero Grade Nitrogen or House Nitrogen
9.1.5. ASTM Type II Water or equivalent
9.1.6. Dynamic Dilution system

9.2. Standards

9.2.1. General Information and Disclaimers

9.2.1.1. EPA Method TO-15 and Appendix A provide guides for preparing standards from neat chemicals. Neat standards that are used for making trace gas standards must be of high purity; generally a purity of 98 percent or better is commercially available. At this time, this lab does not use the Static Dilution Bottle technique. A modified version of the high-pressure cylinder technique is used (see Appendix A). A canister is used in place of the high-pressure cylinder and final pressures are reduced to less than 40 psi. Standards are purchased as mixes or prepared as mixes by the local lab. Any additional compounds to be added to these mixes are added by syringe during dilution.

9.2.1.2. Vendors and vendors' products are sometimes listed for the ease of the analyst using this SOP, but products and purchased concentrations are examples only and subject to change at any time. All purchased standards are certified by the vendor. Certificates of Analysis are kept in the department until the standards are no longer being used – at which time they are filed with QA. Certificates of Analysis are available upon request. Purchased standards are routinely checked against an independent source for both analyte identification and analyte concentration.

9.2.1.3. The initial calibration curves given are typical, but also subject to variation due to targets and detection levels needed. The curves will always be at least 5 points. The lowest concentration level shall be at the method reporting level. The remaining levels should define the working linear range of the analytical system. Any other standard concentrations listed may be changed at any time.

9.2.1.4. All Standards must be traceable using the lot system (ADM-DATANTRY).

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9.2.1.5. Working standards are prepared by dilution of stocks of uniform concentration in units of ppbv. Due to the requirements of the Starlims reporting system the GC/MS is calibrated in units of ng on column. The ng/L concentrations of the individual components in the standards are calculated by the equations found in section 13 of this document. The individual standards may be analyzed at multiple volumes to produce the required calibration range.

9.2.2. Instrument Performance Check, Internal Standard and Surrogate Spiking Mixture (also known as Monitoring Standard) - p-Bromofluorobenzene (BFB-used as both a tune check and surrogate compound), bromochloromethane, chlorobenzene-d5, and 1,4-difluorobenzene in humidified zero air.

9.2.2.1. An Intermediate Monitoring Standard is prepared from neat compounds in a canister. After the volume of the canister is determined, calculate the mass of each compound to be spiked to achieve the final concentration. Then use the density of each neat compound to calculate the microliter amount to be spiked into the canister. Heat the injection area and inject the compounds while pressurizing the canister with zero nitrogen. Allow the contents to equilibrate for approximately 24 hours before using.

9.2.2.2. The amount required to achieve the desired concentration is determined through the use of the following equation.

$$A = \frac{C * M * V}{D * 24.46}$$

Where:

A	Amount of each compound required to achieve the desired concentration of the standard (µL)
C	Desired concentration (ppmv)
M	Molecular weight of the compound (g/mole)
V	Actual volume of the canister (L)
D	Density of the compound in question (µg/µL)
24.46	is the molar volume of an ideal gas (l/mol) at 298 K (25 °C) and 760 mmHg (1 atm).

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Example:

Calculate the amount (uL) of neat bromochloromethane needed to achieve the final concentration of 250 ppmv of that compound in a 6L canister pressurized to 29.4 psi.

V = 18L
D = 1934.4µg/µL
C = 250ppmv

$$A = \frac{(250\,ppmv)(129.38\,g/mole)(18L)}{1934.4\frac{\mu g}{\mu L} * 24.46\frac{L}{mole}} = 12.3\mu L$$

Molecular Weight (g/mole)	Density (µg/µL)	Compound
129.38	1934.4	Bromochloromethane
114.09	1170.1	1,4-Difluorobenzene
117.59	1157	Chlorobenzene-d5
175.00	1593	BFB

9.2.2.3. The Working Monitoring Standard is prepared in a Summa canister by spiking an aliquot of the Intermediate Stock Standard using a gastight syringe. Connect a cleaned, evacuated Summa canister to a source of pure diluent gas (humidified zero air) using a teflon line with a stainless steel tee directly above the canister valve. One port of the tee is fitted with a septum. Withdraw the required volume of standard from the stock cylinder and allow sufficient time for the syringe to reach equilibrium with barometric pressure. Spike the intermediate stock through the septum with flow of diluent gas to flush the spike into the can. Pressurize the can to the target pressure with humid zero air, and allow the contents to equilibrate for approximately 24 hours before using. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met. The target pressure of the canister is typically 1 times the barometric pressure to result in a final volume of twice the canister volume.

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If the final pressure of the 15L canister is 29.9"Hg, the pressurized volume is 30L through the use of the following equation.

$$V_P = \frac{P_{atm} + P_f}{P_{atm} + P_i}(V)$$

Where:

V_P	Pressurized canister volume (L)
P_f	Final Canister Pressure
P_i	Initial Canister Pressure
V	Volume of canister @ 1atm
P_{atm}	Atmospheric Pressure = 29.9"Hg

Example:

$$\frac{29.9"+29.9"}{29.9"+0"}(15L) = 30L$$

To determine how much of the intermediate standard is required:

$$A = \frac{(F)(V_P)}{(C)\left(1000\frac{ppbv}{ppmv}\right)}$$

Where:

F	Desired concentration of working standard (ppbv)
V_p	Pressurized Volume of receiving Canister (L)
C	Concentration of intermediate standard (ppmv)
A	Amount of standard (mL) of the intermediate standard required to obtain the desired working standard concentration

Example: if a 10 ppbv standard is desired and the concentration of the intermediate standard is 250 ppmv, the amount to add to the 30L standard volume is 1.2 mL as shown:

$$A = \frac{(10\,ppbv)(30L)(1000mL/L)}{(250\,ppmv)(1000\,ppbv/ppmv)} = 1.2mL$$

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9.2.3. Initial Calibration (ICAL) Standard

9.2.3.1. The primary source calibration standard is purchased commercially as a mixture in a cylinder at a nominal concentration of 1000 ppbv. The certified concentration will vary and the certified value is used in calculation of the true value of the calibration standards. Working standards are prepared in Summa canisters using Syringe or Dynamic Dilution. Typically, three working standards (10, 1.0, and 0.10 ppbv) are prepared by dilution of the 1000 ppbv and the other calibration levels are achieved by injecting varying volumes of these standards. The actual concentrations are documented in the ICAL file. Compounds may be added individually during dilution to expand the compound list. A "cocktail" or "soup" may be made according to Attachment A and an intermediate standard prepared. The typical preparation is as follows:

Nominal ppbv	0.01	0.02	0.95	0.2	0.5	1.0	2.5	5.0	7.5	10
Working Stock used (ppbv)	0.10		1.0			10				
mL injected	100	200	95	200	500	100	250	500	750	1000

Enviroquant compares the responses to the mass (ng) of the compound injected onto the column. To calculate the "ng on column", first convert the concentration of ppbv to ng/L using:

$$C_{ng/L} = C_{ug/m^3} = C_{ppbv}\left(\frac{FW}{24.46}\right)$$

Use Table 3 for the FW.

Then multiply the volume injected (L) by the concentration of the stock (ng/L).

The working standards are prepared by syringe dilution into a 6L summa canister pressurized to 1 atm of pressure for a total volume of 12L. The injected volumes are: 120 mL for 10 ppbv, 12 mL for 1.0 ppbv, 1.2 mL for 0.10 ppbv.

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9.2.3.2. Intermediate Standard Preparation (Gaseous Compounds) If compounds need to be analyzed in addition to the existing list add them into an intermediate standard prepared in a Summa canister. After the volume of the Summa canister is determined, calculate the mass of each compound to be spiked to achieve a final concentration of 100 ppmv. Then use the molecular weight and density (Table 3) of each gaseous compound to calculate the microliter amount to be spiked into the Summa canister. The required spike volume of this intermediate standard, to be added during the dilution of the working standard, is calculated as in the previous example.

9.2.3.2.1. The microliter spike amount is determined by using the following equation.

$$S = \frac{C * V * M}{d * 24.46}$$

S Spike amount required in order to obtain the desired concentration (µl)
C Desired concentration (ppmv)
V Final Volume of the pressurized Summa canister (L)
M Molecular Weight of the compound
d Density of the compound (ug/uL)
Molar Volume of gas at 25°C, 1atm

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9.2.3.3. Dynamic Dilution – Dynamic dilution equipment is not currently used in Rochester for the preparation of standards. This section is left intact for future reference. Working standards are prepared by syringe dilution as covered in the previous sections.

9.2.3.4. Turn on the power to the diluter one hour prior to using to allow for the components to come to thermal equilibrium. Zero all flow controllers without pressure applied prior to use. Connect Zero Air source to the humidification chamber (flow controller #1). Set the supply pressure to 20psi. Back purge standard flow controllers with humid air prior to use, when switching from one controller to another, and after the dilution of all standards is complete. Connect the stock standard cylinder or Summa canister to the appropriate flow controller depending upon the standard flow required. Open the valves. The inlet pressure of the standard regulator is set to 25psi. The backpressure regulator should be at a maximum of 10 psi. Purge each connection to minimize room air contamination and to deliver fresh standard to the flow controller. One or more working standards may be prepared depending on reporting limits and linear range.

9.2.3.4.1. **Step1**: Determine the required flow rate of the stock standard. When choosing these flows, keep in mind that the flow rate range of the standard and diluent gas must be from 10% to 100% of the selected flow controller.

9.2.3.4.2. **Step 2**: Determine the required dilution factor for each stock.

Dilution factor = Stock Conc. (ppbv) / Desired Standard Conc. (ppbv)

9.2.3.4.3. **Step 3**: Calculate Total Flow

Total Flow=(Sum of stock std. flows)*(Dilution Factor)

Choose stock flows that will give a total flow of less than 10000ml/min, since this would represent the maximum possible flow of diluent gas.

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9.2.3.4.4. **Step 4**: Calculate Diluent Air Flow

Air Flow=Total Flow-(Sum of stock std. flows)

Example: Prepare a 10ppbv working standard. The concentration of each stock standard is 1000ppbv.

Choosing stock flows of 60 mL/min,

$$DilutionFactor = \frac{1000\,ppbv}{10\,ppbv} = 100$$

Total Flow=60 mL/min*100 = 6000 mL/min

Air Flow=6000 mL/min-60 mL/min = 5940 mL/min

9.2.3.4.5. **Step 5:** Set the flow rates for each of the appropriate flow controllers. Start the air flow first and then the standard gas flow. Allow flows to equilibrate for at least five minutes or until a minimum of 20 mL have passed through the standard gas flow controller. Attach an empty canister to the outlet port, allowing the standard gas to flush the connection. Close the manifold valve and note the pressure. Check the pressure gauge for fifteen seconds to make sure there is no leak. Reopen the manifold valve and slowly open the canister valve to avoid rapid pressure changes in the standard manifold.

9.2.3.4.6. **Step 6:** If additional components are to be added by syringe dilution, spike the calculated volume of intermediate standard through the septum port while the canister is filling

9.2.3.4.7. **Step 7:** Close the canister valve when the pressure reaches 10 psig. The back pressure regulator will open when it reaches 10 psig, so the canister will still be usable if the valve is not closed in time. Use the purchased stock concentrations to determine the final analyte concentrations in the standard.

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9.2.4. Initial Calibration Verification (ICV) - (Laboratory Control Sample - LCS)

This standard is prepared from a secondary source standard (either a different manufacturer or different lot from the same manufacturer as the initial calibration standard) by dilution of a purchased cylinder mix. The ICV/LCS working standard should contain all of the target analytes in the calibration working standard. Differing injection volumes will account for differing concentrations. Most targets will be at a nominal concentration of 2.5 ppbv, though these concentrations may vary. The actual concentrations are documented.

9.2.5. Continuing Calibration Verification Standard

The CCV is the same canister as the ICAL standard diluted to a concentration approximately midpoint of the ICAL.

9.2.6. Canister Quality Control Check and Method Blank

Pressurize a cleaned canister with humidified zero grade air prior to analysis. Analyze an aliquot of one liter along with the same volume of internal standard and surrogate as standards and samples. The supply of humidified zero grade air may be analyzed directly from the dilution manifold as the method blank when a QC canister is not available.

9.3. Storage and Expiration Dates

- Neat Stock Liquids – are stored @ -10°C to -20°C for a period of five years or as specified by the manufacturer.
- Purchased Stock Standards Cylinders must be stored at room temperature for a period of up to 2 years or as specified by the manufacturer.
- Prepared Stock / Intermediate Calibration Standards (ppmv) prepared in canisters in a nitrogen matrix may be stored at laboratory conditions for up to twelve months in an atmosphere free of potential contaminants. This expiration time may be decreased for reactive components that are not typically available as purchased stock standards. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.
- Calibration or Working Calibration Standards prepared in canisters in a humidified air matrix may be stored at laboratory conditions for one month in an atmosphere free of potential contaminants. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.

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10. RESPONSIBILITIES

It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP may perform analysis, interpretation and peer review of the results. The supervisor/manager must also ensure that method proficiency is documented initially and whenever significant changes in the instrument type, personnel, matrix or test method are made. The department supervisor/manager or designee shall perform final review and sign-off of the data.

11. PROCEDURE

11.1. Be sure the system has a current LOD and the analyst has a current demonstration of capability.

11.2. Sample Preparation

11.2.1. The pressure/vacuum is checked and the canister pressurized as needed prior to analysis by the laboratory. Samples collected in canisters shall be pressurized with humidified zero grade air.

11.2.2. Canister Pressurization Samples may be pressurized to approximately 1.0 psig up to approximately 3.5 psig. If pressurization occurs, humidified zero air must be utilized. This may be accomplished by connecting the sample canister to a source of pure diluent gas (zero air) using a teflon line with a stainless steel tee directly above the canister valve. One port of the tee is fitted with a septum and injecting 100µL of water into the can through the septum and allowed to vaporize for approximately 10 minutes. Alternatively, pressurize at a fill station with humidified zero air. Both of these procedures shall utilize ASTM Type II water or equivalent.

11.2.3. Initial and final pressures are recorded on the Starlims detailed sample information report and the back of the sample identification tag. The dilution factor created by filling the sample canister is calculated by Starlims using the equation in Section 13.

11.3. Screening

11.3.1. The analyst must screen a sample or subset of samples if the source is of unknown origin. Typically, if the source is known to be indoor or ambient outdoor air, no screening is necessary. However, if screening is required, inject a 1mL or smaller aliquot of each sample into a GC/flame ionization detector (FID) system that has been calibrated with a standard containing a subset of the target analytes. This subset

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represents the most commonly found compounds in air samples, such as acetone, trichloroethylene, and toluene. A single point calibration is sufficient.

11.3.2. Alternately a sample screen may be performed on the GC/MS system by injecting an aliquot of the sample into the GC/MS injection port while running a modified TO-15 method. The results shall be quantified by an external calibration method. A dilution factor will be calculated based on sample volume and split ratio. The results are to be used for screening purposes only. Currently a Markelov HS9000 headspace auto sampler with an Agilent 5973 GC/MS system is used to screen samples. A 10 mL aliquot of sample is injected into a sealed head space vial. The pressure in the vial is then released by venting with a needle. A single point calibration is prepared in the same manner.

11.3.3. Use the results to determine the maximum volume of sample to be analyzed by TO-15 by utilizing the following equation. Dilutions may be prepared as necessary.

$$I = \frac{C}{H}$$

Where:

I Injection volume (mL)
C Maximum calibration level (ppbv)
H Compound screening concentration (ppbv)

Example: Select the compound with the highest concentration (toluene = 500ppbv). If the upper calibration level is 10 ppbv, then the following calculation determines the maximum injection volume to analyze, based upon a normal injection volume of 1000mL.

$$\frac{10\,ppbv}{500\,ppbv} * 1000mL = 20\text{mL maximum injection volume}$$

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11.4. Analytical Sequence and Data System Setup

11.4.1. Data System

11.4.1.1. For the Entech 7100, fill in the sequence log of the SmartLab program with the appropriate information.

11.4.1.2. For the HP Chemstation, load the appropriate acquisition method for the GC/MS in the top window of the Chemstation program

11.4.2. Analytical Sequence

11.4.2.1. For this internal standard calibration method analysis, a CCV standard is to be analyzed every 24 hours. That is, the last analysis in the sequence must be started within 24 hours from the time of the initiation of the sequence. The initiation is considered to be the injection of the BFB tune standard.

11.4.2.2. The analytical sequence must be completed for the analysis of ≤20 (19 samples including dilutions with one laboratory duplicate) field samples. A method blank (MB) shall be run to monitor for laboratory introduced contamination. There must be at a minimum a laboratory duplicate (DUP) analyzed in each batch to access batch precision. A laboratory control sample (LCS) shall be analyzed at a rate of at least one per batch of twenty or fewer samples. The concentration of the LCS (ICV standard) should be at the lower end of the calibration curve as an indication that the system allows for good recovery at those concentrations. The LCS is prepared at a nominal 10 ppbv concentration and injected at a 250 mL volume for a final concentration of 2.5 ppbv. The ICV is injected at 500ml for a final concentration of 5 ppbv. The following generalized analytical sequence is to be followed:

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Analytical Sequence Guideline

With Calibration Tune Check[1]
- Calibration Standards (5 Standards Minimum)
- ICV Standard[2] (Acts as the ICV and LCS)
- QC Canister Checks[6]
- MB[7]
- Sample(s) – 1-19
- Laboratory Duplicate[4]

With Continuing Calibration
- Tune Check[1]
- CCV Standard[5]
- LCS[3]
- QC Canister Checks[6]
- MB[7]
- Sample(s) – 1-19
- Laboratory Duplicate[4]

[1] The introduction of the tune check standard is the start of the 24 hour analysis window. The instrument performance check solution must be analyzed initially and once per 24 hour time period of operation.
[2] In this scenario, the ICV may also be evaluated as the LCS.
[3] An LCS shall be analyzed at a rate of 1 in 20 or fewer samples. The LCS is the second source calibration check standard analyzed at the lower end of the calibration curve.
[4] A laboratory duplicate must be analyzed at a rate of 1 per 20 or fewer samples. The duplicate must be rotated among clients, whenever possible
[5]A CCV must be analyzed at the beginning of every analytical sequence
[6]Any number of QC check canisters may be analyzed in the sequence to determine a canister cleaning batch or batches acceptability. They may be run at any point in the batch. QC check samples are not counted against LCS frequency.
[7]Any of the QC Check Canisters may serve as the method blank as long as the minimum requirements detailed in this document are met. A method blank shall be analyzed at a rate of 1 in 20 or fewer samples.

Note: Client project batch specifications may require certain modifications to the analytical sequence; however, a batch may not be more lenient than that which is specified in this document.

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11.5. Conditions

11.5.1. Sample Collection Conditions The suggested settings and system parameters are as follows:

Stream: Sample
Preflush (sec): 10
Trap (cc/min): 100
Volume (cc): 25 to 1000

Stream: Internal Standard
Preflush (sec): 10
Trap (cc/min): 100
Volume (cc): 25 to 1000

Stream: Analytical Standard
Preflush (sec): 5
Trap (cc/min): 100
Volume (cc): 0

Stream: Sweep/Purge
Preflush (sec): 5
Trap (cc/min): 100
Volume (cc): 75

Stream: M1 -> M2
Preflush (sec):
Trap (cc/min): 10
Volume (cc): 40

Module1:
Trap temp(C): -150 Preheat? Yes
Preheat temp(C): 10
Desorb temp(C): 10
Bake temp(C): 150
Bake time(Min): 5

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Bulk1:
Trap temp(C): 10
Desorb temp(C): 10
Bake temp(C): 150

Module2:
Trap temp(C): -30 Preheat? No
Preheat temp(C): 50
Desorb temp(C): 180
Bake temp(C): 190
Desorb time(C): 3.5

Bulk2:
Trap temp(C): 30
Desorb temp(C): 150
Bake temp(C): 150

Module3:
Trap temp(C): -160 Focus? Yes
Inject temp(C): 100
Inject time(Min):2
Bake temp(C): 100
Bake time(Min): 15
Bake on EventEx# : 3
Total Time (Min) : 33

Misc:
Sample Xfer temp(C): 80
GC Xfer temp(C): 100
MPOS Valve temp(C): 100

Wait for GC before injecting
Active GC: GC1
Pressure: 100
MPOS Valve temp(C): 100

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11.5.2. GC/MS System

Optimize GC conditions for compound separation and sensitivity.

Item	Condition
Carrier Gas	Helium
Flow Rate	1.0-1.5mL/minute
Temperature Program	Initial Temperature: 40°C Initial Hold Temperature: 5 minutes Ramp Rate: 4°C/min to 130°C 2nd Ramp: 20°C/min to 200°C for 9 min hold
Detector B (MSD *Interface)*:	280°C
Electron Energy	70 Volts (nominal)
Mass Range	33 to 300 amu (SCAN mode)
Scan Time	To give at least 10 scans per peak, not to exceed 1 second per scan.

11.6. Instrument Performance Check (Tuning)

Inject 50ng or less (on column). The internal/surrogate standard containing BFB is typically used at an injection volume of 250 mL for the 10ppbv standard. The GC/MS system must meet the BFB ion abundance criteria shown in Table 1 and 1A. The Analysis may not proceed until the tune meets these criteria. The mass spectrum of BFB is acquired as follows: Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. When background subtraction is required, subtraction is accomplished using a single scan no more than 20 scans prior to the elution of BFB. No part of the BFB peak may be used to background subtract.

If tune is not met, perform auto tune or manual tune and then re-analyze BFB. If the BFB acceptance criteria are still not met, the MS must be retuned according to the procedure outlined in the instrument users manual. Perform necessary maintenance and make notations in the instrument maintenance logbook. It may be necessary to clean the ion source, or quadrupole, or take other necessary actions to achieve the acceptance criteria.

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11.7. Initial Calibration

11.7.1. Follow the requirements for initial calibration in ADM-ICAL unless otherwise stated in this SOP.

11.7.2. Frequency - Each GC/MS system must be initially calibrated upon instrument set-up and recalibrated following any instrument maintenance which may change or effect the sensitivity or linearity of the instrument or if the continuing calibration verification acceptance criteria have not been met.

11.7.3. ICAL Procedure -

11.7.3.1. Attach the calibration standard and internal standard/surrogate canisters to the designated inlets on the preconcentrator and open the canister valves. Analyzing different volume aliquots of the calibration standards produces differing concentrations. Internal standards/surrogates must be added at the same volume for every standard, sample and QC sample.

11.7.3.2. Analyte responses (target ion areas) are tabulated and recorded using the Enviroquant program. Quantitation ions for the target compounds are shown in Table 2 and the primary ion should be used unless interferences are present, in which case the secondary ion may be used.

11.7.4. Calculate the RRF for each target compound relative to the appropriate internal standard

Relative Response Factor (RRF):

$$RRF = \frac{A_x C_{is}}{A_{is} C_x}$$

where:

A_x	is the area response of the analyte quantitation ion.
A_{is}	is the area response of the corresponding internal standard quantitation ion.
C_{is}	Internal standard concentration, ng.
C_x	Analyte concentration, ng.

Note: The equation above is valid under the condition that the volume of internal standard spiking mixture added in all field and QC samples is the same from run to run.

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11.7.5. Using RRFs from the initial calibration, calculate the %RSD for all target compounds

Standard Deviation, SD:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{\left(RRF_i - \overline{RRF}\right)^2}{N-1}}$$

where:

RRF_i are the individual RRFs from each concentration level in the initial calibration curve.
$\overline{RRF}$ Average (or Mean) RRF of all concentration levels in the initial calibration curve.
N total number of calibration concentration levels

Percent Relative Standard Deviation, %RSD:

$$\%RSD = \frac{SD}{\overline{RRF}}(100)$$

where:

SD Standard Deviation calculated in equation number 3
$\overline{RRF}$ Average or Mean RRF

11.7.6. Calculate the RRT for each compound over the initial calibration range

Relative Retention Time (RRT)

$$RRT = \frac{RT_C}{RT_{is}}$$

where:

RT_C Retention time of the target compound, seconds.
RT_{is} Retention time of the internal standard, seconds.

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11.7.7. Calculate the mean RRT for each analyte target compound over the initial calibration range:

Mean Relative Retention Time ($\overline{RRT}$)

$$\overline{RRT} = \sum_{i=1}^{n} \frac{RRT_i}{n}$$

where:

$\overline{RRT}$ Mean relative retention time (seconds) for the target compound for all initial calibration levels.

RRT_i Relative retention time for the target compound in level i.

n Number of calibration levels

11.7.8. Calculate the mean area response $\overline{Y}$ for each internal standard compound over the initial calibration range

Mean Area Response ($\overline{Y}$) for Internal Standard

$$\overline{Y} = \sum_{i=1}^{n} \frac{Y_i}{n}$$

where:

Y_i Area response for the primary quantitation ion for the internal standard for each initial calibration standard.

N number of calibration concentration levels

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11.7.9. Calculate the mean of the retention times for each internal standard over the initial calibration range

Mean Retention Times ($\overline{RT}$)

$$\overline{RT} = \sum_{i=1}^{n} \frac{RT_i}{n}$$

Where:

$\overline{RT}$ Mean retention time, seconds

RT_i Retention time for the internal standard for each initial calibration standard, seconds.

n number of initial calibration levels

11.7.10. Acceptance criteria –

- The RRT for each target compound at each calibration level must be within 0.06RRT units of the mean RRT for the compound.

- The calculated %RSD for the RRF for each compound in the calibration standard must be less than 30% with at most two exceptions up to a limit of 40% (this may not be true for all projects).

- If the % RSD of any compound is > 30%, construct a linear regression calibration curve of area ratio (A/A_{is}) versus concentration using the equation of a line ($y=mx+b$). The origin may not be used as a calibration point and the required Correlation Coefficient must be ≥ 0.99. If the Calibration Correlation is not met, linear regression may not be used to quantitate the target. It is good lab practice to mark all target compounds on a curve to identify target compounds calculated using linear regression.

- For each Internal Standard the area response (Y) at each calibration level must be within 40% of the mean area response $\overline{Y}$ over the initial calibration range.

- The retention time shift for each of the internal standards at each calibration level must be within 20s of the mean retention time over the initial calibration range for each internal standard.

- All of the following information must be retained to permit reconstruction of the initial instrument calibration: calibration date, test method, instrument, analysis date, analyte identification, analyst's initials, concentration and responses, and response factors.

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11.8. Initial Calibration Verification Standard

Verify the initial calibration by analyzing an initial calibration verification standard (ICV) immediately after the calibration standards. This standard shall be obtained or prepared from materials acquired from a different manufacturer or lot from that of the initial calibration. The ICV must be 70-130% recovery for all target compounds.

If the initial calibration verification technical acceptance criteria are not met, reanalyze and if it still fails prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column. Perform a new initial calibration if any performed maintenance has altered instrument linearity and/or sensitivity. A demonstration of an acceptable ICV is required. When the acceptance criteria for the ICV are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise any samples affected by the unacceptable ICV shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

11.9. Continuing Calibration Verification Standard –

11.9.1. Frequency - Verify the calibration each working day, where necessary (e.g., an ICAL was not analyzed or the 24-hour tune window has closed) by analyzing a continuing calibration verification (CCV) standard. The concentration of the calibration verification may be varied within the established calibration range. It may be necessary to analyze more than one CCV standard when linear range limitations require different concentration levels for specific compounds. This will be determined based upon the initial calibration and will be applied to only those compounds with a modified linear range.

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11.9.2. Acceptance Criteria - %D must be within 30% of the initial calibration average RRFs for all target compounds to be reported from the analytical batch.

11.9.2.1. For Calibrations based on RF, calculate the %Difference:

The %D is used for evaluating CCV RRFs vs. the initial calibration $\overline{RRF}$:

$$\%D = \frac{RRF_{CCV} - \overline{RRF}}{\overline{RRF}}(100)$$

where, for any given analyte:

RRF_{CCV}	is the RRF from the CCV being evaluated.
$\overline{RRF}$	is the mean RRF from the current calibration curve.

11.9.2.2. For Linear Regression Calibrations, calculate the %Drift using:

$$\%\ Drift = \frac{C_c - C_T}{C_T} x\ 100$$

where:
C_c = Calculated concentration of Calibration Check Compound standard.
C_T = Theoretical concentration of prepared standard.

11.9.3. Corrective Action –

11.9.3.1. If the continuing calibration verification technical acceptance criteria are not met, reanalyze and if it still fails prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources of the problem and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column.

11.9.3.2. If any corrective action and/or reanalysis fails to produce continuing calibration verification within acceptance criteria (analyzed immediately following the initial failure), then either two consecutive successful verifications must be performed following corrective action or a new initial calibration must be performed. However, sample data associated with an unacceptable calibration verification may be reported as qualified data under the following special conditions:

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- When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise the sample affected by the unacceptable CCV shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. If the CCV is out of control (bias high or low) for any particular analyte and that analyte is detected in a sample then that sample must be re-analyzed.

11.10. Sample Analysis –

11.10.1. Prior to analysis, bring all sample containers (canisters and bags) to temperature equilibrium with the laboratory.

11.10.2. Index the Entech 7100 auto sampler to a open sample line and back flush the line with nitrogen. Attach a sample canister using a 9/16" wrench. Index the auto sampler to the next position and repeat for all the samples to be run.

11.10.3. Before opening the sample valves, check for leaking fittings by running the leak check program in the SmartLab software or by manually indexing to each sample position and verifying that the line has held pressure.

11.10.4. If sample pressures/vacuums are to be checked, manually index the sample valve to each position and note the sample pressure/vacuum.

11.10.5. Index the sample position valve to the first sample position.

11.10.6. Perform the system bake out routine.

11.10.7. Open the canister valves and start the automated preconcentration procedure. Make sure the Chemstation data acquisition software has been readied.

11.10.8. Introduce the same volume of internal standards (surrogates included) as used for the standards and QC samples.

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11.11. Evaluation of Sample Analysis

11.11.1. Check all target compounds using the QEdit routine in Enviroquant, making sure all extracted ion chromatogram peaks are integrated properly. See ADM-INT for manual integration procedure and policies.

Note: *The secondary ion quantitation is only allowed if there is sample matrix interference with the primary ion. If the secondary ion quantitation is performed, document the reasons in the instrument run logbook and/or on the quantitation report (initial and date any notation).*

11.11.2. Check the internal standard peak areas and retention times as well as applicable surrogate recoveries to see if they meet acceptance criteria (see Section 12).

11.11.3. Upon sample injection onto the column, the GC/MS system is operated so that the MS scans the atomic range from 33 to 300 amu. At least ten scans per eluting chromatographic peak should be acquired. Scanning allows identification of unknown compounds in the sample through searching of library spectra.

11.11.4. Each run is approximately 45 minutes long. Generate a quantitation report for each run.

11.11.5. Sample Dilution

11.11.5.1. If any target analyte results are above the highest level of the initial calibration, a smaller sample aliquot should be analyzed. The dynamic range of volume aliquots for the automatic cryogenic concentrator is 50cc to 1L. If a volume smaller than 50cc is to be analyzed, a dilution should be made in a Tedlar bag, a Summa canister, or the sample directly injected using a gastight syringe. Note the method of dilution and the dilution gas used in the run log.

- Use results of the original analysis to determine the approximate dilution factor required and get the largest analyte peak within the initial calibration range.
- The dilution factor chosen should keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument.
- All dilution factors must be documented and included in the final report.

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11.11.5.2. Tedlar bag dilution:

- Make a dilution by filling a Tedlar bag with 1.0 liter of humidified zero air using a one-liter gas syringe.
- Calculate the volume of balance gas needed to obtain the required dilution.
- Remove the difference in the balance gas using a syringe.
- Add the calculated sample amount using a gastight syringe.

11.11.5.3. Direct injection:

- Make a direct injection by attaching a supply of clean, humidified zero to the preconcentrator autosampler using 1/4" stainless steel or teflon tubing with a "tee" septum port. This air should be the same supply that was used as the method blank. Alternatively, the humidified dilution air may be supplied from a Summa canister connected to the sampling system by means of a "tee" septum port.
- Inject the sample through the septum while the preconcentrator withdraws an aliquot from the supply of air.

11.11.6. Tentatively Identified Compounds

11.11.6.1. When requested, a mass spectral library search may be made for the purpose of tentatively identifying sample components not associated with the calibration standards. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system mass spectral library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

11.11.6.2. Certain programs may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. The following guidelines are used for making tentative identifications.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within ±20%. For example, for an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance should be between 30 and 70%.
- Molecular ions present in the reference spectrum should be present in the sample spectrum.

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- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.
- The concentration of the tentatively identified compound is estimated by assuming a response factor of 1.0 and comparing the response of the tentatively identified compound to the response of the nearest internal standard.

11.12. Storing Electronic Data

The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. There are multiple quantitation methods, which are subsets of the compound list in Table 2. Therefore, files will be named with a notation indicating the compound list and the date of the corresponding initial calibration. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files are saved in a unique sub-directory on the server.

11.13. Releasing Canister for Cleaning

After all analyses are complete on the canister sample in question, the analyst records the identification and concentration level of the most prominent compounds found in the sample on the sample identification tag. This includes not only target compounds from the analytical methods, but tentatively identified compounds and any anomalous observations. Only after the corresponding data is reviewed and approved including verification that all reporting and QA/QC requirements are met that the canisters released for cleaning and certification.

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11.14. Cleaning Canisters

High level canisters may be pre purged with house nitrogen to remove the bulk concentration of contaminates. Canisters are automatically cleaned on the Entech 3100A cleaning system, consisting of the controller, vacuum pump, and two ovens with 12 position manifolds. The oven temperatures are set to 210º F. The number of cleaning cycles depends upon how dirty the canisters are. Canisters are cleaned in batches of similar concentrations of contaminates. The canister with the highest level of contaminates is selected to be the QC canister for batch QC cleaning.

Ambient canisters may be cleaned in as little as 5 cycles as long as the batch quality control acceptance criteria are met. Higher level canisters may be cycled through the weekend if necessary to ensure thorough removal of contaminants. Typical settings are pressurization with nitrogen to 20 psia, rough evacuation to 2 psia, and high evacuation to 600 mtorr. This cycle typically requires 1 hour for twenty-four 6L canisters. Settings may be varied to create longer cycles and lower final vacuums to lengthen cycle time and improve the removal of higher molecular weight compounds. The canister cleaning QC check criteria is listed in section 12.

Mark the canister identification tag with a "Q" for any canister that was individually analyzed for QC. The quantitation report and chromatogram are provided to the client upon request.

11.15. Leak Check

Following the cleaning procedure, the canisters are evacuated to about 28.0 to 29.0 inHg and allowed to sit for a minimum of 24 hours to determine if any leaks exist. The vacuum of each canister is evaluated using a calibrated pressure/vacuum gauge and the results recorded. All canisters that pass both the batch analyte concentration QC and individual leak check are certified and ready for use. See Section 12 for QC requirements.

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11.16. Tracking of Canisters and Flow Controllers

The database for tracking canisters and flow controllers is in LIMS:
-Under "Resource Manager" on console, select "Materials Manager"
-Select "Reusable Containers" on console
-Select "Container Cleaning" button on "Reusable Containers" screen

The database is used to build cleaning batches, associate results with the batch, track availability of canisters and flow controllers for cleaning, track availability of canisters and flow controllers for sampling, document leak check vacuums, document initial and final sampling pressures, document shipping and receipt dates, remove items for maintenance, and maintain a history of the item. Barcodes are used for scanning items to be tracked.

12. QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

12.1. ICAL, ICV, CCV, Instrument Performance Check (**tune**), are discussed in the procedure (Section 11)

12.2. Canister Cleanliness

12.2.1. Frequency – the cleanliness of the canisters can be verified by cleaning batch or individually. When selecting a canister to represent a batch, choose the "dirtiest" canister based on the results of the last sample that was in each canister. The highest concentrations are examined, but other factors must be considered, such as the volatility of the contaminants (less volatile compounds are generally more difficult to remove).

12.2.2. Acceptance Criteria –

12.2.2.1. A canister is considered "clean" if the analysis shows <0.2ppbv of any target analyte, except acetone and ethanol. These compounds are considered exceptions; the concentration requirement for these analytes is <3.0ng/L (<1.26ppbv for acetone and <1.59ppbv for ethanol) or the target MRL, whichever is lower. A container may "pass with conditions" if it can be used for a limited target list, but not a full list.

12.2.2.2. If the batch of canisters are to be used for tentatively identified compounds (TIC) analysis, any non-target peaks present in the QC check canister analysis must be evaluated and determined to be less than the TIC reporting limit (<10% of the peak height of Internal Standard 2, as referenced in Table 2).

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12.2.3. Corrective Action – return the batch of canisters for recleaning.

12.3. Canister Leak Check –

12.3.1. Frequency – each canister must be leak checked after cleaning. See Section 11 for procedure.

12.3.2. Limits - The change in the initial and final readings must be <2.0"Hg.

12.3.3. Corrective action - Once a canister has been selected for repair (failed leak check) the canister must be placed on maintenance hold in the container tracking system. All canister maintenance must be noted in the LIMS tracking canister module.

12.3.3.1. The most common cause is a leaking valve seat, which may have been caused by repeated over-tightening or debris falling into the valve and preventing it from closing. Another possibility is that the valve is not sufficiently tightened onto the canister. It may be necessary to find the exact position of the leak by utilizing one or more of the following procedures.

- It is also possible to find gross leaks by pressurizing the canister to 20 psig and submerging it in water and looking for a stream of bubbles.

- A leaking canister may also be detected by pressurizing the canister to 20psig of UHP Helium gas and using a Helium gas leak detector to "sniff" out leak. The operator will use the detector probe around the valve head, valve seat, valve body, valve stem and the fastener nut fitting of the canister to allow the detector to find the leak.

12.3.3.2. Leaking Valve

If it is determined that a canister valve is leaking and needs to be replaced, a Nupro "H" Series stainless steel bellows seated valve should be used. For Entech canisters a TOV1 valve may be repaired with the factory repair kit. The valve body has 1/4" male Swagelok end fittings and the only tools needed for changing a valve are a 13/16" and a 9/16" wrench.

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12.3.3.3. Leaking Summa Canisters

If a leaking valve is identified, it should be replaced with an identical or equivalent valve. The canister is put in the "Maintenance" section in LIMS and tagged as such and repairs are specified on the tag. The laboratory supervisor should be contacted regarding this type of repair. After replacing the valve, the canister shall be put in "to be cleaned" mode in the tracking database. It must be part of a cleaning set and pass batch QC before being put back in service

12.4. Method Blank

12.4.1. Frequency – One per batch. A cleanliness check may serve dual purpose as a method blank. Even if the blank fails criteria for cleanliness it may be used as a MB if it meets MB criteria.

12.4.2. Acceptance Criteria

- The area response for each internal standard in the blank must be within ±40 percent of the area response for each internal standard in the mid-level standard of the ICAL if the method blank follows the ICAL. If the method blank follows a CCV then the area response for each internal standard in the blank must be within ±40 percent of the area response of the CCV.
- The retention time for each internal standard in the blank must be within ±0.33 minutes of the retention time for each internal standard in the mid-level standard of the ICAL if the method blank follows the ICAL. If the method blank follows a CCV then the retention time for each internal standard in the blank must be within ±0.33 minutes of the retention time of the CCV.
- The method blank result for any target analyte should not be greater than the reporting limit and should not contain additional compounds with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.

12.4.3. Corrective Action If the method blank is performed on humidified ultra zero air direct from the canister pressurization system, the blank may be repeated. If the analyte results in the blank still do not meet the acceptance criteria the source of the problem must be investigated and measures taken to eliminate the source. If the analyte concentration results in the blank from a cleaning QC canister do not meet the acceptance criteria repeat analysis with remaining QC canisters until results are acceptable. Any QC canister passing the method blank criteria may be used as a method blank when a batch of QC canisters is followed by sample analysis. If no QC canisters pass method blank criteria determine whether the contamination is from the instrument

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or due to contamination in the blank containers. Regardless, appropriate corrective measures must be taken and documented before sample analysis proceeds. However, if this is not a possibility and the results must be reported follow the reporting requirements stated in Section 13.

12.5. Laboratory Duplicate

12.5.1. Frequency – One per batch.

12.5.2. Acceptance Criteria Samples selected for duplicate analysis shall be rotated among client samples. The relative percent difference must fall within ±25%.

12.5.3. Corrective Action If the duplicate results do not meet the technical acceptance criteria, perform another duplicate analysis. If the results are still unacceptable and the associated samples are not reanalyzed then all of the sample results in the associated batch must be flagged accordingly.

12.6. Surrogates

- Frequency – added to all injections
- Acceptance Criteria – 70-130%
- Corrective Action – Analyze a smaller aliquot to reduce matrix interference.

12.7. Internal Standards

12.7.1. Frequency – added to all injections

12.7.2. Acceptance Criteria

12.7.2.1. The retention time for each internal standard must be within ±20 seconds of the retention time of the internal standard in the most recent valid calibration. If the most recent valid calibration is an initial calibration, internal standard area responses and retention times in the sample are evaluated against the corresponding internal standard area responses and RTs in the mid level standard of the initial calibration.

12.7.2.2. The area response for any internal standard must be within the range of 60 - 140% of the area of the most recent valid calibration (CCV or mid-point from the initial calibration, whichever is most current).

12.7.3. Corrective Action –

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12.7.3.1. Internal Standard Responses If the problem is with the instrument, perform maintenance. If the problem is with a sample, check for interferences. If the response is high, it is likely that interference is present. In this case, lower the volume or aliquot of the sample and re-analyze. If the problem persists, report the results with the best quality and qualify the results. If the problem is corrected with the lower volume analysis, report those results.

12.7.3.2. Internal Standard Retention Times If the retention time for any internal standard within the sample changes by more than 20 sec from the latest daily calibration or initial calibration mid-point standard, the GC/MS system must be inspected for malfunctions, and maintenance performed as required. Repeat sample analysis where required.

12.8. Laboratory Control Sample

- Frequency – one per batch. It may be necessary to analyze more than one LCS standard when linear range limitations require different concentration levels for specific compounds. This will be determined based upon the initial calibration and will be applied to only those compounds with a modified linear range.
- Acceptance Criteria – the recovery of the LCS must be 70-130% of the true value for all target compounds reported from the analytical batch. Exception: If the LCS recovery is greater than 130%, samples which are <MRL are acceptable to report.
- Corrective Action - If the LCS criteria are not met, determine whether the cause is instrumentation or the result of a poor injection. If the problem is instrumentation, perform maintenance (and recalibrate if necessary). If the problem is the injection, re-analyze the LCS.

12.9. Detection and Quantitation Limits

12.9.1. Ongoing verification of detection and quantitation limits are required. See ADM-MDL for requirements.

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13. DATA REDUCTION AND REPORTING

13.1.1. All data records must explicitly connect data to the initial instrument calibration. This includes all samples, continuing calibrations and QC samples.

13.1.2. The calculations for the Initial Calibration and Daily Calibration evaluations are given in the Section 11.

13.1.3. Sufficient raw data records must be retained of the analysis, instrument calibrations and method detection limit studies including: analysis/calibration date and time, test method, instrument, sample identification, analyte identification, analyst's initials, concentrations and responses, as well as standards used for the analysis and calibrations, all manual calculations including sample dilutions and manual integrations to permit reconstruction of analyses. Make sure that all information entered and reported on the quantitation report and instrument run log is complete and accurate. Retain all daily QC per sequence on file for future reference including tune checks, opening standards, method blanks, laboratory control samples, laboratory duplicates, and initial calibrations and initial calibration verifications. Additionally, all passing QC Canister checks must also be retained on file

13.1.4. The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Sample ID code, date and time of analysis, instrument operating conditions/parameters (or reference to such data), analysis type, all manual calculations including dilutions and manual integrations, analyst's initials, sample preparation (pressure readings and balance gas if pressurized with helium), standard and reagent origin, receipt, preparation, and use, as well as calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions.

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13.2. Calculations

13.2.1. The equations needed for initial and continuing calibration are in Section 11. The equations for calculating the concentrations and volumes of standards are in Section 9.

13.2.2. For calculating analyte concentrations in a sample:

13.2.2.1. The HP Enviroquant software uses the following equation to produce the result, in ng, which appears on the quantitation report. The equation used:

$$C_x = \frac{A_x C_{is}}{A_{is}\,\overline{RRF}}$$

where:

C_x is the concentration, in ng, of analyte *x*.
A_x is the area response of the analyte's quantitation ion.
A_{is} is the area response of the corresponding internal standard's quantitation ion.
C_{is} is the internal standard concentration, in ng.
$\overline{RRF}$ is the average or mean RRFs

13.2.2.2. Pressure Dilution Factor, PDF, for samples collected in Summa canisters:

$$\text{PDF} = \frac{P_{atm} + P_f}{P_{atm} + P_i}$$

where:

P_{atm} is the ambient atmospheric pressure, 14.7 psig at sea level.
P_f is the final sample canister pressure, in psig
P_i is the initial sample canister pressure, in psig. This will most often be a negative value (sub-ambient initial pressure.) The STARLIMS system accepts the initial sample pressure in either psig or "Hg to accommodate vacuum gauges calibrated in "Hg.

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13.2.3. The final analyte concentration, $FinalC_x$, in units of ng/L (ug/m^3), is then calculated from the following:

$$FinalC_x = PDF\left(\frac{Cx}{Vs}\right)$$

where:

Vc is the calibration standard sample volume analyzed, in liters.
Vs is the sample volume analyzed, in liters.
PDF is the sample canister pressure dilution factor

13.2.4. To convert concentrations units between mass/volume and volume/volume units the equations are:

$$C_{ug/m^3} = C_{ppbv}\left(\frac{FW}{24.46}\right) \quad \text{or} \quad C_{ppbv} = C_{ug/m^3}\left(\frac{24.46}{FW}\right)$$

where:

FW is the formula weight of the analyte, in g/mole.
24.46 is the molar volume of an ideal gas at 298 K (25 °C) and 760 mmHg (1 atm), in liters per mole (l/mol).
C_{ug/m^3} the analyte concentration in micrograms per cubic meter.
C_{ppbv} the analyte concentration in parts per billion by volume.

Refer to Table 3 for the appropriate molecular weights.

13.3. Data Review

13.3.1. The Initial Calibration will be reviewed by the analyst and a qualified peer using the ICAL checklist found in ADM-ICAL.

13.3.2. Daily sample data and associated QC data will be reviewed by the analyst and a qualified peer using a Data Review Checklist and validated by a supervisor as outlined in ADM-DREV. ADM-DREV also describes the subsequent reviews by the Project Manager and the Lab Director or QAPM.

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13.4. Reporting - Most reports are generated using STARLIMS. Data is transferred electronically from the instrument into STARLIMS. Both ug/m3 and ppbv results are included on the Form 1 in the final report.

14. METHOD PERFORMANCE

Detection and Quantitation limits are determined according to the requirements in ADM-MDL.

Demonstration of Capability is performed upon instrument set-up, whenever a new analyst begins independent analysis, and annually thereafter according to ADM-TRANDOC and section 19 below. The documentation of this method performance is retained by the Quality Assurance office.

15. POLLUTION PREVENTION AND WASTE MANAGEMENT

It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when disposed of properly.

The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the EH&S Manual.

16. CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA

If data is produced that is out of control, the samples are to be re-analyzed with in-control QA whenever possible. See corrective actions in Sections 11 and 12 of this SOP.

17. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

If data is produced that is out of control and is not to be re-analyzed due to sample volume restrictions, holding times, or QC controls can not be met, flag and narrate appropriately.

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18. REFERENCES

- EPA Method TO-14A, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/010b, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1997.

- EPA Method TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/010b, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1997.

- Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, January 1999.

- Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Addendum, January 17, 2002.

19. TRAINING OUTLINE

Read current SOP. Demonstrate a general understanding of the methodology and chemistry. Follow policies in ADM-TRANDOC.

Observe Sample Preparation and Analysis. Follow Training Plan Form (May be found on the Rochester Intranet at P:\INTRANET\QAQC\TRAINING\QAforms.HTM.)

Participate in the methodology, documentation, and data reduction with guidance.

Perform Initial Demonstration of Capability by performing the analysis independently and analyzing a known standard four times. If recovery is within acceptable limits, complete Training Plan Form and IDC certificate and file with QA. Continuing proficiency shall be demonstrated annually using an outside PE source, an internal unknown, or a new 4 replicate study.

20. METHOD MODIFICATIONS

9.2 of the TO-15 Method described various procedures for standards preparation. This lab modifies the High Pressure Cylinder technique in 9.2.5 of TO-15 by using a canister instead of a cylinder and final pressures are reduced to less than 40psi.

9.2.2.3 of the TO-15 Method requires an internal standard concentration of 10 ppbv. This lab uses 1-10 ppbv as not to push the upper end of the linear range with internal standard. The internal

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standard is set depending upon the required analytical range and the injection volume utilized during the initial calibration.

21. INSTRUMENT-SPECIFIC ADDENDUM

Instrument manuals are located near the instrument(s)

22. ATTACHMENTS

Table 1: Instrument Tune Check Ion Abundance Criteria (TO-15)
Table 1A: Instrument Tune Check Ion Abundance Criteria (TO-14A)
Table 2: Target Compounds, CAS Numbers, Quantitation Ions, MRLs, and Internal Standard Associations
Table 3: Molecular Weights and Densities
Attachment A - Preparation of Gas Phase Standards for Ambient Air Analysis
Attachment B - Sampling Instructions
Attachment C – Example Calculation
Attachment D – Cleaning and Calibration of Flow Controllers

23. CHANGES FROM PREVIOUS REVISION

- Added ALS format for cover pages, header, and footer.
- 9.2.3 – modified for explanation of preparation of ICAL .
- 11.13 Added section for releasing cans for cleaning
- 11.14 Added section for cleaning canisters
- 11.15 Added section for Leak Check
- 11.16 Added section for tracking canisters and flow controllers in LIMS
- 12.2 Added details for batch QC of can cleanliness
- 12.3 Added QC for leak check
- 13.4 Added that both ug/m3 and ppbv results are included on Form 1 of report
- Added Attachments C and D

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TABLE 1
Required BFB Key Ions and
Ion Abundance Criteria for Method TO-15

Mass	Ion Abundance Criteria[2]
50	8.0 to 40.0 percent of m/e 95
75	30.0 to 66.0 percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5.0 to 9.0 Percent of m/e 95
173	Less than 2.0 Percent of m/e 174
174	50.0 to 120.0 Percent of m/e 95
175	4.0 to 9.0 Percent of m/e 174
176	93.0 to 101.0 Percent of m/e 174
177	5.0 to 9.0 Percent of m/e 176

TABLE 1A
Required BFB Key Ions and
Ion Abundance Criteria for Method TO-14A

Mass	Ion Abundance Criteria
50	15 to 40 percent of m/e 95
75	30 to 60 percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5 to 9 Percent of m/e 95
173	Less than 2 Percent of m/e 174
174	>50 Percent of m/e 95
175	5 to 9 Percent of m/e 174
176	>95 and <101 Percent of m/e 174
177	5 to 9 Percent of m/e 176

Note: The criteria listed in Tables 1 and 1A shall be met or exceeded in order for EPA Compendium Methods TO-15 or TO-14A to be referenced.

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TABLE 2

Target Compounds, CAS Numbers, Quantitation Ions, MRLs, and Internal Standard Associations					
Compound[1]	**CAS Number**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL (ug/m^3)**	**Internal Standards[4]**
Bromochloromethane (IS1)	74-97-5	130	128, 132		Internal Standard 1
Propene	115-07-1	42	39,41	5.0	IS1
Dichlorodifluoromethane (CFC 12)	75-71-8	85	87	1.09	IS1
Chloromethane	74-87-3	50	52	0.45	IS1
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	76-14-2	135	137	1.54	IS1
Vinyl Chloride	75-01-4	62	64	0.060	IS1
1,3-Butadiene	106-99-0	54	39, 53	0.49	IS1
Bromomethane	74-83-9	94	96	0.43	IS1
Chloroethane	75-00-3	64	66	0.58	IS1
Ethanol	64-17-5	45	46	5.0	IS1
Acetone	67-64-1	58	43	5.00	IS1
Trichlorofluoromethane	75-69-4	101	103	0.62	IS1
Isopropyl Alcohol	67-63-0	45	43	5.00	IS1
1,1-Dichloroethene	75-35-4	96	61	0.44	IS1
Methylene Chloride	75-09-2	84	49	0.38	IS1
Trichlorotrifluoroethane	76-13-1	151	101	0.17	IS1
Carbon Disulfide	75-15-0	76	78	0.34	IS1
trans-1,2-Dichloroethene	156-60-5	61	96	0.44	IS1
1,1-Dichloroethane	75-34-3	63	65	0.45	IS1
Methyl tert-Butyl Ether	1634-04-4	73	57	0.79	IS1
Vinyl Acetate	108-05-4	86	43	5.00	IS1
2-Butanone (MEK)	78-93-3	72	43	0.65	IS1
cis-1,2-Dichloroethene	156-59-2	61	96	0.44	IS1
Ethyl Acetate	141-78-6	61	70	0.79	IS1
n-Hexane	110-54-3	57	86	0.78	IS1
Chloroform	67-66-3	83	85	0.54	IS1
Tetrahydrofuran	109-99-9	72	71,42	0.65	IS1
1,4-Difluorobenzene(IS2)	540-36-3	114	88		Internal Standard 2

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TABLE 2 (Continued)

Target Compounds, CAS Numbers, Quantitation Ions, MRLs, and Internal Standard Associations					
Compound[1]	**CAS Number**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL (ug/m^3)**	**Internal Standards[4]**
1,2-Dichloroethane	107-06-2	62	64	0.45	IS2
1,1,1-Trichloroethane	71-55-6	97	99, 61	0.60	IS2
Benzene	71-43-2	78	77	0.35	IS2
Carbon Tetrachloride	56-23-5	117	119	0.070	IS2
Cyclohexane	110-87-7	84	69,56	0.76	IS2
1,2-Dichloropropane	78-87-5	63	62	0.51	IS2
Bromodichloromethane	75-27-4	83	85	0.15	IS2
Trichloroethene	79-01-6	130	132	0.060	IS2
1,4-Dioxane	123-91-1	88	58	5.0	IS2
n-Heptane	142-82-5	71	57,100	0.90	IS2
cis-1,3-Dichloropropene	10061-01-5	75	77	1.00	IS2
4-Methyl-2-Pentanone	108-10-1	58	85	0.90	IS2
trans-1,3-Dichloropropene	10061-02-6	75	77	0.50	IS2
1,1,2-Trichloroethane	79-00-5	97	83	0.60	IS2
Toluene	108-88-3	91	92	0.41	IS2
2-Hexanone	591-78-6	43	58	0.45	IS2
Dibromochloromethane	124-48-1	129	127	0.19	IS2
1,2-Dibromoethane	106-93-4	107	109	0.17	IS2
Tetrachloroethene	127-18-4	166	164	0.080	IS2
Chlorobenzene-d5(IS3)	3114-55-4	82	117		Internal Standard 3
Chlorobenzene	108-90-7	112	114	0.51	IS3
Ethylbenzene	100-41-4	91	106	0.96	IS3
m-, p-Xylenes	1330-20-7	91	106	1.91	IS3
Bromoform	75-25-2	173	175	1.14	IS3
Styrene	100-42-5	104	78, 103	0.94	IS3
1,1,2,2-Tetrachloroethane	79-34-5	83	85	0.15	IS3
o-Xylene	95-47-6	91	106	0.96	IS3
4-Bromofluorobenzene(S)	460-00-4	174	176		IS3
4-Ethyltoluene	622-96-8	105	120	1.08	IS3

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TABLE 2 (Continued)

Target Compounds, CAS Numbers, Quantitation Ions, MRLs, and Internal Standard Associations					
Compound[1]	**CAS Number**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL (ug/m^3)**	**Internal Standards[4]**
1,3,5-Trimethylbenzene	108-67-8	105	120	1.08	IS3
1,2,4-Trimethylbenzene	95-63-6	105	120	1.08	IS3
Benzyl Chloride	100-44-7	91	126	2.85	IS3
1,3-Dichlorobenzene	541-73-1	146	148	1.32	IS3
1,4-Dichlorobenzene	106-46-7	146	148	1.32	IS3
1,2-Dichlorobenzene	95-50-1	146	148	1.32	IS3
1,2,4-Trichlorobenzene	120-82-1	184	145, 182	1.63	IS3
Hexachlorobutadiene	87-68-3	225	227	2.35	IS3
Naphthalene	90-20-3	128	127, 102	2.0	IS3

(S) = Surrogate (IS1) = Internal Standard 1 (IS2) = Internal Standard 2 (IS3) = Internal Standard 3

Note 1: Additional compounds may be reported as long as the minimum requirements of this document are met. The compounds listed in this table are reported using TO-15 SCAN. These compounds are included in the laboratories' standard 62 compound reporting list.
Note 2: These are suggested primary and secondary ions. However, any ions in the analyte spectra that are sufficient enough in response to reach the desired reporting limit and having a limited amount of interference, is acceptable for both the primary and secondary ion selection. Analyst experience should be utilized in determining appropriate ions.

Note 3: The method reporting limit listed is the standard SCAN limit (lowest concentration in the initial calibration curve), but may change with each new initial calibration performed. Therefore, current reporting limits should be reviewed.

Note 4: The listing of the internal standard by which the compounds are quantitated is for TO-15 SCAN only.

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Table 3
Molecular Weight and Density

Compound Name	Molecular Weight	Density (g/mL)
Propene	42.08	N/A
Dichlorodifluoromethane	120.9	1.329
Chloromethane	50.49	0.911
Freon 114	170.9	1.455
Vinyl Chloride	62.5	0.9106
1,3-Butadiene	54.09	0.6149
Bromomethane	94.94	1.6755
Chloroethane	64.52	0.8902
Ethanol	46.07	0.7893
Acetone	58.08	0.7845
Trichlorofluoromethane	137.4	N/A
Isopropyl Alcohol	60.1	0.7809
1,1-Dichloroethene	96.94	1.213
Methylene Chloride	84.94	1.3266
Trichlorotrifluoroethane	187.38	1.5635
Carbon Disulfide	76.14	1.2632
trans-1,2-Dichloroethene	96.94	1.2565
1,1-Dichloroethane	98.96	1.1757
Methyl tert-Butyl Ether	88.15	0.7402
Vinyl Acetate	86.09	0.9317
2-Butanone	72.11	0.7999
cis-1,2-Dichloroethene	96.94	1.2837
Ethyl Acetate	88.106	0.9003
n-Hexane	86.17	0.6548
Chloroform	119.4	1.4832
Tetrahydrofuran	72.11	0.8892
1,2-Dichloroethane	98.96	1.2351
1,1,1-Trichloroethane	133.4	1.339
Benzene	78.11	0.8765
Carbon Tetrachloride	153.8	1.594
Cyclohexane	84.16	0.7739
1,2-Dichloropropane	113	1.156
Bromodichloromethane	163.8	1.98
Trichloroethene	131.4	1.4642
1,4-Dioxane	88.11	1.0337
n-Heptane	100.2	0.6837

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Table 3
Molecular Weight and Density

Compound Name	Molecular Weight	Density (g/mL)
cis-1,3-Dichloropropene[2]	111	1.224
4-Methyl-2-Pentanone	100.2	0.7965
trans-1,3-Dichloropropene[2]	111	1.217
1,1,2-Trichloroethane	133.4	1.4397
Toluene	92.14	0.8669
2-Hexanone	100.16	0.8113
Dibromochloromethane	208.3	2.451
1,2-Dibromoethane	187.9	2.1791
Tetrachloroethene	165.8	1.6227
Chlorobenzene	112.6	1.1058
Ethylbenzene	106.2	0.867
m- & p-Xylene	106.2	0.8642,0.8611
Bromoform	252.8	2.899
Styrene	104.1	0.906
1,1,2,2-Tetrachloroethane	167.9	1.5953
o-Xylene	106.1	0.8802
4-Ethyltoluene	120.2	0.8614
1,3,5-Trimethylbenzene	120.2	0.8652
1,2,4-Trimethylbenzene	120.2	0.8758
Benzyl Chloride	126.59	1.1004
1,3-Dichlorobenzene	147	1.2884
1,4-Dichlorobenzene*	147	1.2475
1,2-Dichlorobenzene	147	1.3059
1,2,4-Trichlorobenzene	181.5	1.459
Hexachlorobutadiene	260.8	1.556
Naphthalene*	128.7	1.145

* Indicates a solid at room temperature.

Note 1: The density for a mixture of cis- & trans-1,3-Dichloropropene is 1.2205g/mL.

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Attachment A

Preparation of Gas Phase Standards for Ambient Air Analysis

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Preparation of Gas Phase Standards for Ambient Air Analysis

Application Note

By: Valerie J. Naughton

Introduction

Understanding gas phase standard preparation for ambient air methods is paramount to successful analyses. Standard preparation using EPA water, wastewater, and soil methods is routine. The analyst purchases stock methanolic standards and dilutes them into the working range of the instrument. Unlike conventional methods, air standard preparation is significantly more time consuming and technique intensive. Stock standards in compressed gas cylinders are available for specific method analytes, such as Compendium Method TO14[1] compounds. These, however, can be cost prohibitive and do not always address the needs of every customer. Custom blends are available in compressed gas cylinders, but are also costly and usually require four to eight weeks for preparation and stabilization.

This paper addresses several approaches to preparing gas phase standards for air toxics analysis. Included are techniques and calculations for making multi-component neat mixtures which can be diluted into static dilution bottles and ultimately into canisters for system calibration and performance checks. These techniques can be used to help alleviate cost when specific, non-routine analyses are requested. They can also be utilized by laboratories not receiving sufficient requests for air toxics analyses to justify the purchase of a compressed gas standard.

Also discussed are techniques for using compressed gas standards alone and combined with static dilution bottle standards to produce working standards in canisters. Some canister cleaning techniques are specified along with the importance of humidifying canisters for cleaning and standard preparation. Throughout the paper, good laboratory practices are described as these are essential to accurate and reproducible standard preparation.

Preparing Primary Stock Mixtures from Neat Liquids

A static dilution bottle (SDB) is a glass round bottom flask of known volume equipped with a septum-containing (Mininert) valve. It is used to vaporize and dilute small volumes of neat liquids to the gas phase, producing an intermediate standard. To prepare a gas phase standard in an SDB, a calculated amount of neat compound is injected into the flask. When preparing a multi-component standard, it is generally easier and more efficient to prepare an equimolar primary stock mixture of compatible neat compounds and make a single injection of the mixture into the SDB. This equimolar mixture is commonly referred to as a soup.

Before preparing the soup, the desired analytes are identified and categorized according to reactivity. An effective way to accomplish this is to group the compounds based on functionality, i.e., hydrocarbons, halocarbons, aromatics, alcohols, aldehydes, ketones, etc. If there are only a few compounds in each subset, decide if any subsets can be combined, such as alcohols, aldehydes, and ketones into a polar soup. The ratio of the molecular weight to the density provides the volume required for one mole of each component. This ratio is multiplied by the desired number of millimoles to adjust the volume per component injected. The number of millimoles injected per component is determined by the cost and availability of neat compounds, and the total volume of soup required. Soups are commonly prepared in 2 ml amber vials; therefore an appropriate total soup volume is 500 µl to 1500 µl.

$$\frac{\text{(Molecular weight (mg/mmol)}}{\text{Density (mg/ul)}} \text{ (Desired mmol (mmol/cmp))} = \text{Volume(ul)/mmole component}$$

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The total volume for the soup is determined by summing the individual component volumes, and adjusting the number of moles injected if the total volume is greater or less than the desired range. To establish the approximate molar concentration of an individual soup component, the following calculation is applied:

$$\frac{\text{Number of mmoles injected (mmol)}}{\text{Total soup volume (ul)}} = \text{Molar Concentration (mmol/ul)}$$

When sealed with a septum-containing screw cap or Mininert valve and stored in the freezer, a compatible primary stock soup is stable for approximately six months.

Meticulous cleaning of syringes by flushing with methanol and vacuum drying with a syringe cleaner will minimize contamination of the primary standard and the source neat compound. Ideally, a single syringe should be used for each neat compound. If this is not possible, carefully clean and dry the syringe between injections, and flush the syringe several times with a small volume of neat solution prior to final measurement and injection.

Preparing Gas Phase Intermediate Standards from Primary Stock Mixtures

Primary neat stock mixtures are diluted and vaporized in an SDB producing a gas phase intermediate standard. The SDB must first be cleaned and dried. The SDB is opened in a hood to allow existing contents to exhaust, and is then filled with water to force the remaining components out of the bottle. If the SDB is new, these first two steps can be eliminated. Next, the SDB is washed with laboratory detergent and warm water. The bottle is rinsed until no more soap is evident and lastly, several rinses are made with organic free water. The SDB is dried in a 100ºC oven, removed, and allowed to cool. The SDB can be placed in a 300ºC muffle furnace to char any remaining organics; however, high temperatures will change the shape and ultimately the volume of the container. As a general rule, the actual SDB volume should be determined upon initial purchase, and after baking at temperatures in excess of 100ºC. Several clean glass beads are placed in the SDB, and the bottle is flushed with nitrogen gas. The SDB is capped immediately with a clean Mininert valve containing a new septum, and is now ready for standard preparation.

The desired SDB concentration is established and the actual SDB volume is recorded. From the ideal gas law, the molar volume of an ideal gas is determined (V=nRT/P). The volume of soup required for a given final concentration in the SDB is calculated by the following equation:

$$\frac{(\text{Conc}_{\text{SDB}}\,(\text{ul/L}))\,(V_{\text{SDB}}\,(\text{L}))}{(\text{Molar Conc (umol/ul)})\,((\text{nRT/P})\,(\text{ul/umol}))} = V_{\text{soup added to SDB}}\,(\text{ul})$$

The calculated volume of soup is added to the SDB through the septum port of the Mininert™ valve. The bottle is swirled, stirring the glass beads to enhance vaporization and the standard is allowed to equilibrate several hours. Heating the SDB to 65ºC may be required for intermediate standards containing components with low vapor pressures similar to trichlorobenzenes and hexachlorobutadiene to ensure complete vaporization[2].

Concentration units for air analysis are commonly expressed as a volume to volume ratio. That is, an SDB containing analytes at a concentration of 200ppm v/v contains 200 microliters of analyte per liter of air. Conventional water and soil methodologies express concentration units in terms of mass of analyte per volume of water (ug/L) or mass of analyte per mass of soil (mg/kg)[3,4]. Volume to volume measurements are easily converted to the more familiar mass to volume measurements by using the molar volume and molecular weight in a conversion equation. For example, an SDB containing acetone at a concentration 10ppm v/v yields 23.9ug/L of acetone:

$$\frac{\text{(SDB concentration(ul/L))}}{\text{(Molar volume of an ideal gas(ul/umol))}}\ \text{(MW of acetone(ug/umol))} = \text{Concentration of acetone (ug/L)}$$

$$\frac{10\text{ul/L}}{24.45\text{ul/umol}}\ (58.08\ \text{ug/umol}) = 23.9\text{ug/L}$$

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Preparing Working Standards from SDB's

Canister Cleaning

The final step in ambient air standard preparation is diluting the SDB into a working range canister standard. Care must be taken to ensure the canister is clean. Many questions exist regarding parameters for canister cleaning, including the necessity of heat and humidity, the use of nitrogen or compressed air, the number of fill/evacuate cycles, the duration of final evacuation and the final evacuation pressure. The procedure outlined here performs well for cleaning canisters containing a modified TO14 standard up to 200ppbv, 100% relative humidity, and 5% carbon dioxide. Cleanliness specifications are less than 0.2ppbv per target analyte. Modifications to this procedure may be necessary depending on the source of the samples.

The canister is placed in an oven with the canister valve exposed to ambient air, and is heated to 140°C. A cold finger is placed in line before the vacuum pump to trap impurities which may diffuse from the vacuum pump oil. The canister is initially evacuated to ~25in vacuum, followed by pressurization to ~30psig, with humidified zero air. The cycles are repeated seven to ten times. The humidity chamber is then taken off line, and seven to ten fill/evacuate cycles are repeated with dry zero air. The final evacuation is held for 30-60 minutes. The canister valve is closed and the canister is now ready for standard preparation or sampling. Per EPA methodologies, all canisters must be tested for cleanliness until the cleaning system is verified, after which, a smaller percentage of canisters is tested. Canisters must also be pressure tested over a 24 hour period to ensure that the container is leak free[5].

Standard Preparation

Prior to injecting standard into the cleaned, evacuated canister, the canister is humidified with purified water. Humidification further passivates the interior surface, reducing activity and facilitating the removal of compounds, and creates an environment that more accurately represents the actual sample matrix. Preparing canister standards at 50% relative humidity provides sufficient moisture to reduce canister surface activity. It is standard practice to base relative humidity on the canister volume at ambient pressure, not the final pressurized volume.

From a relative humidity table[6], the mass of water contained in a cubic meter of saturated air at a specific temperature can be obtained. This value is used to calculate the volume of water required for a specific relative humidity. For example, at 25°C, 23.05g of water saturates a cubic meter of air. To calculate the volume of water required to provide 100% relative humidity in a six liter canister, apply the following relationship:

$$(23.05 g/m^3)\ (m^3/1000L)\ (6L) = 0.1383g\ H_2O \text{ in 6L canister}$$

$$\frac{(0.1383g)}{1g/ml}\ (1000ul/ml) = 138.3ul\ H_2O \text{ in 6L canister}$$

Injecting 138.3ul of water into a six liter canister will provide 100% relative humidity. Reducing the volume injected to 69ul will result in 50% relative humidity.

Relative humidity is strongly dependent on temperature. A drop of only 5°C in room temperature creates a 25% difference in the mass of water required to saturate a cubic meter of air. Therefore, for greatest accuracy, room temperature should be monitored and humidity tables utilized to determine the correct value for specific laboratory conditions.

Once the canister is humidified, the gas phase intermediate standard can be injected. To determine the volume of SDB intermediate standard to inject, the desired canister concentration, SDB concentration, and final canister volume must be known. The following relationship is used to calculate the volume required.

$$\frac{(\text{Desired canister concentration (ul/L)})\ (\text{Final canister volume (L)})}{\text{Concentration}_{SDB}\ (ul/L)} = \text{Volume}_{\text{from SDB}}\ (L)$$

A six liter canister at atmospheric pressure has a volume of six liters. From this, the final canister volume can be calculated from the final canister pressure. The following conversion factors between atmospheric pressure units are valuable for making this determination.

1atm = 14.7psia = 0psig = 29.9in Hg = 760mm Hg = 760 Torr

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To accurately transfer a volume of gas from the SDB to the canister, a gas tight syringe must be used. Insert the syringe through the Mininert™ valve and draw an aliquot of standard. Flush the contents of the syringe into a hood and repeat. Once flushed, insert the syringe through the Mininert™ valve and pump several times, filling the syringe and releasing the contents back into the SDB. Finally, slowly draw standard into the syringe past desired final volume; allow several seconds for equilibration, then adjust to the correct volume. Remove the syringe from the SDB and immediately inject the contents into the humidified canister. The canister can now be pressurized to the final dilution volume.

Every time standard is removed from the SDB, the concentration changes. To increase the useful lifetime of an SDB standard, remove volumes of 25ml or less. The volume removed can be manipulated by increasing the SDB concentration or adjusting the canister final volume/pressure. Depending upon the volume removed, an SDB intermediate standard is usable for approximately two months.

Compressed gas standards are often used in conjunction with SDB standards to increase the number of compounds per analysis. Metering the cylinder standard through an electronic mass flow controller (MFC) is an accurate, effective and relatively inexpensive method for delivering the standard to a canister. The standard is allowed to flow through the MFC for approximately 15min to ensure that the contents are homogeneous. The outlet to the MFC is then connected to the canister and the standard transfer is timed to obtain the desired volume. Alternately, gas blending or permeation tube systems can be utilized to create working range standards. Although these techniques automate the standards preparation process, they are costly.

Conclusion

Standard preparation for air toxics analysis requires analyst skill and is time intensive. Understanding the basic calculations and close attention to good laboratory practices will greatly simplify the process. To eliminate repeated tedious calculations, the equations outlined can be incorporated into a spreadsheet program. Once established, spreadsheets are easily customized to reflect any analyte mixture.

Acknowledgment

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Preparation of Standards Using a "Cocktail" or "Soup".

The Teldyne Application Note above is included for reference for technique. The actual procedures used by the lab are as follows:

The Summa can stock standard is prepared by spiking a small amount of a neat chemical cocktail and pressurizing with humid zero air in accordance with procedures below:

Cocktail Preparation Equi-mass "soup" (contains compounds in equal mass amounts) or cocktail prepared from the neat compounds:

Step 1: This cocktail is prepared by combining 25mg of each neat compound into a small glass vial. Use a microliter syringe to transfer each compound, cleaning with solvents in between. Put the vial in the freezer between aliquots to minimize volatilization. Take the density of each compound into account to determine the **actual amount of each compound to spike into the cocktail:**.

$$S = \frac{A}{D}$$

Where:

S Actual spike amount (µL)
A Desired amount for each compound (mg)
D Density (mg/µL), refer to Table 3 for the density

Example: The actual amount of acrolein to add to the cocktail is calculated by the following.

$$S(\text{Acrolein}) = \frac{25mg}{\left(0.840\frac{mg}{\mu l}\right)} = 29.8\mu L$$

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Step 2: The concentration of each compound in the cocktail:

$$C = \frac{A}{V}\left(1000\frac{\mu g}{mg}\right)$$

Where:

C Concentration of cocktail (µg/µL)
A Amount of each compound (mg)
V Final volume of cocktail (added spike amounts of each compound) (µL)

Example:

$$C = \frac{25mg}{631.8\mu L}\left(1000\frac{\mu g}{mg}\right) = 39.569\mu g/\mu L$$

Intermediate Standard - Prepare the intermediate standard by spiking a small aliquot of the soup into a certified clean, evacuated Summa canister in order to achieve a final nominal concentration of 1000ng/L. Attach a teflon line with a stainless steel tee to the fill station. Attach the empty canister to the tee. Put a septum in the remaining tee fitting. Open the canister valve for a few seconds, and then close it. Check the vacuum gauge for fifteen seconds to make sure there is no leak. Then open the valve again and spike in the neat cocktail. Start air flow into the can and slowly pressurize to 58.8 psig. Then allow the contents to equilibrate for approximately 24 hours before using the spike amount is determined by using the following equation.

$$S = \frac{C_1 V}{C_2 * 1000ng/\mu g}$$

Where:

S Spike amount required in order to obtain the desired concentration (µL)
C_1 Desired concentration (ng/L)
C_2 Concentration of cocktail (µg/µL)
V Final volume of Summa canister (L) – as calculated above

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Example: Determine the spike amount of the cocktail required to achieve the desired intermediate standard concentration.

$$S = \frac{\left(1000\frac{ng}{L}\right)(30L)}{1000\frac{ng}{\mu g} * 27.81\frac{\mu g}{\mu L}} = 1.08\mu L$$

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ATTACHMENT B
SAMPLING INSTRUCTIONS

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Sampling with a Summa Canister and Flow Controller

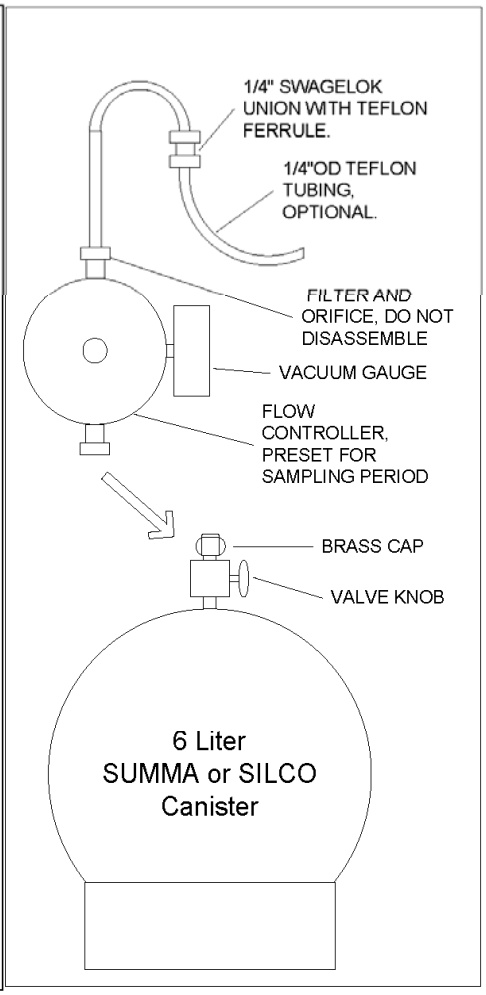
Equipment: **Summa or Silco canister, Flow Controller, Teflon Tubing** (optional)

Important Notes:

- Care must be used with the canister valves. DO NOT OVER-TIGHTEN THE VALVES.
- Do not connect flow controllers to a source with positive pressure greater than 5 psi. Do not disassemble the flow controller.
- The Flow controller accepts ¼" OD tubing. Teflon tubing is available from CAS.
- Tighten steel compression fittings 1/8 turn past finger tight. Over tightening will cause damage to threads.
- Avoid the collection of liquids, which may block the flow controller and interrupt sampling.
- Do not remove the bar code or serial number labels from the canisters.
- Do not make any markings directly on the canister or affix any labels.
- Please call the laboratory with any questions regarding proper use or shipping of equipment.
- Please return all equipment provided. Please wrap flow controllers securely in bubble wrap for shipping.

Procedure:

1. Ensure that the valve is fully closed (the valve knob should be turned completely clockwise).
2. Using a 9/16" wrench, remove the brass cap from the valve on the Summa canister.
3. Attach the flow controller to the valve and tighten with a wrench.
4. If sampling through tubing, attach the tubing to the flow controller. The Swagelok nut contains a ¼" Teflon ferrule which seals easily with 1/8" of a turn past finger tight.
5. Open the canister valve, turn the knob counterclockwise, and note the initial vacuum. The initial vacuum will vary with barometric pressure of the sampling location but is usually within 28-30"Hg.
6. At the end of the sampling period, note the final vacuum. The flow controller is set to end at 5"Hg over the specified sampling period. Samples with vacuums greater than 5"Hg may not meet required method reporting limits. If 5"Hg has not been reached, sampling should be allowed to continue.
7. Close the valve by turning the knob clockwise. Do not over tighten.
8. Remove the flow controller. Wrap securely in bubble wrap for shipping.
9. Replace the brass cap. Tighten it with a 9/16" wrench.
10. Label the sample tag provided and complete a chain of custody form.
11. Place the chain of custody form, along with the canister, and flow controller back into the original box in which they were shipped to you.



Columbia Analytical Services
1565 Jefferson Rd. Building 300, Suite 360 Rochester, New York 14623
Ph 585-288-5380 Fax 585-288-8475

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Sampling with a Summa Canister How to take a Grab Sample

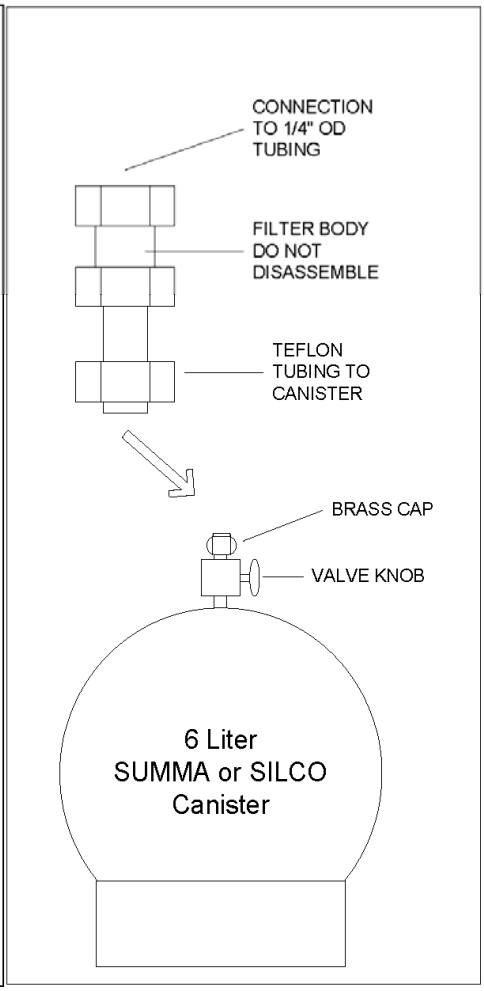
Equipment: **Summa or Silco canister, Particulate Filter, Vacuum Gauge, Teflon Tubing** (optional)

Important Notes:

- Care must be used with the canister valves. DO NOT OVER-TIGHTEN THE VALVES.
- Do not connect to a source with positive pressure greater than 40 psi.
- When collecting grab samples please use the particulate filter provided. Failure to filter the sample stream may result in damage to the canister and valve. The filter is a ¼" Swagelok fitting, it accepts ¼" OD tubing. Teflon tubing is available from CAS.
- Tighten compression fittings 1/8 turn past finger tight. Over tightening will cause damage to threads.
- Avoid the collection of liquid water or process condensate.
- Do not remove the bar code or serial number labels from the canisters.
- Do not make any markings directly on the canister or affix any labels.
- Please call the laboratory with any questions regarding proper shipping of canisters.
- Please return all equipment provided.

Procedure:

1. Ensure that the valve is fully closed (the valve knob should be turned completely clockwise).
2. Using a 9/16" wrench, remove the brass cap from the valve on the Summa canister.
3. Attach the Vacuum Gauge and tighten with a wrench.
4. Open the canister valve, turn the knob counterclockwise, and note the initial vacuum. The initial vacuum will vary with barometric pressure of the sampling location but is usually within 28-30"Hg.
5. Close the canister valve and remove the vacuum gauge.
6. Attach the particulate filter to the canister valve. The short piece of Teflon tubing attaches to the canister. Tighten with a wrench. Do not disassemble the tubing from the Swagelok union. It contains a 2-micron particulate filter.
7. If sampling through tubing, attach the tubing to the particulate filter. The Swagelok nut contains a ¼" Teflon ferrule which seals easily with 1/8" of a turn past finger tight.
8. Fully open the canister valve, turn the knob counterclockwise until there is no resistance. You will hear a hissing noise as the vacuum dissipates and air flows in.
9. Once the hissing noise stops, the vacuum has fully dissipated, and your sample has been collected. This takes approximately 5-10 seconds. Close the valve by turning the knob clockwise.
10. Check the canister final vacuum in the same manner as the initial vacuum check.
11. Replace the brass cap. Tighten it with a 9/16" wrench.
12. Label the sample tag provided and complete a chain of custody form.
13. Place the chain of custody form, along with the canister, back into the original box in which it was shipped to you.



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Sampling with a Summa Canister How to take a Grab Sample

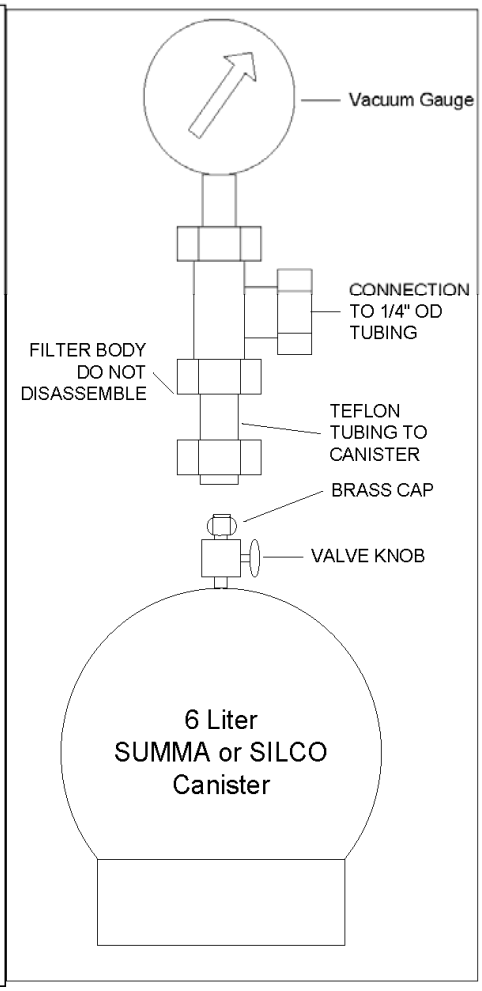
Equipment: **Summa or Silco canister, Particulate Filter, Vacuum Gauge, Teflon Tubing** (optional)

Important Notes:

- Care must be used with the canister valves. DO NOT OVER-TIGHTEN THE VALVES.
- Do not connect to a source with positive pressure greater than 40 psi.
- When collecting grab samples please use the particulate filter provided. Failure to filter the sample stream may result in damage to the canister and valve. The filter is a ¼" Swagelok fitting, it accepts ¼" OD tubing. Teflon tubing is available from CAS.
- Tighten compression fittings 1/8 turn past finger tight. Over tightening will cause damage to threads.
- Avoid the collection of liquid water or process condensate.
- Do not remove the bar code or serial number labels from the canisters.
- Do not make any markings directly on the canister or affix any labels.
- Please call the laboratory with any questions regarding proper shipping of canisters.
- Please return all equipment provided.

Procedure:

1. Ensure that the valve is fully closed (the valve knob should be turned completely clockwise).
2. Using a 9/16" wrench, remove the brass cap from the valve on the Summa canister.
3. Attach the Vacuum Gauge and tighten with a wrench.
4. Open the canister valve, turn the knob counterclockwise, and note the initial vacuum. The initial vacuum will vary with barometric pressure of the sampling location but is usually within 28-30"Hg.
5. Close the canister valve and remove the vacuum gauge.
6. Attach the particulate filter to the canister valve. The short piece of Teflon tubing attaches to the canister. Tighten with a wrench. Do not disassemble the tubing from the Swagelok union. It contains a 2-micron particulate filter.
7. If sampling through tubing, attach the tubing to the particulate filter. The Swagelok nut contains a ¼" Teflon ferrule which seals easily with 1/8" of a turn past finger tight.
8. Fully open the canister valve, turn the knob counterclockwise until there is no resistance. You will hear a hissing noise as the vacuum dissipates and air flows in.
9. Once the hissing noise stops, the vacuum has fully dissipated, and your sample has been collected. This takes approximately 5-10 seconds. Close the valve by turning the knob clockwise.
10. Check the canister final vacuum in the same manner as the initial vacuum check.
11. Replace the brass cap. Tighten it with a 9/16" wrench.
12. Label the sample tag provided and complete a chain of custody form.
13. Place the chain of custody form, along with the canister, back into the original box in which it was shipped to you.



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ATTACHMENT C
EXAMPLE CALCULATION

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[redacted] TO-15 air calculations.

All page references are from the hardcopy report. Copies of the referenced pages are included with additional notes and values circled to aid in following the calculations.

The referenced formulas have been copied from our SOP

Page 269-270 of the report is the routine Chemstation report. The format and labels can not be edited. The table headers are the calibration level IDs. They are labeled as the nominal PPB value of the injected standard. The table contains the response factors for each point. This data is reproduced on pages 276-277 with more significant figures. It is important to note that these are values direct from chemstation and not externally calculated.

Pages 271-272 list the ng injected on column for each standard, the same units as indicated on the chromatograms. Page 272 contains the foot note indicating this. TO-15 standards are sold as nominal standard and the true value may vary by as much as 10% from the nominal value. The values in the table are the injected ng on column calculated from the certified values of the stock standard not the nominal value.

Pages 273-274 are the raw area responses. These match the area values on each standard's quant report. (page 282)

The calibration and calculation of TCE.

Relative Response Factor (RRF):

$$RRF = \frac{A_x C_{is}}{A_{is} C_x}$$

where:

A_x is the area response of the analyte quantitation ion. 1338 (page 274)
A_{is} is the area response of the corresponding internal standard 741336 (page 273) quantitation ion.
C_{is} Internal standard concentration, ng. 11.6400 (page 271)
C_x Analyte concentration, ng. 0.0564 (page 272)

RRF= 0.37249
Reported by chemstation as 0.372 (page 269)
Also calculated as 0.3725 (page 277)

The Average RRF is listed as 0.346 (page 269) when calculated manually for more significant figures it is 0.34551 (page277)

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Target concentration calculation for TCE, Sample [redacted] raw data values on page 25.

$$C_x = \frac{A_x C_{is}}{A_{is} \overline{RRF}}$$

where:

C_x is the concentration, in ng, of analyte x.
A_x is the area response of the analyte's quantitation ion. 834064
A_{is} is the area response of the corresponding internal standard's quantitation ion. 646650
C_{is} is the internal standard concentration, in ng. 11.6400
$\overline{RRF}$ is the average or mean RRFs 0.346 (page 269) also found on CCV summary (page 336) when calculated manually it is 0.34551 (page277)

Concentration calculates as 43.453ng , when using the average RRF of 0.34551.
This agrees with the reported result of 43.4530 (page 25)

Pressure Dilution Factor, PDF, for samples collected in Summa canisters:

$$\text{PDF} = \frac{P_{atm} + P_f}{P_{atm} + P_i}$$

where:

P_{atm} is the ambient atmospheric pressure, 14.7 psig at sea level.
P_f is the final sample canister pressure, in psig 3.5 (page 23)
P_i is the initial sample canister pressure, in psig -3.2 (page 23)

Calculates as 1.58 compared to 1.59 on the report page 23. This difference is due to the number of significant figures entered as raw Pi and Pf value into the LIMS data.

The final analyte concentration, $FinalC_x$, in units of ng/L (ug/m^3), is then calculated from the following:

$$FinalC_x = PDF\left(\frac{Cx}{Vs}\right)$$

where:

Cx calculated above 43.453
Vc is the calibration standard sample volume analyzed, in liters, always 1L
Vs is the sample volume analyzed, in liters. 0.116L (page23, 25)
PDF is the sample canister pressure dilution factor. 1.59 (page 23)

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Calculates as 595.6 reported as 600 ug/m3 on page 23.

To convert concentrations units between mass/volume and volume/volume units the equations are:

$$C_{ug/m^3} = C_{ppbv}\left(\frac{FW}{24.46}\right) \quad \text{or} \quad C_{ppbv} = C_{ug/m^3}\left(\frac{24.46}{FW}\right)$$

where:

FW is the formula weight of the analyte, in g/mole, 131.4 for TCE
24.46 is the molar volume of an ideal gas at 298 K (25 °C) and 760 mmHg (1 atm), in liters per mole (l/mol).
C_{ug/m^3} the analyte concentration in micrograms per cubic meter.
C_{ppbv} the analyte concentration in parts per billion by volume.

Calculates as 111.7 reported as 110 on page 23.

Regarding the question of surrogate recoveries page 25 shows the calculated value of 17.7213ng for a 17.880ng spike with a recovery of 99.11%

Regarding the calculation on ng values for the chemstation method.
This data is not generally provided with a report.

The attached pages trace the concentration from the purchased stock standard to the ng on column value. The values for TCE are circled on each page.

An example of the stock standard certificate of analysis (pages A-C)
Conversion from ppb to ng/L (page D)
Calculation of ng on column for each standard injected during calibration (pages E-G)
Table of combined data for standards (pages H-I)

These ng values match the values reported from chemstation on page 272.
These values are recalculated with the purchase of a new standard or the annual recertification of an existing one.

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Response Factor Report Air2.rpt Response Factor Report Air2.rpt

Method Path : J:\ACQUDATA\AIR2\METHODS\
Method File : 030911.M
Title : TO-15
Last Update : Thu Mar 10 10:06:30 2011
Response Via : Initial Calibration

Calibration Files
0.01=B0721.D 0.02=B0722.D 0.1 =B0723.D 0.2 =B0724.D 0.5 =B0725.D 1.0 =B0726.D 2.5 =B0727.D
5.0 =B0728.D 7.5 =B0729.D 10.0=B0730.D

Calibration level ID in nominal PPB,

	Compound	0.01	0.02	0.1	0.2	0.5	1.0	2.5	5.0	7.5	10.0	Avg	%RSD
1) I	bromochloromethane				ISTD								
2)	propylene			2.450	2.443	2.267	2.089	2.289	2.190	2.199	2.157	2.260	
3)	dichlorodifluo...	2.901	3.004	2.868	2.975	2.930	2.723	3.023	2.871	2.898	2.844	2.904	5.76
4)	freon-114	2.364	2.302	2.371	2.424	2.360	2.296	2.394	2.296	2.334	2.292	2.344	3.01
5)	chloromethane		2.594	2.327	2.481	2.356	2.324	2.444	2.299	2.353	2.293	2.386	1.99
6)	vinyl chloride	2.261	2.347	2.209	2.416	2.367	2.296	2.441	2.324	2.351	2.300	2.331	4.22
7)	1,3-butadiene	1.989	1.783	1.843	1.928	1.893	1.918	2.005	1.932	1.950	1.922	1.916	2.97
8)	bromomethane	1.719	1.583	1.438	1.476	1.439	1.406	1.464	1.403	1.417	1.388	1.473	3.40
9)	chloroethane	1.136	1.249	1.215	1.265	1.242	1.269	1.283	1.221	1.243	1.212	1.233	6.96
10)	trichlorofluor...	2.400	2.488	2.438	2.505	2.444	2.426	2.484	2.386	2.418	2.376	2.436	3.36
11)	ethanol				0.744	0.603	0.834	0.748	0.604	0.512	0.697	0.678	1.82
12)	freon-113	1.513	1.532	1.463	1.502	1.493	1.513	1.518	1.483	1.523	1.513	1.505	16.23
13)	1,1-dichloroet...	2.236	1.990	2.040	2.096	2.113	2.147	2.211	2.169	2.205	2.179	2.139	1.37
14)	acetone					3.446	3.218	3.079	3.036	3.083	3.059	3.153	3.69
15)	isopropanol				2.477	1.871	2.777	2.717	2.045	1.551	1.770	2.173	4.97
16)	carbon disulfide	5.333	5.198	5.142	5.375	5.320	5.310	5.478	5.298	5.387	5.286	5.313	22.32
17)	methylene chlo...	1.411	1.427	1.393	1.428	1.421	1.458	1.469	1.426	1.450	1.438	1.432	1.78
18)	trans-1,2-dich...	1.774	1.959	1.832	1.960	1.964	2.046	2.074	2.037	2.086	2.082	1.981	1.58
19)	methyl tert bu...	4.110	3.800	3.853	3.793	3.948	4.145	4.199	4.255	4.401	4.397	4.090	5.42
20)	hexane	2.306	2.382	2.256	2.326	2.368	2.508	2.572	2.525	2.587	2.573	2.440	5.66
21)	1,1-diclethane	2.533	2.489	2.492	2.576	2.560	2.652	2.621	2.555	2.612	2.583	2.567	5.15
22)	vinyl acetate			3.137	3.187	3.388	3.617	3.722	3.802	3.959	3.974	3.598	2.08
23)	2-butanone			3.088	2.723	3.042	3.298	3.450	3.414	3.596	3.675	3.286	9.12
24)	cis-1,2-dichlo...			1.433	1.473	1.451	1.499	1.541	1.519	1.563	1.555	1.504	9.67
25)	ethyl acetate	4.182	4.645	3.913	4.264	4.237	4.166	4.078	4.206	4.264	4.176	4.213	3.23
26)	chloroform	2.125	2.209	2.279	2.361	2.337	2.420	2.415	2.364	2.430	2.419	2.336	4.37
27)	tetrahydrofuran				0.819	0.893	0.949	0.948	0.968	1.004	1.004	0.941	4.39
28) I	1,4-difluorobenzene						ISTD						6.99
29)	1,1,1-trichlor...	0.468	0.456	0.478	0.490	0.487	0.501	0.503	0.489	0.507	0.498	0.488	
30)	cyclohexane	0.545	0.553	0.558	0.583	0.590	0.621	0.641	0.623	0.647	0.636	0.600	3.33
31)	carbon tetrach...	0.438	0.432	0.434	0.438	0.437	0.453	0.455	0.442	0.459	0.450	0.444	6.48
32)	1,2-dichloroet...	0.349	0.355	0.389	0.389	0.392	0.405	0.404	0.396	0.409	0.402	0.389	2.15
33)	benzene	1.346	1.266	1.229	1.266	1.239	1.303	1.321	1.288	1.349	1.338	1.294	5.36
34)	heptane	0.322	0.338	0.319	0.333	0.348	0.377	0.387	0.378	0.394	0.387	0.356	3.40
35)	trichloroethene	0.372	0.344	0.327	0.336	0.329	0.344	0.350	0.340	0.358	0.354	0.346	8.12
36)	1,2-diclpropane	0.306	0.324	0.323	0.328	0.331	0.345	0.347	0.340	0.354	0.351	0.335	3.95
37)	1,4-dioxane			0.172	0.172	0.154	0.210	0.203	0.169	0.162	0.202	0.181	4.53
38)	bromodichlorom...	0.371	0.395	0.410	0.435	0.426	0.450	0.457	0.446	0.465	0.460	0.431	11.67

030911.M Thu Mar 10 10:06:50 2011 Page: 1

Calibration Concentrations in Ng.
Same units as above.

3/10/11

00269

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Area Response Factor Report in Air Raw Response Factor Report in Air 2 with Average Response Factor Report

Method Path : J:\ACQUDATA\AIR2\METHODS\
Method File : 030911.M
Title : TO-15

39)		cis-1,3-dichlo...		0.444	0.465	0.483	0.505	0.527	0.527	0.555	0.549	0.507	7.91
40)		4-methyl-2-pen...		0.602	0.601	0.652	0.687	0.706	0.718	0.746	0.742	0.682	8.47
41)		toluene	1.161	1.184	1.228	1.259	1.310	1.348	1.334	1.407	1.402	1.292	6.95
42)		trans-1,3-dich...		0.422	0.436	0.437	0.469	0.492	0.496	0.522	0.520	0.474	8.30
43)		1,1,2-trichlor...	0.293	0.309	0.316	0.312	0.319	0.324	0.320	0.337	0.334	0.318	4.17
44)		tetrachloroethene	0.311	0.311	0.333	0.333	0.350	0.352	0.349	0.371	0.372	0.342	6.25
45)		2-hexanone		0.539	0.533	0.602	0.633	0.662	0.680	0.711	0.700	0.633	10.93
46)		dibromochlorom...	0.307	0.330	0.331	0.335	0.346	0.359	0.358	0.377	0.376	0.347	6.70
47)		1,2-dibromoethane	0.289	0.315	0.320	0.325	0.334	0.343	0.342	0.364	0.362	0.332	7.12
48)	I	chlorobenzene-d5					ISTD						
49)		chlorobenzene	0.910	0.977	0.942	0.962	0.951	0.971	0.972	0.951	0.984	0.985	0.960	2.39
50)		ethylbenzene	1.506	1.519	1.511	1.550	1.610	1.650	1.695	1.678	1.751	1.759	1.623	6.04
51)		M+P xylene		1.122	1.158	1.210	1.250	1.292	1.315	1.328	1.396	1.413	1.276	7.86
52)		O xylene		1.059	1.086	1.143	1.206	1.260	1.282	1.295	1.356	1.367	1.228	9.14
53)		styrene				0.881	0.972	1.025	1.055	1.075	1.131	1.141	1.040	8.78
54)		bromoform		0.279	0.281	0.280	0.292	0.307	0.315	0.320	0.337	0.340	0.306	7.84
55)	S	surr 1, bromof...	0.397	0.400	0.402	0.402	0.408	0.412	0.411	0.417	0.413	0.416	0.408	1.71
56)		1,1,2,2-tetrac...	0.674	0.663	0.617	0.633	0.647	0.640	0.641	0.641	0.661	0.657	0.647	2.56
57)		4-ethyltoluene				1.353	1.501	1.543	1.572	1.616	1.698	1.701	1.569	7.74
58)		1,3,5-trimethy...		1.161	1.088	1.147	1.238	1.258	1.261	1.291	1.342	1.347	1.237	7.18
59)		1,2,4-trimethy...				1.015	1.136	1.190	1.212	1.250	1.312	1.310	1.204	8.68
60)		1,3-dclbenz	0.661	0.716	0.628	0.641	0.677	0.674	0.679	0.694	0.725	0.727	0.682	4.95
61)		1,4-dclbenz	0.686	0.717	0.643	0.661	0.693	0.678	0.693	0.707	0.737	0.738	0.695	4.42
62)		benzyl chloride	1.001	0.997	0.916	0.977	1.082	1.085	1.119	1.172	1.219	1.213	1.078	9.66
63)		1,2-dclbenz	0.683	0.687	0.610	0.625	0.655	0.640	0.636	0.650	0.676	0.674	0.654	3.99
64)		1,2,4-trichlor...				0.320	0.331	0.285	0.334	0.340	0.372	0.349	0.333	8.03
65)		hexachlorobuta...			0.270	0.270	0.274	0.229	0.253	0.264	0.280	0.279	0.265	6.34
66)		naphthalene			0.884	0.910	1.018	0.883	1.084	1.113	1.243	1.166	1.037	13.17

(#) = Out of Range

00270

030911.M Thu Mar 10 10:06:50 2011 Page: 2

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Method File : 030911.M Calibration Title : TO-15 Last Calibration Update : Thu Mar 10 09:36:59 2011

Calibration Table Concentrations (Level 1-20)

file		B0721.D	B0722.D	B0723.D	B0724.D	B0725.D	B0726.D	B0727.D	B0728.D	B0729.D	B0730.D
Level		1	2	3	4	5	6	7	8	9	10
ID	Compound	0.01	0.02	0.1	0.2	0.5	1.0	2.5	5.0	7.5	10.0
1)	bromochloromethane	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.22
2)	propylene	0.0104	0.0368	0.1749	0.3682	0.9204	1.8408	4.6020	9.2039	13.8059	18.4078
3)	dichlorodifluoromethane	0.0494	0.0989	0.4696	0.9886	2.4716	4.9432	12.3579	24.7159	37.0738	49.4317
4)	freon-114	0.0706	0.1412	0.6705	1.4115	3.5288	7.0576	17.6440	35.2881	52.9321	70.5761
5)	chloromethane	0.0213	0.0425	0.2020	0.4252	1.0631	2.1261	5.3153	10.8306	15.9458	21.2611
6)	vinyl chloride	0.0261	0.0521	0.2476	0.5213	1.3031	2.6063	6.5157	13.0315	19.5472	26.063
7)	1,3-butadiene	0.0232	0.0464	0.2206	0.4644	1.1610	2.3219	5.8048	11.6097	17.4145	23.2193
8)	bromomethane	0.0392	0.0784	0.3723	0.7837	1.9593	3.9186	9.7965	19.5930	29.3895	39.186
9)	chloroethane	0.0269	0.0538	0.2555	0.5379	1.3448	2.6897	6.7242	13.4485	20.1727	26.897
10)	trichlorofluoromethane	0.0584	0.1168	0.5549	1.1682	2.9204	5.8408	14.6019	29.2038	43.8056	58.4075
11)	ethanol	0.0173	0.0347	0.1646	0.3466	0.8664	1.7328	4.3320	8.6640	12.9960	17.328
12)	freon-113	0.0789	0.1578	0.7496	1.5781	3.9452	7.8905	19.7262	39.4525	59.1787	78.9049
13)	1,1-dichloroethene	0.0416	0.0832	0.3953	0.8323	2.0807	4.1614	10.4034	20.8068	31.2102	41.8137
14)	acetone	0.0252	0.0503	0.2391	0.5034	1.2585	2.5170	6.2924	12.5848	18.8772	25.1696
15)	isopropanol	0.0285	0.0570	0.2708	0.5700	1.4251	2.8502	7.1255	14.2510	21.3765	28.502
16)	carbon disulfide	0.0324	0.0647	0.3075	0.6475	1.6187	3.2374	8.0934	16.1868	24.2801	32.3735
17)	methylene chloride	0.0361	0.0722	0.3431	0.7222	1.8055	3.6111	9.0277	18.0554	27.0832	36.1109
18)	trans-1,2-dichloroethene	0.0416	0.0832	0.3953	0.8323	2.0807	4.1614	10.4034	20.8068	31.2102	41.6137
19)	methyl tert butyl ether	0.0386	0.0771	0.3663	0.7712	1.9281	3.8561	9.6403	19.2806	28.9208	38.5611
20)	hexane	0.0377	0.0754	0.3581	0.7540	1.8850	3.7699	9.4248	18.8497	28.2745	37.6993
21)	1,1-diclethane	0.0421	0.0842	0.3997	0.8415	2.1038	4.2076	10.5191	21.0381	31.5572	42.0762
22)	vinyl acetate	0.0313	0.0626	0.2976	0.6265	1.5662	3.1325	7.8312	15.6623	23.4935	31.3247
23)	2-butanone	0.0321	0.0643	0.3053	0.6427	1.6067	3.2134	8.0335	16.0670	24.1005	32.1341
24)	cis-1,2-dichloroethene	0.0420	0.0840	0.3991	0.8402	2.1005	4.2010	10.5025	21.0050	31.5075	42.01
25)	ethyl acetate	0.0378	0.0756	0.3593	0.7585	1.8912	3.7823	9.4558	18.9116	28.3674	37.8232
26)	chloroform	0.0512	0.1025	0.4868	1.0249	2.5823	5.1247	12.8116	25.6233	38.4349	51.2465
27)	tetrahydrofuran	0.0324	0.0649	0.3081	0.6486	1.6214	3.2429	8.1072	16.2144	24.3216	32.4289
28)	1,4-difluorobenzene	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.64
29)	1,1,1-trichloroethane	0.0582	0.1123	0.5337	1.1235	2.8087	5.6174	14.0435	28.0871	42.1306	56.1742
30)	cyclohexane	0.0368	0.0736	0.3497	0.7363	1.8408	3.6816	9.2039	18.4078	27.6118	36.8157
31)	carbon tetrachloride	0.0641	0.1283	0.6094	1.2829	3.2072	6.4144	16.0360	32.0720	48.1081	64.1441
32)	1,2-dichloroethane	0.0429	0.0858	0.4074	0.8577	2.1443	4.2885	10.7213	21.4427	32.1640	42.8854
33)	benzene	0.0338	0.0677	0.3216	0.6770	1.6925	3.3850	8.4624	16.9249	25.3873	33.8498

calibration table level ID in Nominal PPB.

Page 1 of 3

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3/10/2011 2:49 PM

00274

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		0.0438	0.0877	0.4164	0.8766	2.1916	4.3832	10.9581	21.9162	32.8743	43.8324
34)	heptane	0.0564	0.1128	0.5358	1.1280	2.8201	5.6402	14.1005	28.2010	42.3016	56.4021
35)	trichloroethene	0.0485	0.0970	0.4608	0.9701	2.4252	4.8503	12.1259	24.2517	36.3776	48.5035
36)	1,2-dichloropane	0.0378	0.0756	0.3593	0.7565	1.8912	3.7823	9.4558	18.9116	28.3674	37.8232
37)	1,4-dioxane	0.0703	0.1407	0.6681	1.4066	3.5164	7.0328	17.5819	35.1638	52.7458	70.3277
38)	bromodichloromethane	0.0467	0.0935	0.4439	0.9346	2.3364	4.6729	11.6822	23.3645	35.0467	46.729
39)	cis-1,3-dichloropropene	0.0459	0.0917	0.4357	0.9172	2.2931	4.5862	11.4656	22.9312	34.3967	45.8623
40)	4-methyl-2-pentanone	0.0399	0.0799	0.3793	0.7986	1.9965	3.9930	9.9825	19.9649	29.9474	39.9298
41)	toluene	0.0481	0.0962	0.4569	0.9618	2.4045	4.8090	12.0225	24.0450	36.0675	48.09
42)	trans-1,3-dichloropropene	0.0573	0.1145	0.5440	1.1453	2.8632	5.7265	14.3162	28.6325	42.9487	57.2649
43)	1,1,2-trichloroethane	0.0712	0.1424	0.6763	1.4237	3.5593	7.1186	17.7966	35.5931	53.3897	71.1862
44)	tetrachloroethene	0.0450	0.0901	0.4279	0.9009	2.2522	4.5043	11.2608	22.5217	33.7825	45.0433
45)	2-hexanone	0.0920	0.1839	0.8737	1.8393	4.5982	9.1963	22.9908	45.9817	68.9725	91.9634
46)	dibromochloromethane	0.0814	0.1628	0.7734	1.6282	4.0706	8.1411	20.3528	40.7056	61.0583	81.4111
47)	1,2-dibromoethane	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.02
48)	chlorobenzene-d5	0.0492	0.0985	0.4678	0.9848	2.4620	4.9239	12.3098	24.6196	36.9294	49.2392
49)	chlorobenzene	0.0460	0.0920	0.4371	0.9202	2.3005	4.6010	11.5025	23.0049	34.5074	46.0099
50)	ethylbenzene	0.0903	0.1806	0.8577	1.8057	4.5142	9.0284	22.5709	45.1418	67.7127	90.2836
51)	M+P xylene	0.0464	0.0929	0.4412	0.9289	2.3222	4.6444	11.6110	23.2220	34.8330	46.4439
52)	O xylene	0.0451	0.0903	0.4288	0.9027	2.2567	4.5135	11.2836	22.5673	33.8509	45.1345
53)	styrene	0.1075	0.2149	1.0208	2.1491	5.3728	10.7457	26.8642	53.7284	80.5926	107.4567
54)	bromoform	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.88
55)	surr 1, bromofluorobenzene	0.0734	0.1469	0.6975	1.4685	3.6713	7.3426	18.3564	36.7129	55.0693	73.4258
56)	1,1,2,2-tetrachloroethane	0.0526	0.1052	0.4995	1.0515	2.6288	5.2577	13.1442	26.2885	39.4327	52.577
57)	4-ethyltoluene	0.0521	0.1042	0.4948	1.0417	2.6043	5.2086	13.0214	26.0428	39.0642	52.0856
58)	1,3,5-trimethylbenzene	0.0526	0.1052	0.4995	1.0515	2.6288	5.2577	13.1442	26.2885	39.4327	52.577
59)	1,2,4-trimethylbenzene	0.0649	0.1298	0.6166	1.2981	3.2453	6.4906	16.2265	32.4530	48.6795	64.906
60)	1,3-dclbenz	0.0637	0.1274	0.6052	1.2741	3.1852	6.3704	15.9280	31.8520	47.7780	63.704
61)	1,4-dclbenz	0.0559	0.1118	0.5310	1.1179	2.7947	5.5894	13.9735	27.9471	41.9206	55.8942
62)	benzyl chloride	0.0637	0.1274	0.6052	1.2741	3.1852	6.3704	15.9260	31.8520	47.7780	63.704
63)	1,2-dclbenz	0.0778	0.1558	0.7400	1.5578	3.8946	7.7891	19.4728	38.9457	58.4186	77.8915
64)	1,2,4-trichlorobenzene	0.1130	0.2260	1.0735	2.2601	5.6502	11.3003	28.2508	58.5016	84.7523	113.0031
65)	hexachlorobutadiene	0.0581	0.1121	0.5326	1.1214	2.8034	5.6068	14.0170	28.0339	42.0509	56.0678
66)	naphthalene										

Calibration levels are labeled at nominal ppb value
Concentrations are ng injected on column

00272

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3/10/2011 2:49 PM

Page 2 of 3

HP CHEMSTATION CUSTOM REPORT CALIBRATION SUMMARY

Method File : 030911.M | Calibration Title : TO-15 | Last Calibration Update : Thu Mar 10 09:38:59 2011

Calibration Table Responses (Level 1-20)

file		B0721.D	B0722.D	B0723.D	B0724.D	B0725.D	B0726.D	B0727.D	B0728.D	B0729.D	B0730.D	
Level		1	2	3	4	5	6	7	8	9	10	11
ID	Compound	0.01	0.02	0.1	0.2	0.5	1.0	2.5	5.0	7.5	10.0	
1)	bromochloromethane	196006	189334	187053	184167	181965	185390	184824	190081	190869	198117	-1
2)	propylene	-1	-1	6062	12530	28723	53917	147240	289822	438298	595051	-1
3)	dichlorodifluorometh	2125	4255	19055	40971	99665	188792	522349	1020350	1551302	2106582	-1
4)	freon-114	2475	4655	22493	47672	114652	227219	590660	1165204	1783979	2424220	-1
5)	chloromethane	-1	1579	6651	14698	34476	69286	181596	351394	541731	730674	-1
6)	vinyl chloride	875	1751	7739	17543	42453	83916	222396	435457	663573	898365	-1
7)	1,3-butadiene	884	1185	5752	12475	30256	62465	162679	322444	490356	668960	-1
8)	bromomethane	999	1777	7576	16119	38818	77257	200473	395308	601151	814902	-1
9)	chloroethane	453	962	4392	9479	22989	47847	120568	236153	362072	488736	-1
10)	trichlorofluorometha	2078	4162	19138	40774	98246	198729	506998	1001844	1529080	2079793	-1
11)	ethanol	-1	-1	-1	3594	7192	20268	45298	75219	96141	180967	-1
12)	freon-113	1770	3462	15518	33010	81092	167455	418627	841131	1301201	1789663	-1
13)	1,1-dichloroethene	1379	2371	11411	24304	60512	125279	321576	648864	993800	1358970	-1
14)	acetone	-1	-1	-1	-1	59693	113593	270887	549281	840172	1153922	-1
15)	isopropanol	-1	-1	-1	19669	36698	111011	270648	419093	478734	755839	-1
16)	carbon disulfide	2562	4817	22374	48487	118529	241083	619846	1233135	1888321	2564620	-1
17)	methylene chloride	755	1476	6761	14371	35314	73829	185380	370193	567079	777969	-1
18)	trans-1,2-dichloroeth	1094	2334	10246	22720	56247	119388	301599	809291	940088	1298692	-1
19)	methyl tert butyl ethe	2352	4196	19970	40755	104775	224141	565877	1179629	1837835	2541116	-1
20)	hexane	1289	2572	11432	24430	61447	132601	338947	684460	1055888	1453876	-1
21)	1,1-diclethane	1581	3001	14094	30201	74138	156483	385512	772843	1190097	1628638	-1
22)	vinyl acetate	-1	-1	13209	27818	73034	158877	407549	856095	1342828	1865351	-1
23)	2-butanone	-1	-1	13339	24380	67281	148613	387477	788748	1251349	1769632	-1
24)	cis-1,2-dichloroether	-1	-1	8093	17240	41940	88295	226286	458908	710895	978973	-1
25)	ethyl acetate	2344	5029	19892	44932	110294	220991	539061	1143731	1746239	2367127	-1
26)	chloroform	1613	3243	15696	33704	82435	173901	432633	870867	1348617	1858113	-1
27)	tetrahydrofuran	-1	-1	-1	7401	19933	43157	107469	225707	352696	487837	-1
28)	1,4-difluorobenzene	741336	710467	689717	691260	890378	703556	695118	723739	718788	755425	-1
29)	1,1,1-trichloroethane	1675	3128	15102	32706	81096	170116	422211	853499	1317929	1816565	-1
30)	cyclohexane	1278	2482	11563	25474	64467	138192	352333	712801	1104022	1518732	-1
31)	carbon tetrachloride	1789	3386	15654	33399	83135	175650	435639	880932	1363437	1872387	-1
32)	1,2-dichloroethane	954	1857	9398	19795	49794	104986	258859	528074	813046	1120147	-1
33)	benzene	2898	5231	23414	50890	124355	266691	667465	1355180	2115359	2938872	-1

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3/10/2011 2:52 PM

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		800	1807	7883	17353	45212	99831	253262	514653	799664	1101363	-1
34)	heptane	1338	2370	10394	22503	55055	117332	294906	596746	934037	1294500	-1
35)	trichloroethene	940	1918	8808	18873	47586	101233	251399	512393	795145	1105014	-1
36)	1,2-dichpropane		-1	3660	7709	17325	47930	114494	198914	284411	498482	-1
37)	1,4-dioxane	1659	3391	16216	36334	88820	191332	479474	975514	1515926	2097925	-1
38)	bromodichloromethe	-1	-1	11677	25786	66917	142572	367650	765086	1201621	1665566	-1
39)	cis-1,3-dichloropropé	-1	-1	15551	32718	88734	190498	483457	1023785	1583912	2207229	-1
40)	4-methyl-2-pentanor	-1	5662	26801	58234	149116	316122	803556	1655555	2601382	3633263	-1
41)	toluene	-1	-1	11420	24891	62316	136182	353403	741413	1162935	1623237	-1
42)	trans-1,3-dichloropr	-1	2046	9949	21500	52919	110471	277287	569349	892809	1240528	-1
43)	1,1,2-trichloroethane	-1	2702	13343	28187	70266	150757	374517	771315	1222169	1719268	-1
44)	tetrachloroethene	1412	-1	13674	28518	80428	172376	445207	952538	1483838	2047020	-1
45)	2-hexanone	-1	3441	17070	36198	91463	192530	492689	1024949	1606564	2242071	-1
46)	dibromochlorometha	-1	2868	14424	30903	78447	164138	416691	866552	1371246	1910031	-1
47)	1,2-dibromoethane	-1	637028	614237	611043	613630	625153	621778	659558	665547	691793	-1
48)	chlorobenzene-d5	662448	5099	22524	48170	119565	248548	618910	1284137	2011498	2792301	-1
49)	chlorobenzene	2467	7405	33744	72498	189039	394833	1008780	2118004	3345322	4658162	-1
50)	ethylbenzene	3818	10735	50754	111046	288141	606514	1535540	3289375	5234276	7343604	-1
51)	M+P xylene	-1	5214	24479	53951	143013	304316	769973	1650049	2615819	3655020	-1
52)	O xylene	-1	-1	-1	40437	111963	240635	615532	1331430	2119021	2965003	-1
53)	styrene	-1	3181	14673	30627	80011	171318	438139	942621	1502927	2105320	-1
54)	bromoform	-1	379158	387417	365044	372145	383350	379784	409000	408937	427685	-1
55)	surr 1, bromofluorob	391521	2725	21989	47282	121253	244354	608713	1290659	2016711	2774575	-1
56)	1,1,2,2-tetrachloroet	2725	5158	-1	72333	201395	421966	1069051	2331429	3708302	5148263	-1
57)	4-ethyltoluene	-1	-1	27521	60766	164615	340863	849061	1844598	2903583	4038807	-1
58)	1,3,5-trimethylbenze	-1	6411	-1	54269	152507	325295	823853	1803322	2863641	3964636	-1
59)	1,2,4-trimethylbenze	-1	-1	-1	42328	112127	227391	570238	1235027	1955133	2716997	-1
60)	1,3-dclbenz	2365	4923	19796	42781	112889	224521	571016	1235681	1949121	2707208	-1
61)	1,4-dclbenz	2410	4838	19888	55506	154332	315308	808559	1786680	2829335	3902283	-1
62)	benzyl chloride	3084	5908	24855	40507	106497	212019	524025	1136728	1789128	2471801	-1
63)	1,2-dclbenz	2397	4640	18864	25333	65907	115428	336239	726822	1202145	1564500	-1
64)	1,2,4-trichlorobenzer	-1	-1	-1	30973	79160	134781	369383	818078	1311994	1817179	-1
65)	hexachlorobutadiene	-1	-1	14802	51889	145639	257350	786041	1711468	2693060	3763828	-1
66)	naphthalene	-1	-1	24047								

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3/10/2011 2:52 PM

Page 2 of 3

00274

HP CHEMSTATION CUSTOM REPORT CALIBRATION SUMMARY

Calibration Table Responses (Level 1-20) file | Method File : 030911.M | Calibration Title : TO-15 | Last Calibration Update : Thu Mar 10 09:36:59 2011

Level		1	2	3	4	5	6	7	8	9	10	
ID	Compound	0.01	0.02	0.1	0.2	0.5	1	2.5	5	7.5	10	AVG
1)	bromochloromethane	196006	189334	187053	184167	181965	185390	184824	190081	190869	198117	188781
28)	1,4-difluorobenzene	741336	710467	689717	691260	690376	703556	695118	723739	718788	755425	711978
48)	chlorobenzene-d5	662448	637028	614237	611043	613630	625153	621778	659558	665547	691793	640222
1)	bromochloromethane	1.04	1.00	0.99	0.98	0.96	0.98	0.98	1.01	1.01	1.05	
28)	1,4-difluorobenzene	1.04	1.00	0.97	0.97	0.97	0.99	0.98	1.02	1.01	1.06	
48)	chlorobenzene-d5	1.03	1.00	0.96	0.95	0.96	0.98	0.97	1.03	1.04	1.08	

Response for internal standards is within 40% of the mean

all values are within 0.6 → 1.4
Therfore all Internals are within spec ±40%

00275

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HP CHEMSTATION CUSTOM REPORT CALIBRATION SUMMARY

Calibration Table Response Factors (Level 1-20)

Method File : 030911.M | Calibration Title : TO-15 | Last Calibration Update : Thu Mar 10 09:36:59 2011

file		B0721.D	B0722.D	B0723.D	B0724.D	B0725.D	B0726.D	B0727.D	B0728.D	B0729.D	B0730.D
Level		1	2	3	4	5	6	7	8	9	10
ID	Compound	0.01	0.02	0.1	0.2	0.5	1.0	2.5	5.0	7.5	10.0
1)	bromochloromethane	14826	14322	14149	13931	13764	14023	13981	14378	14438	14986
2)	propylene	-1.0000	-1.0000	2.4496	2.4428	2.2672	2.0886	2.2885	2.1900	2.1989	2.1571
3)	dichlorodifluoromethane	2.9013	3.0040	2.8678	2.9749	2.9296	2.7235	3.0234	2.8712	2.8982	2.8437
4)	freon-114	2.3645	2.3019	2.3709	2.4244	2.3605	2.2958	2.3945	2.2965	2.3344	2.2920
5)	chloromethane	-1.0000	2.5942	2.3270	2.4813	2.3561	2.3238	2.4437	2.2989	2.3531	2.2932
6)	vinyl chloride	2.2612	2.3467	2.2090	2.4157	2.3669	2.2960	2.4414	2.3240	2.3513	2.3001
7)	1,3-butadiene	1.9885	1.7832	1.8428	1.9283	1.8933	1.9184	2.0046	1.9316	1.9503	1.9225
8)	bromomethane	1.7189	1.5826	1.4382	1.4764	1.4394	1.4059	1.4637	1.4032	1.4167	1.3877
9)	chloroethane	1.1358	1.2485	1.2149	1.2650	1.2420	1.2685	1.2825	1.2213	1.2432	1.2125
10)	trichlorofluoromethane	2.3999	2.4681	2.4375	2.5055	2.4441	2.4262	2.4835	2.3859	2.4177	2.3761
11)	ethanol	-1.0000	-1.0000	-1.0000	0.7443	0.6031	0.8341	0.7479	0.6038	0.5124	0.6969
12)	freon-113	1.5131	1.5319	1.4631	1.5015	1.4933	1.5133	1.5179	1.4828	1.5229	1.5135
13)	1,1-dichloroethene	2.2358	1.9898	2.0402	2.0961	2.1129	2.1468	2.2110	2.1689	2.2055	2.1791
14)	acetone	-1.0000	-1.0000	-1.0000	-1.0000	3.4460	3.2182	3.0792	3.0356	3.0827	3.0592
15)	isopropanol	-1.0000	-1.0000	-1.0000	2.4770	1.8709	2.7774	2.7168	2.0453	1.5511	1.7696
16)	carbon disulfide	5.3333	5.1985	5.1424	5.3753	5.3199	5.3103	5.4780	5.2984	5.3867	5.2862
17)	methylene chloride	1.4106	1.4274	1.3927	1.4284	1.4210	1.4579	1.4688	1.4260	1.4502	1.4376
18)	trans-1,2-dichloroethene	1.7737	1.9588	1.8319	1.9595	1.9640	2.0458	2.0736	2.0366	2.0863	2.0825
19)	methyl tert butyl ether	4.1097	3.8000	3.8531	3.7934	3.9480	4.1449	4.1986	4.2552	4.4014	4.3973
20)	hexane	2.3061	2.3818	2.2562	2.3258	2.3683	2.5082	2.5724	2.5254	2.5865	2.5734
21)	1,1-diclethane	2.5329	2.4886	2.4921	2.5762	2.5602	2.6520	2.6214	2.5549	2.6120	2.5828
22)	vinyl acetate	-1.0000	-1.0000	3.1369	3.1873	3.3878	3.6167	3.7224	3.8015	3.9588	3.9736
23)	2-butanone	-1.0000	-1.0000	3.0879	2.7230	3.0423	3.2979	3.4500	3.4143	3.5962	3.6747
24)	cis-1,2-dichloroethene	-1.0000	-1.0000	1.4332	1.4729	1.4506	1.4987	1.5411	1.5195	1.5627	1.5550
25)	ethyl acetate	4.1824	4.6448	3.9128	4.2635	4.2370	4.1664	4.0777	4.2062	4.2636	4.1761
26)	chloroform	2.1248	2.2092	2.2788	2.3606	2.3374	2.4198	2.4154	2.3638	2.4303	2.4195
27)	tetrahydrofuran	-1.0000	-1.0000	-1.0000	0.8191	0.8932	0.9490	0.9482	0.9681	1.0044	1.0038
28)	1,4-difluorobenzene	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
29)	1,1,1-trichloroethane	0.4680	0.4563	0.4776	0.4902	0.4868	0.5010	0.5034	0.4887	0.5066	0.4983
30)	cyclohexane	0.5453	0.5525	0.5580	0.5826	0.5905	0.6210	0.6410	0.6228	0.6475	0.6356
31)	carbon tetrachloride	0.4382	0.4324	0.4335	0.4384	0.4370	0.4531	0.4549	0.4418	0.4590	0.4498
32)	1,2-dichloroethane	0.3492	0.3546	0.3893	0.3886	0.3915	0.4050	0.4043	0.3961	0.4094	0.4025
33)	benzene	1.3462	1.2659	1.2287	1.2658	1.2388	1.3035	1.3208	1.2878	1.3493	1.3378

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34)	heptane	0.3223	0.3376	0.3195	0.3333	0.3478	0.3768	0.3870	0.3777	0.3939	0.3872
35)	trichloroethene	0.3725	0.3442	0.3274	0.3359	0.3292	0.3442	0.3502	0.3403	0.3576	0.3536
36)	1,2-dichloropane	0.3063	0.3240	0.3226	0.3276	0.3308	0.3453	0.3472	0.3398	0.3540	0.3510
37)	1,4-dioxane	-1.0000	-1.0000	0.1719	0.1716	0.1545	0.2097	0.2028	0.1692	0.1624	0.2023
38)	bromodichloromethane	0.3705	0.3949	0.4096	0.4350	0.4259	0.4501	0.4567	0.4462	0.4654	0.4598
39)	cis-1,3-dichloropropene	-1.0000	-1.0000	0.4439	0.4646	0.4829	0.5048	0.5270	0.5267	0.5552	0.5492
40)	4-methyl-2-pentanone	-1.0000	-1.0000	0.6024	0.6007	0.6524	0.6872	0.7061	0.7180	0.7457	0.7416
41)	toluene	-1.0000	1.1610	1.1836	1.2279	1.2593	1.3098	1.3479	1.3337	1.4067	1.4020
42)	trans-1,3-dichloropropene	-1.0000	-1.0000	0.4218	0.4358	0.4370	0.4685	0.4922	0.4959	0.5221	0.5201
43)	1,1,2-trichloroethane	-1.0000	0.2928	0.3086	0.3161	0.3116	0.3192	0.3243	0.3198	0.3366	0.3338
44)	tetrachloroethene	0.3114	0.3109	0.3330	0.3334	0.3328	0.3504	0.3524	0.3485	0.3707	0.3721
45)	2-hexanone	-1.0000	-1.0000	0.5393	0.5330	0.6021	0.6331	0.6620	0.6802	0.7113	0.7003
46)	dibromochloromethane	-1.0000	0.3066	0.3297	0.3314	0.3354	0.3464	0.3589	0.3585	0.3772	0.3757
47)	1,2-dibromoethane	-1.0000	0.2886	0.3147	0.3196	0.3249	0.3336	0.3428	0.3424	0.3637	0.3615
48)	chlorobenzene-d5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
49)	chlorobenzene	0.9098	0.9768	0.9422	0.9622	0.9513	0.9706	0.9720	0.9506	0.9837	0.9853
50)	ethylbenzene	1.5060	1.5187	1.5107	1.5498	1.6096	1.6500	1.6954	1.6779	1.7509	1.7591
51)	M+P xylene	-1.0000	1.1216	1.1580	1.2097	1.2503	1.2917	1.3152	1.3280	1.3961	1.4133
52)	O xylene	-1.0000	1.0580	1.0857	1.1425	1.2064	1.2598	1.2820	1.2949	1.3563	1.3674
53)	styrene	-1.0000	-1.0000	-1.0000	0.8812	0.9718	1.0251	1.0546	1.0752	1.1308	1.1414
54)	bromoform	-1.0000	0.2793	0.2813	0.2803	0.2917	0.3065	0.3153	0.3197	0.3368	0.3404
55)	surr 1, bromofluorobenzene	0.3973	0.4001	0.4021	0.4016	0.4077	0.4122	0.4106	0.4169	0.4131	0.4156
56)	1,1,2,2-tetrachloroethane	0.6736	0.6626	0.6169	0.6334	0.6469	0.6399	0.6411	0.6407	0.6614	0.6566
57)	4-ethyltoluene	-1.0000	-1.0000	-1.0000	1.3532	1.5007	1.5431	1.5723	1.6162	1.6884	1.7013
58)	1,3,5-trimethylbenzene	-1.0000	1.1609	1.0884	1.1475	1.2382	1.2583	1.2605	1.2908	1.3424	1.3473
59)	1,2,4-trimethylbenzene	-1.0000	-1.0000	-1.0000	1.0153	1.1364	1.1896	1.2117	1.2501	1.3116	1.3102
60)	1,3-dclbenz	0.6612	0.7157	0.6283	0.6414	0.6768	0.6736	0.6794	0.6935	0.7254	0.7273
61)	1,4-dclbenz	0.6865	0.7165	0.6431	0.6605	0.6930	0.6777	0.6931	0.7070	0.7368	0.7384
62)	benzyl chloride	1.0010	0.9971	0.9160	0.9767	1.0817	1.0846	1.1186	1.1716	1.2189	1.2131
63)	1,2-dclbenz	0.6828	0.6872	0.6100	0.6254	0.6549	0.6399	0.6361	0.6504	0.6763	0.6742
64)	1,2,4-trichlorobenzene	-1.0000	-1.0000	-1.0000	0.3199	0.3315	0.2849	0.3338	0.3401	0.3716	0.3490
65)	hexachlorobutadiene	-1.0000	-1.0000	0.2698	0.2686	0.2744	0.2293	0.2528	0.2639	0.2796	0.2794
66)	naphthalene	-1.0000	-1.0000	0.8835	0.9102	1.0176	0.8825	1.0841	1.1126	1.2425	1.1664

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Page 2 of 2

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Quantitation Report (QT Reviewed)

RH 3/10/11

Data Path : J:\ACQUDATA\air2\Data\030911\
Data File : B0721.D
Acq On : 9 Mar 2011 9:50 am
Operator : Herring
Sample : 0.01PPB ← calibration level ID in nominal PPB
Misc : 100mL,0-656-49A
ALS Vial : 3 Sample Multiplier: 1

Quant Time: Mar 10 09:03:28 2011
Quant Method : J:\ACQUDATA\AIR2\METHODS\030911.M
Quant Title : TO-15
QLast Update : Tue Feb 08 11:48:46 2011
Response via : Initial Calibration

Compound	R.T.	QIon	Response	Conc	Units		Dev(Min)
Internal Standards							
1) bromochloromethane	12.828	130	196006	13.2200	ng		0.00
28) 1,4-difluorobenzene	14.473	114	741336	11.6400	ng		0.00
48) chlorobenzene-d5	19.569	117	662448	12.0200	ng		0.00
System Monitoring Compounds							
55) surr 1, bromofluoroben...	21.681	174	391521	18.3977	ng		0.00
Spiked Amount 17.880	Range 70 - 130		Recovery = 102.90%				
Target Compounds							Qvalue
2) propylene	5.510	41	1304	0.0397	ng	#	48
3) dichlorodifluoromethane	5.615	85	2125	0.0513	ng		94
4) freon-114	5.977	85	2475	0.0826	ng		93
5) chloromethane	6.124	50	1194	0.0361	ng		92
6) vinyl chloride	6.431	62	875	0.0274	ng		76
7) 1,3-butadiene	6.530	54	684	0.0256	ng	#	32
8) bromomethane	7.291	94	999	0.0512	ng		90
9) chloroethane	7.530	64	453	0.0260	ng	#	43
10) trichlorofluoromethane	8.113	101	2078	0.0618	ng		87
12) freon-113	9.188	101	1770	0.0823	ng		92
13) 1,1-dichloroethene	9.200	61	1379	0.0438	ng	#	64
14) acetone	9.366	43	8091	0.1825	ng		99
15) isopropanol	9.630	45	1462	0.0496	ng	#	59
16) carbon disulfide	9.667	76	2562	0.0338	ng		97
17) methylene chloride	10.139	84	755	0.0371	ng		100
18) trans-1,2-dichloroethene	10.643	61	1094	0.0373	ng	#	58
19) methyl tert butyl ether	10.710	73	2352	0.0384	ng		96
20) hexane	11.109	57	1289	0.0360	ng		91
21) 1,1-diclethane	11.398	63	1581	0.0431	ng		99
22) vinyl acetate	11.453	43	1413	0.0336	ng	#	71
23) 2-butanone	12.478	43	1787m	0.0402	ng		
24) cis-1,2-dichloroethene	12.405	96	1273m	0.0581	ng		
25) ethyl acetate	12.509	43	2344m	0.0411	ng		
26) chloroform	12.920	83	1613	0.0476	ng		94
27) tetrahydrofuran	12.994	72	229	0.0174	ng		79
29) 1,1,1-trichloroethane	13.283	97	1675	0.0552	ng		95
30) cyclohexane	13.381	56	1278	0.0340	ng		96
31) carbon tetrachloride	13.565	117	1789	0.0663	ng		95
32) 1,2-dichloroethane	13.933	62	954	0.0372	ng		94
33) benzene	13.915	78	2898	0.0365	ng		89
34) heptane	14.234	71	899	0.0395	ng		88
35) trichloroethene	14.965	130	1338	0.0629	ng		86
36) 1,2-diclpropane	15.370	63	946	0.0465	ng		93
37) 1,4-dioxane	15.775	88	292	0.0265	ng	#	21
38) bromodichloromethane	15.787	83	1659	0.0614	ng		99
39) cis-1,3-dichloropropene	16.524	75	1366	0.0454	ng		92
40) 4-methyl-2-pentanone	16.825	43	1529	0.0349	ng		86
41) toluene	17.138	91	2882	0.0360	ng		96
42) trans-1,3-dichloropropene	17.463	75	1137	0.0402	ng		93
43) 1,1,2-trichloroethane	17.801	97	926	0.0489	ng		98
44) tetrachloroethene	18.096	166	1412	0.0676	ng		98
45) 2-hexanone	18.249	43	1490	0.0409	ng		86
46) dibromochloromethane	18.531	129	1632	0.0785	ng		98
47) 1,2-dibromoethane	18.783	107	1479	0.0712	ng		92

RH 3/10/11

030911.M Thu Mar 10 09:05:24 2011 Page: 1

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: [redacted]
Project: [redacted]
Sample Matrix: Air

Service Request: [redacted]
Date Collected: [redacted]
Date Received: [redacted]

Sample Name: [redacted]
Lab Code: [redacted]

Analytical Method: TO-15

Date Analyzed: [redacted]
Canister Dilution Factor: 1.59

Initial Pressure (psig): -3.2 Final Pressure (psig): 3.5

CAS #	Analyte Name	Sample Amount mL	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbv	MRL ppbv	MDL ppbv	Data Qualifier
75-71-8	**Dichlorodifluoromethane (CFC 12)**	116	4.1	15	0.25	**0.83**	3.0	0.050	J
74-87-3	**Chloromethane**	116	**0.57**	6.2	0.14	**0.28**	3.0	0.066	J
76-14-2	Freon 114	116	21	21	0.32	3.0	3.0	0.045	U
75-01-4	Vinyl Chloride	116	0.82	0.82	0.19	0.32	0.32	0.075	U
106-99-0	1,3-Butadiene	116	6.7	6.7	0.15	3.0	3.0	0.068	U
74-83-9	Bromomethane	116	5.9	5.9	0.44	1.5	1.5	0.11	U
75-00-3	**Chloroethane**	116	19	8.0	0.32	7.2	3.0	0.12	
67-64-1	**Acetone**	116	64	69	2.6	27	29	1.1	J
75-69-4	**Trichlorofluoromethane (CFC 11)**	116	9.2	8.5	0.30	1.6	1.5	0.054	
75-35-4	**1,1-Dichloroethene**	116	0.74	6.0	0.15	**0.19**	1.5	0.038	J
75-09-2	Methylene Chloride	116	5.2	5.2	0.26	1.5	1.5	0.075	U
76-13-1	1,1,2-Trichlorotrifluoroethane (CFC 113)	116	2.4	2.3	0.53	0.31	0.30	0.069	
75-15-0	**Carbon Disulfide**	116	57	4.7	0.14	18	1.5	0.044	
156-60-5	**trans-1,2-Dichloroethene**	116	0.70	6.0	0.16	**0.18**	1.5	0.042	J
75-34-3	**1,1-Dichloroethane (1,1-DCA)**	116	2.7	6.2	0.23	0.66	1.5	0.058	J
1634-04-4	Methyl tert-Butyl Ether	116	11	11	0.082	3.0	3.0	0.023	U
108-05-4	Vinyl Acetate	116	69	69	0.096	19	19	0.027	U
78-93-3	**2-Butanone (MEK)**	116	7.1	8.9	0.29	2.4	3.0	0.098	J
156-59-2	**cis-1,2-Dichloroethene**	116	0.56	6.0	0.25	**0.14**	1.5	0.062	J
141-78-6	**Ethyl Acetate**	116	2.0	11	0.15	0.55	3.0	0.042	J
110-54-3	**n-Hexane**	116	8.1	11	0.12	2.3	3.0	0.035	J
67-66-3	**Chloroform**	116	38	7.4	0.37	7.8	1.5	0.076	
109-99-9	Tetrahydrofuran (THF)	116	8.9	8.9	0.32	3.0	3.0	0.11	U
107-06-2	**1,2-Dichloroethane**	116	3.5	6.2	0.32	0.87	1.5	0.078	J
71-55-6	**1,1,1-Trichloroethane (TCA)**	116	110	8.2	0.51	20	1.5	0.093	
71-43-2	**Benzene**	116	4.8	4.8	0.14	1.5	1.5	0.043	J
56-23-5	**Carbon Tetrachloride**	116	0.82	0.96	0.41	0.13	0.15	0.065	J
110-82-7	**Cyclohexane**	116	24	10	0.16	6.9	3.0	0.048	
78-87-5	1,2-Dichloropropane	116	7.0	7.0	0.25	1.5	1.5	0.053	U
75-27-4	Bromodichloromethane	116	2.1	2.1	0.59	0.31	0.31	0.088	U
79-01-6	**Trichloroethene (TCE)**	116	600	0.82	0.33	110	0.15	0.061	
142-82-5	**Heptane**	116	1.7	12	0.15	0.41	3.0	0.037	J
10061-01-5	cis-1,3-Dichloropropene	116	14	14	0.19	3.0	3.0	0.042	U
108-10-1	**4-Methyl-2-pentanone**	116	1.5	12	0.14	0.36	3.0	0.033	J
10061-02-6	trans-1,3-Dichloropropene	116	6.9	6.9	0.18	1.5	1.5	0.039	U
79-00-5	1,1,2-Trichloroethane	116	8.2	8.2	0.48	1.5	1.5	0.088	U

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Form 1A

SuperSet Reference: [redacted]
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Quantitation Report (Not Reviewed)

Data Path : J:\ACQUDATA\AIR2\DATA\[redacted]
Data File : [redacted]
Acq On : [redacted]
Operator : Herring
Sample : [redacted]
Misc : 116mL [redacted]
ALS Vial : 4 Sample Multiplier: 1

Quant Time: [redacted]
Quant Method : J:\ACQUDATA\AIR2\METHODS\030911.M
Quant Title : TO-15
QLast Update : [redacted]
Response via : Initial Calibration

~~NT~~ = New target list RH 6/4/11

Compound	R.T.	QIon	Response	Conc Units		Dev(Min)
Internal Standards						
1) bromochloromethane	12.828	130	~~174509~~	13.2200 ng		0.00
28) 1,4-difluorobenzene	14.473	114	646650	11.6400 ng		0.00
48) chlorobenzene-d5	19.569	117	~~602251~~	12.0200 ng		0.00
System Monitoring Compounds						
55) surr 1, bromofluoroben...	21.674	174	362014	17.7213 ng		0.00
Spiked Amount 17.880	Range 70 - 130		Recovery =	99.11%		
Target Compounds						Qvalue
2) propylene	5.529	41	213407	7.1523 ng		94 NT
3) dichlorodifluoromethane	5.633	85	11481	0.2995 ng		~~98~~ NT
5) chloromethane	6.124	50	1316 ~~1234~~ (m)	0.0392 ng RH 6/3/11		99
~~7) 1,3-butadiene~~	~~6.640~~	~~54~~	~~821~~	0.0325 ng	#	~~1~~
9) chloroethane	7.524	64	22665	1.3921 ng		100
10) trichlorofluoromethane	8.107	101	21476	0.6677 ng		99
11) ethanol	8.518	45	160534	17.9502 ng		99 NT
12) freon-113	9.188	101	3496	0.1759 ng		92
13) 1,1-dichloroethene	9.194	61	1529	0.0542 ng	#	69
14) acetone	9.329	43	193977	4.6599 ng		100
15) isopropanol	9.568	45	2734731	95.3568 ng		98 NT
16) carbon disulfide	9.685	76	291858	4.1615 ng		100
~~17) methylene chloride~~	~~10.139~~	~~84~~	~~2110~~	~~0.1116 ng~~	~~#~~	~~75~~
18) trans-1,2-dichloroethene	10.643	61	1340	0.0512 ng	#	69 ✓
~~19) methyl-test-butyl ether~~	~~10.667~~	~~73~~	~~632~~	~~0.0117 ng~~	~~#~~	~~53~~
20) hexane	11.097	57	18990	0.5895 ng		100 NT
21) 1,1-diclethane	11.404	63	6554	0.1934 ng		91
~~22) vinyl acetate~~	~~11.471~~	~~43~~	~~601~~	~~0.0127 ng~~	~~#~~	~~71~~
23) 2-butanone	12.435	43	22403 30814 (m)	0.~~4104~~ ng RH 6/3/11		84
24) cis-1,2-dichloroethene	12.417	96	808	0.0407 ng	#	72 ✓
25) ethyl acetate	12.435	43	30814	0.5541 ng	#	71
26) chloroform	12.920	83	85647	2.7776 ng		98
~~27) tetrahydrofuran~~	~~12.920~~	~~72~~	~~439~~	~~0.0333 ng~~	~~#~~	~~4~~
29) 1,1,1-trichloroethane	13.282	97	214192	7.9057 ng		100
30) cyclohexane	13.387	56	57753	1.7336 ng	#	78 NT
31) carbon tetrachloride	13.559	117	1473	0.0597 ng		89
32) 1,2-dichloroethane	13.927	62	5545	0.2566 ng		99
33) benzene	13.915	78	25118	0.3493 ng		97
34) heptane	14.228	71	2411	0.1911 ng		96 NT
35) trichloroethene	14.958	130	834064	43.4530 ng		98
~~36) 1,2-dichloropropane~~	~~15.300~~	~~63~~	~~2649~~	~~0.1101 ng~~	~~#~~	~~61~~
~~37) 1,4-dioxane~~	~~15.689~~	~~88~~	~~2287~~	~~0.2280 ng~~	~~#~~	~~74~~
~~38) bromodichloromethane~~	~~15.830~~	~~83~~	~~692~~	~~0.0289 ng~~	~~#~~	~~18~~
40) 4-methyl-2-pentanone	16.788	43	4119	0.1088 ng		92
41) toluene	17.132	91	164825	2.2956 ng		99
~~42) trans-1,3-dichloropropene~~	~~17.586~~	~~75~~	~~357~~	~~0.0136 ng~~	~~#~~	~~1~~
~~43) 1,1,2-trichloroethane~~	~~17.764~~	~~97~~	~~181351~~	~~10.2622 ng~~	~~#~~	~~19~~
44) tetrachloroethene	18.089	166	92075	4.8524 ng		97
~~45) 2-hexanone~~	~~18.210~~	~~43~~	~~5436~~	~~0.1547 ng~~	~~#~~	~~68~~
~~47) 1,2-dibromoethane~~	~~18.783~~	~~107~~	~~398~~	~~0.0216 ng~~	~~#~~	~~2~~
~~48) chlorobenzene~~	~~19.618~~	~~112~~	~~2132~~	~~0.0443 ng~~		~~84~~
50) ethylbenzene	19.765	91	207057	2.5466 ng		100
51) M+P xylene	19.962	91	212308	3.3210 ng		99
52) O xylene	20.704	91	894820	14.5412 ng		99

[redacted]

Page: 1
00025

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Evaluate Continuing Calibration Report

Data Path : [redacted]
Data File : [redacted]
Acq On : [redacted]
Operator : Herring
Sample : CCV
Misc : 500mL
ALS Vial : 15 Sample Multiplier: 1

Quant Time: [redacted]
Quant Method : J:\ACQUDATA\AIR2\METHODS\030911.M
Quant Title : TO-15
QLast Update : [redacted]
Response via : Initial Calibration

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

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	bromochloromethane	1.000	1.000	0.0	92	0.00
2		propylene	2.260	2.173	3.8	92	0.00
3		dichlorodifluoromethane	2.904	2.877	0.9	93	0.00
4		freon-114	2.344	2.202	6.1	89	0.00
5		chloromethane	2.386	2.265	5.1	91	0.01
6		vinyl chloride	2.331	2.181	6.4	87	0.00
7		1,3-butadiene	1.916	1.782	7.0	85	0.00
8		bromomethane	1.473	1.331	9.6	88	0.00
9		chloroethane	1.233	1.125	8.8	85	0.00
10		trichlorofluoromethane	2.436	2.396	1.6	93	0.00
11		ethanol	0.678	0.563	17.0	86	0.01
12		freon-113	1.505	1.438	4.5	90	0.00
13		1,1-dichloroethene	2.139	2.072	3.1	88	0.00
14		acetone	3.153	3.041	3.6	92	0.01
15		isopropanol	2.173	1.750	19.5	79	0.02
16		carbon disulfide	5.313	5.098	4.0	89	0.00
17		methylene chloride	1.432	1.353	5.5	88	0.00
18		trans-1,2-dichloroethene	1.981	1.940	2.1	88	0.00
19		methyl tert butyl ether	4.090	4.055	0.9	88	0.01
20		hexane	2.440	2.391	2.0	87	0.00
21		1,1-diclethane	2.567	2.462	4.1	89	0.00
22		vinyl acetate	3.598	3.595	0.1	87	0.00
23		2-butanone	3.286	3.377	-2.8	91	0.00
24		cis-1,2-dichloroethene	1.504	1.456	3.2	88	0.00
25		ethyl acetate	4.213	4.083	3.1	90	0.00
26		chloroform	2.336	2.301	1.5	90	0.00
27		tetrahydrofuran	0.941	0.922	2.0	88	0.01
28	I	1,4-difluorobenzene	1.000	1.000	0.0	89	0.00
29		1,1,1-trichloroethane	0.488	0.503	-3.1	92	0.00
30		cyclohexane	0.600	0.612	-2.0	88	0.00
31		carbon tetrachloride	0.444	0.461	-3.8	93	0.00
32		1,2-dichloroethane	0.389	0.414	-6.4	94	0.00
33		benzene	1.294	1.280	1.1	89	0.00
34		heptane	0.358	0.368	-2.8	87	0.00
35		trichloroethene	0.346*	0.354	-2.3	93	0.00
36		1,2-diclpropane	0.335	0.341	-1.8	90	0.00
37		1,4-dioxane	0.181	0.171	5.5	90	0.02
38		bromodichloromethane	0.431	0.454	-5.3	91	0.00
39		cis-1,3-dichloropropene	0.507	0.531	-4.7	90	0.00
40		4-methyl-2-pentanone	0.682	0.715	-4.8	89	0.00
41		toluene	1.292	1.351	-4.6	91	0.00
42		trans-1,3-dichloropropene	0.474	0.512	-8.0	92	0.00
43		1,1,2-trichloroethane	0.318	0.327	-2.8	91	0.00
44		tetrachloroethene	0.342	0.382	-11.7	98	0.00
45		2-hexanone	0.633	0.697	-10.1	92	0.00
46		dibromochloromethane	0.347	0.378	-8.9	94	0.00
47		1,2-dibromoethane	0.332	0.352	-6.0	92	0.00
48	I	chlorobenzene-d5	1.000	1.000	0.0	89	0.00

[redacted]

00336

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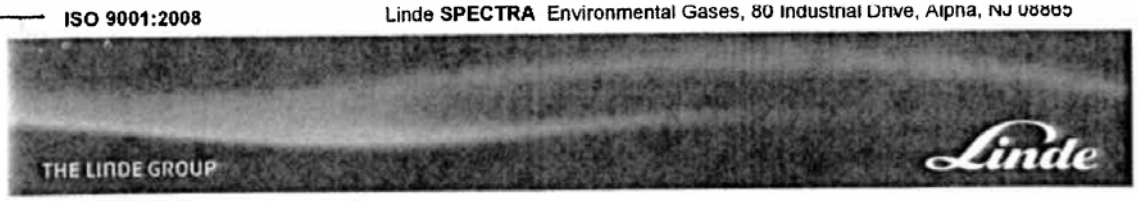

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1 Mustard Street, Suite 250
Rochester, NY 14609

(1)

PAGE: 1 of 3

21447

CERTIFICATE OF ANALYSIS

Batch#:	273331	**Cylinder Size:**	6A (3.2" X 9.4")
Item#:	1	**Cylinder # :**	AB-4433
Certification Date:	11/24/2010	**Cylinder Pressure:**	1200 psig
P.O.# :	Verbal	**Cylinder Valve:**	CGA 180 / Steel
Blend Type:	CERTIFIED	**Cylinder Volume:**	0.8 Liter
Material#:	14004551	**Cylinder Material:**	Aluminum
		Gas Volume:	70 Liter
Expiration Date:	11/24/2011	**Blend Tolerance:**	10% Relative
Do NOT use under:	150 psig	**Analytical Accuracy:**	5% Relative

COMPONENT	CAS NUMBER	REQUESTED CONC	CERTIFIED CONC
Propylene	115-07-1	1.00 ppm	1.07 ppm
Freon-12	75-71-8	1.00 ppm	1.00 ppm
Chloromethane	74-87-3	1.00 ppm	1.03 ppm
Freon-114	76-14-2	1.00 ppm	1.01 ppm
Vinyl Chloride	75-01-4	1.00 ppm	1.02 ppm
1,3-Butadiene	106-99-0	1.00 ppm	1.05 ppm
Bromomethane	74-83-9	1.00 ppm	1.01 ppm
Chloroethane	75-00-3	1.00 ppm	1.02 ppm
Ethanol (Analytical Accuracy +/- 10%)	64-17-5	1.00 ppm	0.92 ppm
Acrolein (No Stability Guarantee)	107-02-8	1.00 ppm	0.95 ppm
Acetone	67-64-1	1.00 ppm	1.06 ppm
Freon-11	75-69-4	1.00 ppm	1.04 ppm
Isopropyl Alcohol	67-63-0	1.00 ppm	1.16 ppm
1,1-Dichloroethene	75-35-4	1.00 ppm	1.05 ppm
Carbon Disulfide (Analytical Accuracy +/- 10%)	75-15-0	1.00 ppm	1.04 ppm
Methylene Chloride	75-09-2	1.00 ppm	1.04 ppm
Freon-113	76-13-1	1.00 ppm	1.03 ppm
Trans-1,2-Dichloroethene	156-60-5	1.00 ppm	1.05 ppm
1,1-Dichloroethane	75-34-3	1.00 ppm	1.04 ppm
Methyl Tert Butyl Ether	1634-04-4	1.00 ppm	1.07 ppm
Vinyl Acetate (No Stability Guarantee)	108-05-4	1.00 ppm	0.89 ppm
Methyl Ethyl Ketone	78-93-3	1.00 ppm	1.09 ppm
Cis-1,2-Dichloroethene	156-59-2	1.00 ppm	1.06 ppm
Hexane	110-54-3	1.00 ppm	1.07 ppm
Chloroform	67-66-3	1.00 ppm	1.05 ppm
Ethyl Acetate	141-78-6	1.00 ppm	1.05 ppm
Tetrahydrofuran	109-99-9	1.00 ppm	1.10 ppm
1,2-Dichloroethane	107-06-2	1.00 ppm	1.06 ppm
1,1,1-Trichloroethane	71-55-6	1.00 ppm	1.03 ppm
Benzene	71-43-2	1.00 ppm	1.06 ppm

(A)

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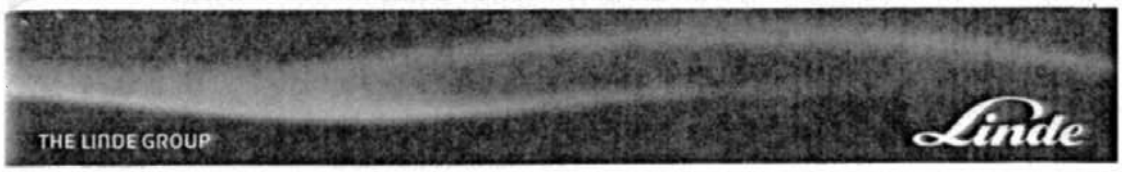

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PAGE: 2 of 3

CERTIFICATE OF ANALYSIS

Batch#:	273331	**Cylinder Size:**	6A (3.2" X 9.4")
Item#:	1	**Cylinder # :**	AB-4433
Certification Date:	11/24/2010	**Cylinder Pressure:**	1200 psig
P.O.# :	Verbal	**Cylinder Valve:**	CGA 180 / Steel
Blend Type:	CERTIFIED	**Cylinder Volume:**	0.8 Liter
Material#:	14004551	**Cylinder Material:**	Aluminum
		Gas Volume:	70 Liter
Expiration Date:	11/24/2011	**Blend Tolerance:**	10% Relative
Do NOT use under:	150 psig	**Analytical Accuracy:**	5% Relative

COMPONENT	CAS NUMBER	REQUESTED CONC	CERTIFIED CONC
Carbon Tetrachloride	56-23-5	1.00 ppm	1.02 ppm
Cyclohexane	110-82-7	1.00 ppm	1.07 ppm
1,2-Dichloropropane	78-87-5	1.00 ppm	1.05 ppm
Trichloroethylene	79-01-6	1.00 ppm	1.05 ppm
Bromodichloromethane	75-27-4	1.00 ppm	1.05 ppm
1,4-Dioxane	123-91-1	1.00 ppm	1.05 ppm
Methyl Methacrylate	80-62-6	1.00 ppm	1.03 ppm
Heptane	142-82-5	1.00 ppm	1.07 ppm
Cis-1,3-Dichloropropene	10061-01-5	1.00 ppm	1.03 ppm
Methyl Isobutyl Ketone	108-10-1	1.00 ppm	1.12 ppm
Trans-1,3-Dichloropropene	10061-02-6	1.00 ppm	1.06 ppm
1,1,2-Trichloroethane	79-00-5	1.00 ppm	1.05 ppm
Toluene	108-88-3	1.00 ppm	1.06 ppm
Methyl Butyl Ketone	591-78-6	1.00 ppm	1.10 ppm
Dibromochloromethane	124-48-1	1.00 ppm	1.08 ppm
1,2-Dibromoethane	106-93-4	1.00 ppm	1.06 ppm
Tetrachloroethylene	127-18-4	1.00 ppm	1.05 ppm
Chlorobenzene	108-90-7	1.00 ppm	1.07 ppm
Ethylbenzene	100-41-4	1.00 ppm	1.06 ppm
p-xylene	106-42-3	1.00 ppm	1.04 ppm
m-xylene	108-38-3	1.00 ppm	1.04 ppm
Bromoform	75-25-2	1.00 ppm	1.04 ppm
Styrene	100-42-5	1.00 ppm	1.06 ppm
o-xylene	95-47-6	1.00 ppm	1.07 ppm
1,1,2,2-Tetrachloroethane	79-34-5	1.00 ppm	1.07 ppm
4-Ethyltoluene	622-96-8	1.00 ppm	1.07 ppm
1,3,5-Trimethylbenzene	108-67-8	1.00 ppm	1.06 ppm
1,2,4-Trimethylbenzene	95-63-6	1.00 ppm	1.07 ppm

B

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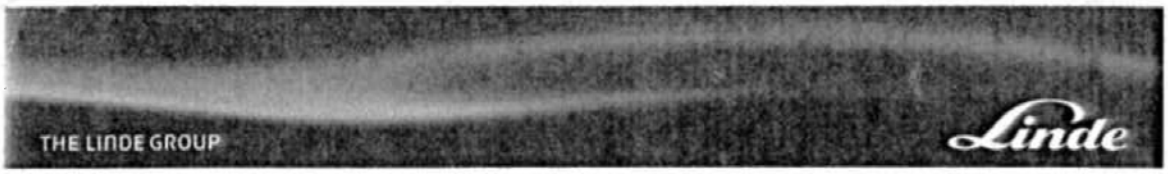

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PAGE: 3 of 3

CERTIFICATE OF ANALYSIS

Batch#:	273331	**Cylinder Size:**	6A (3.2" X 9.4")
Item#:	1	**Cylinder # :**	AB-4433
Certification Date:	11/24/2010	**Cylinder Pressure:**	1200 psig
P.O.# :	Verbal	**Cylinder Valve:**	CGA 180 / Steel
Blend Type:	CERTIFIED	**Cylinder Volume:**	0.8 Liter
Material#:	14004551	**Cylinder Material:**	Aluminum
		Gas Volume:	70 Liter
Expiration Date:	11/24/2011	**Blend Tolerance:**	10% Relative
Do NOT use under:	150 psig	**Analytical Accuracy:**	5% Relative

COMPONENT	CAS NUMBER	REQUESTED CONC	CERTIFIED CONC
1,3-Dichlorobenzene	541-73-1	1.00 ppm	1.08 ppm
Benzyl Chloride (Analytical Accuracy +/- 10%)	100-44-7	1.00 ppm	1.08 ppm
1,4-Dichlorobenzene	106-46-7	1.00 ppm	1.06 ppm
1,2-Dichlorobenzene	95-50-1	1.00 ppm	1.06 ppm
1,2,4-Trichlorobenzene	120-82-1	1.00 ppm	1.05 ppm
Naphthalene (Analytical Accuracy +/- 10%)	91-20-3	1.00 ppm	1.07 ppm
Hexachloro-1,3-Butadiene	87-68-3	1.00 ppm	1.06 ppm
Nitrogen	7727-37-9	Balance	Balance

SOURCE REFERENCE# 266569

ANALYST: Lou Lorenzetti

DATE: 11/24/2010

C

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Stock Concentration Conversion
RH checked 04/08/10
RT Order
Factors to convert from PPBV to ng/L
ng/L=un/m3=PPBV*MW/24.46
~~82 Component stock #24447~~

From Cert Sheet.

	cas#	MW	ppbv	ng/L
Internal standard				
propylene	115-07-1	42.08	1070	1841
dichlorodifluoromethane (Freon-12)	75-71-8	120.91	1000	4943
freon-114	76-14-2	170.92	1010	7058
chloromethane	74-87-3	50.49	1030	2126
vinyl chloride	75-01-4	62.5	1020	2606
1,3-butadiene	106-99-0	54.09	1050	2322
bromomethane	74-83-9	94.9	1010	3919
chloroethane	75-00-3	64.5	1020	2690
trichlorofluoromethane (Freon-11)	75-69-4	137.37	1040	5841
ethanol	64-17-5	46.07	920	1733
freon-113	76-13-1	187.38	1030	7890
1,1-dichloroethene	75-35-4	96.94	1050	4161
acetone	67-64-1	58.08	1060	2517
isopropanol	67-63-0	60.1	1160	2850
carbon disulfide	75-15-0	76.14	1040	3237
methylene chloride	75-09-2	84.93	1040	3611
trans-1,2-dichloroethene	156-60-5	96.94	1050	4161
methyl tert butyl ether	1634-04-4	88.15	1070	3856
hexane	110-54-3	86.18	1070	3770
1,1-dichloroethane	75-34-3	98.96	1040	4208
vinyl acetate	108-05-4	86.09	890	3132
2-butanone (Methyl Ethyl Ketone)	78-93-3	72.11	1090	3213
cis-1,2-dichloroethene	156-59-2	96.94	1060	4201
ethyl acetate	141-78-6	88.11	1050	3782
chloroform	67-66-3	119.38	1050	5125
tetrahydrofuran	109-99-9	72.11	1100	3243
Internal standard				
1,1,1-trichloroethane	71-55-6	133.4	1030	5617
cyclohexane	110-82-7	84.16	1070	3682
carbon tetrachloride	56-23-5	153.82	1020	6414
1,2-dichloroethane	107-06-2	98.96	1060	4289
benzene	71-43-2	78.11	1060	3385
heptane	142-82-5	100.2	1070	4383
trichloroethylene	79-01-6	131.39	1050	5640
1,2-dichloropropane	78-87-5	112.99	1050	4850
1,4-dioxane	123-91-1	88.11	1050	3782
bromodichloromethane	75-27-4	163.83	1050	7033
cis-1,3-dichloro-1-propene	10061-01-5	110.97	1030	4673
4-methyl-2-pentanone(Methyl Isobutyl Ketone)	108-10-1	100.16	1120	4586
toluene	108-88-3	92.14	1060	3993
trans-1,3-dichloro-1-propene	10061-02-6	110.97	1060	4809
1,1,2-trichloroethane	79-00-5	133.4	1050	5726
tetrachloroethene	127-18-4	165.83	1050	7119
2-hexanone (Methyl Butyl Ketone)	591-78-6	100.16	1100	4504
dibromochloromethane	124-48-1	208.28	1080	9196
1,2-dibromoethane	106-93-4	187.86	1060	8141
Internal standard				
chlorobenzene	108-90-7	112.56	1070	4924
ethylbenzene	100-41-4	106.17	1060	4601
M+P xylene	179601-23-1	106.17	2080	9028
O xylene	95-47-6	106.17	1070	4644
styrene	100-42-5	104.15	1060	4513
bromoform	75-25-2	252.73	1040	10746
Surrogate standard				
1,1,2,2-tetrachloroethane	79-34-5	167.85	1070	7343
4-ethyltoluene	622-96-8	120.19	1070	5258
1,3,5-trimethylbenzene	108-67-8	120.19	1060	5209
1,2,4-trimethylbenzene	95-63-6	120.19	1070	5258
1,3-dichlorobenzene	541-73-1	147	1080	6491
1,4-dichlorobenzene	106-46-7	147	1060	6370
benzyl chloride	100-44-7	126.59	1080	5589
1,2-dichlorobenzene	95-50-1	147	1060	6370
1,2,4-trichlorobenzene	120-82-1	181.45	1050	7789
hexachlorobutadiene	87-68-3	260.76	1060	11300
naphthalene	91-20-3	128.17	1070	5607

D

NG cal levels #24447 \ Stock

Environmental
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"From Stock"

0.1ppb stock

ug/m3 = ppb * Mw/Mv
Mv = 24.46 at 25C and 760 mmHg
TO-15 Analysis of SUMMA Canisters
Full Scan GC/MS
Compounds listed in Retention time order
62 Component stock #24447

dilution fac 10000.00
Stock Diluted Standard Working Conc Standard

mL nominal volume 1000

Sample volume injected for calibration.

Compound Name	cas#	ng/L	ng/L	Sample Volume mL 100 inj ng	Sample Volume mL 200 inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng
Internal standard				13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200
propylene	115-07-1	1841	0.18	0.0184	0.0368	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
dichlorodifluoromethane R-12	75-71-8	4943	0.49	0.0494	0.0989	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
dichlorotetrafluoroethane R-114	76-14-2	7058	0.71	0.0706	0.1412	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
chloromethane	74-87-3	2126	0.21	0.0213	0.0425	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
chloroethene (vinyl chloride)	75-01-4	2606	0.26	0.0261	0.0521	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,3-butadiene	106-99-0	2322	0.23	0.0232	0.0464	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bromomethane	74-83-9	3919	0.39	0.0392	0.0784	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ethyl chloride	75-00-3	2690	0.27	0.0269	0.0538	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
trichloromonofluoromethane R-11	75-69-4	5841	0.58	0.0584	0.1168	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ethanol	64-17-5	1733	0.17	0.0173	0.0347	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,1,2-trichloro-1,2,2-trifluoroethane R-113	76-13-1	7890	0.79	0.0789	0.1578	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,1-dichloroethene	75-35-4	4161	0.42	0.0416	0.0832	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
acetone	67-64-1	2517	0.25	0.0252	0.0503	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopropanol	67-63-0	2850	0.29	0.0285	0.0570	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
carbon disulfide	75-15-0	3237	0.32	0.0324	0.0647	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylene chloride	75-09-2	3611	0.36	0.0361	0.0722	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-dichloroethene (trans)	156-60-5	4161	0.42	0.0416	0.0832	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methyl tert butyl ether	1634-04-4	3856	0.39	0.0386	0.0771	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
hexane	110-54-3	3770	0.38	0.0377	0.0754	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,1-dichloroethane	75-34-3	4208	0.42	0.0421	0.0842	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
vinyl acetate	108-05-4	3132	0.31	0.0313	0.0626	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-butanone (methyl ethyl ketone)	78-93-3	3213	0.32	0.0321	0.0643	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-dichloroethene(cis)	156-59-2	4201	0.42	0.0420	0.0840	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ethyl acetate	141-78-6	3782	0.38	0.0378	0.0756	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
chloroform	67-66-3	5125	0.51	0.0512	0.1025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
tetrahydrofuran	109-99-9	3243	0.32	0.0324	0.0649	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Internal standard				11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400
1,1,1-trichloroethane	71-55-6	5617	0.56	0.0562	0.1123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclohexane	110-82-7	3682	0.37	0.0368	0.0736	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
carbon tetrachloride	56-23-5	6414	0.64	0.0641	0.1283	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-dichloroethane	107-06-2	4289	0.43	0.0429	0.0858	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
benzene	71-43-2	3385	0.34	0.0338	0.0677	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
heptane	142-82-5	4383	0.44	0.0438	0.0877	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
trichloroethylene	79-01-6	5640	0.56	0.0564	0.1128	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-dichloropropane	78-87-5	4850	0.49	0.0485	0.0970	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,4-dioxane	123-91-1	3782	0.38	0.0378	0.0756	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bromodichloromethane	75-27-4	7033	0.70	0.0703	0.1407	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,3-dichloro-1-propene(cis)	10061-01-5	4673	0.47	0.0467	0.0935	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4-methyl-2-penatanone (methyl isobutyl keto	108-10-1	4586	0.46	0.0459	0.0917	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
toluene	108-88-3	3993	0.40	0.0399	0.0799	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,3-dichloro-1-propene(trans)	10061-02-6	4809	0.48	0.0481	0.0962	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,1,2-trichloroethane	79-00-5	5726	0.57	0.0573	0.1145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
tetrachloroethylene	127-18-4	7119	0.71	0.0712	0.1424	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-hexanone (methyl butyl ketone)	591-78-6	4504	0.45	0.0450	0.0901	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
dibromochloromethane	124-48-1	9196	0.92	0.0920	0.1839	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-dibromoethane	106-93-4	8141	0.81	0.0814	0.1628	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Internal standard				12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200
chlorobenzene	108-90-7	4924	0.49	0.0492	0.0985	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ethylbenzene	100-41-4	4601	0.46	0.0460	0.0920	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
M+P xylene	179601-23-1	9028	0.90	0.0903	0.1806	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
O xylene	95-47-6	4644	0.46	0.0464	0.0929	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
styrene	100-42-5	4513	0.45	0.0451	0.0903	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bromoform	75-25-2	10746	1.07	0.1075	0.2149	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Surrogate standard				17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800
1,1,2,2-tetrachloroethane	79-34-5	7343	0.73	0.0734	0.1469	0.0000	0.0000	0.0000	0.0000	0.0000	2.5000
4-ethyltoluene	622-96-8	5258	0.53	0.0526	0.1052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,3,5-trimethylbenzene	108-67-8	5209	0.52	0.0521	0.1042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2,4-trimethylbenzene	95-63-6	5258	0.53	0.0526	0.1052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,3-dichlorobenzene	541-73-1	6491	0.65	0.0649	0.1298	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,4-dichlorobenzene	106-46-7	6370	0.64	0.0637	0.1274	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
benzyl chloride	100-44-7	5589	0.56	0.0559	0.1118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-dichlorobenzene	95-50-1	6370	0.64	0.0637	0.1274	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1,2,4-trichlorobenzene	120-82-1	7789	0.78	0.0779	0.1558	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
hexachlorobutadiene	87-68-3	11300	1.13	0.1130	0.2260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
naphthalene	91-20-3	5607	0.56	0.0561	0.1121	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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NG cal levels #24447 / syringe dilution 0.1 ppb page1 of 1 3/9/2011 4:00 PM

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1.0 ppb stock

ug/m3 = ppb * Mw/Mv
Mv = 24.46 at 25C and 760 mmHg
TO-15 Analysis of SUMMA Canisters
Full Scan GC/MS
Compounds listed in Retention time order
62 Component stock #24447

dilution fac 1000.00

mL nominal volume 1000

Compound Name	cas#	Stock Diluted Standard Working Conc Standard ng/L	ng/L	Sample Volume mL 95 inj ng	Sample Volume mL 200 inj ng	Sample Volume mL 500 inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng	Sample Volume mL inj ng
Internal standard				13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200
propylene	115-07-1	1841	1.84	0.1749	0.3682	0.9204	0.0000	0.0000	0.0000	0.0000	0.00
dichlorodifluoromethane R-12	75-71-8	4943	4.94	0.4696	0.9886	2.4716	0.0000	0.0000	0.0000	0.0000	0.00
dichlorotetrafluoroethane R-114	76-14-2	7058	7.06	0.6705	1.4115	3.5288	0.0000	0.0000	0.0000	0.0000	0.00
chloromethane	74-87-3	2126	2.13	0.2020	0.4252	1.0631	0.0000	0.0000	0.0000	0.0000	0.00
chloroethene (vinyl chloride)	75-01-4	2606	2.61	0.2476	0.5213	1.3031	0.0000	0.0000	0.0000	0.0000	0.00
1,3-butadiene	106-99-0	2322	2.32	0.2206	0.4644	1.1610	0.0000	0.0000	0.0000	0.0000	0.00
bromomethane	74-83-9	3919	3.92	0.3723	0.7837	1.9593	0.0000	0.0000	0.0000	0.0000	0.00
ethyl chloride	75-00-3	2690	2.69	0.2555	0.5379	1.3448	0.0000	0.0000	0.0000	0.0000	0.00
trichloromonofluoromethane R-11	75-69-4	5841	5.84	0.5549	1.1682	2.9204	0.0000	0.0000	0.0000	0.0000	0.00
ethanol	64-17-5	1733	1.73	0.1646	0.3466	0.8664	0.0000	0.0000	0.0000	0.0000	0.00
1,1,2-trichloro-1,2,2-trifluoroethane R-113	76-13-1	7890	7.89	0.7496	1.5781	3.9452	0.0000	0.0000	0.0000	0.0000	0.00
1,1-dichloroethene	75-35-4	4161	4.16	0.3953	0.8323	2.0807	0.0000	0.0000	0.0000	0.0000	0.00
acetone	67-64-1	2517	2.52	0.2391	0.5034	1.2585	0.0000	0.0000	0.0000	0.0000	0.00
isopropanol	67-63-0	2850	2.85	0.2708	0.5700	1.4251	0.0000	0.0000	0.0000	0.0000	0.00
carbon disulfide	75-15-0	3237	3.24	0.3075	0.6475	1.6187	0.0000	0.0000	0.0000	0.0000	0.00
methylene chloride	75-09-2	3611	3.61	0.3431	0.7222	1.8055	0.0000	0.0000	0.0000	0.0000	0.00
1,2-dichloroethene (trans)	156-60-5	4161	4.16	0.3953	0.8323	2.0807	0.0000	0.0000	0.0000	0.0000	0.00
methyl tert butyl ether	1634-04-4	3856	3.86	0.3663	0.7712	1.9281	0.0000	0.0000	0.0000	0.0000	0.00
hexane	110-54-3	3770	3.77	0.3581	0.7540	1.8850	0.0000	0.0000	0.0000	0.0000	0.00
1,1-dichloroethane	75-34-3	4208	4.21	0.3997	0.8415	2.1038	0.0000	0.0000	0.0000	0.0000	0.00
vinyl acetate	108-05-4	3132	3.13	0.2976	0.6265	1.5662	0.0000	0.0000	0.0000	0.0000	0.00
2-butanone (methyl ethyl ketone)	78-93-3	3213	3.21	0.3053	0.6427	1.6067	0.0000	0.0000	0.0000	0.0000	0.00
1,2-dichloroethene(cis)	156-59-2	4201	4.20	0.3991	0.8402	2.1005	0.0000	0.0000	0.0000	0.0000	0.00
ethyl acetate	141-78-6	3782	3.78	0.3593	0.7565	1.8912	0.0000	0.0000	0.0000	0.0000	0.00
chloroform	67-66-3	5125	5.12	0.4868	1.0249	2.5623	0.0000	0.0000	0.0000	0.0000	0.00
tetrahydrofuran	109-99-9	3243	3.24	0.3081	0.6486	1.6214	0.0000	0.0000	0.0000	0.0000	0.00
Internal standard				11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400
1,1,1-trichloroethane	71-55-6	5617	5.62	0.5337	1.1235	2.8087	0.0000	0.0000	0.0000	0.0000	0.00
cyclohexane	110-82-7	3682	3.68	0.3497	0.7363	1.8408	0.0000	0.0000	0.0000	0.0000	0.00
carbon tetrachloride	56-23-5	6414	6.41	0.6094	1.2829	3.2072	0.0000	0.0000	0.0000	0.0000	0.00
1,2-dichloroethane	107-06-2	4289	4.29	0.4074	0.8577	2.1443	0.0000	0.0000	0.0000	0.0000	0.00
benzene	71-43-2	3385	3.38	0.3216	0.6770	1.6925	0.0000	0.0000	0.0000	0.0000	0.00
heptane	142-82-5	4383	4.38	0.4164	0.8766	2.1916	0.0000	0.0000	0.0000	0.0000	0.00
trichloroethylene	79-01-6	5640	5.64	0.5358	1.1280	2.8201	0.0000	0.0000	0.0000	0.0000	0.00
1,2-dichloropropane	78-87-5	4850	4.85	0.4608	0.9701	2.4252	0.0000	0.0000	0.0000	0.0000	0.00
1,4-dioxane	123-91-1	3782	3.78	0.3593	0.7565	1.8912	0.0000	0.0000	0.0000	0.0000	0.00
bromodichloromethane	75-27-4	7033	7.03	0.6681	1.4066	3.5164	0.0000	0.0000	0.0000	0.0000	0.00
1,3-dichloro-1-propene(cis)	10061-01-5	4673	4.67	0.4439	0.9346	2.3364	0.0000	0.0000	0.0000	0.0000	0.00
4-methyl-2-penatanone (methyl isobutyl keto	108-10-1	4586	4.59	0.4357	0.9172	2.2931	0.0000	0.0000	0.0000	0.0000	0.00
toluene	108-88-3	3993	3.99	0.3793	0.7986	1.9965	0.0000	0.0000	0.0000	0.0000	0.00
1,3-dichloro-1-propene(trans)	10061-02-6	4809	4.81	0.4569	0.9618	2.4045	0.0000	0.0000	0.0000	0.0000	0.00
1,1,2-trichloroethane	79-00-5	5726	5.73	0.5440	1.1453	2.8632	0.0000	0.0000	0.0000	0.0000	0.00
tetrachloroethylene	127-18-4	7119	7.12	0.6763	1.4237	3.5593	0.0000	0.0000	0.0000	0.0000	0.00
2-hexanone (methyl butyl ketone)	591-78-6	4504	4.50	0.4279	0.9009	2.2522	0.0000	0.0000	0.0000	0.0000	0.00
dibromochloromethane	124-48-1	9196	9.20	0.8737	1.8393	4.5982	0.0000	0.0000	0.0000	0.0000	0.00
1,2-dibromoethane	106-93-4	8141	8.14	0.7734	1.6282	4.0706	0.0000	0.0000	0.0000	0.0000	0.00
Internal standard				12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200
chlorobenzene	108-90-7	4924	4.92	0.4678	0.9848	2.4620	0.0000	0.0000	0.0000	0.0000	0.00
ethylbenzene	100-41-4	4801	4.60	0.4371	0.9202	2.3005	0.0000	0.0000	0.0000	0.0000	0.00
M+P xylene	179601-23-1	9028	9.03	0.8577	1.8057	4.5142	0.0000	0.0000	0.0000	0.0000	0.00
O xylene	95-47-6	4644	4.64	0.4412	0.9289	2.3222	0.0000	0.0000	0.0000	0.0000	0.00
styrene	100-42-5	4513	4.51	0.4288	0.9027	2.2567	0.0000	0.0000	0.0000	0.0000	0.00
bromoform	75-25-2	10746	10.75	1.0208	2.1491	5.3728	0.0000	0.0000	0.0000	0.0000	0.00
Surrogate standard				17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800
1,1,2,2-tetrachloroethane	79-34-5	7343	7.34	0.6975	1.4685	3.6713	0.0000	0.0000	0.0000	0.0000	2.50
4-ethyltoluene	622-96-8	5258	5.26	0.4995	1.0515	2.6288	0.0000	0.0000	0.0000	0.0000	0.00
1,3,5-trimethylbenzene	108-67-8	5209	5.21	0.4948	1.0417	2.6043	0.0000	0.0000	0.0000	0.0000	0.00
1,2,4-trimethylbenzene	95-63-6	5258	5.26	0.4995	1.0515	2.6288	0.0000	0.0000	0.0000	0.0000	0.00
1,3-dichlorobenzene	541-73-1	6491	6.49	0.6166	1.2981	3.2453	0.0000	0.0000	0.0000	0.0000	0.00
1,4-dichlorobenzene	106-46-7	6370	6.37	0.6052	1.2741	3.1852	0.0000	0.0000	0.0000	0.0000	0.00
benzyl chloride	100-44-7	5589	5.59	0.5310	1.1179	2.7947	0.0000	0.0000	0.0000	0.0000	0.00
1,2-dichlorobenzene	95-50-1	6370	6.37	0.6052	1.2741	3.1852	0.0000	0.0000	0.0000	0.0000	0.00
1,2,4-trichlorobenzene	120-82-1	7789	7.79	0.7400	1.5578	3.8946	0.0000	0.0000	0.0000	0.0000	0.00
hexachlorobutadiene	87-68-3	11300	11.30	1.0735	2.2601	5.6502	0.0000	0.0000	0.0000	0.0000	0.00
naphthalene	91-20-3	5607	5.61	0.5326	1.1214	2.8034	0.0000	0.0000	0.0000	0.0000	0.00

NG cal levels #24447 / syringe dilution 1 ppb page1 of 1 3/9/2011 4:00 PM

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10ppb stock.

ug/m3 = ppb * Mw/Mv				mL nominal volume		1000					
Mv = 24.46 at 25C and 760 mmHg				Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
TO-15 Analysis of SUMMA Canisters				Volume mL	Volume mL	Volume mL	Volume mL	Volume mL	Volume mL	Volume mL	Volume mL
Full Scan GC/MS				100	250	500	750	1000			
Compounds listed in Retention time order		dilution fac	100.00								
62 Component stock #24447		Stock Standard Conc	Diluted Working Standard								
Compound Name	cas#	ng/L	ng/L	inj ng	inj ng	inj ng	inj ng	inj ng	inj ng	inj ng	inj ng
Internal standard				13.2200	13.2200	13.2200	13.2200	13.2200	13.22	13.22	13.22
propylene	115-07-1	1841	18.41	1.8408	4.6020	9.2039	13.8059	18.4078	0.0000	0.0000	0.00
dichlorodifluoromethane R-12	75-71-8	4943	49.43	4.9432	12.3579	24.7159	37.0738	49.4317	0.0000	0.0000	0.00
dichlorotetrafluoroethane R-114	76-14-2	7058	70.58	7.0576	17.6440	35.2881	52.9321	70.5761	0.0000	0.0000	0.00
chloromethane	74-87-3	2126	21.26	2.1261	5.3153	10.6306	15.9458	21.2611	0.0000	0.0000	0.00
chloroethene (vinyl chloride)	75-01-4	2606	26.06	2.6063	6.5157	13.0315	19.5472	26.0630	0.0000	0.0000	0.00
1,3-butadiene	106-99-0	2322	23.22	2.3219	5.8048	11.6097	17.4145	23.2193	0.0000	0.0000	0.00
bromomethane	74-83-9	3919	39.19	3.9186	9.7965	19.5930	29.3895	39.1860	0.0000	0.0000	0.00
ethyl chloride	75-00-3	2690	26.90	2.6897	6.7242	13.4485	20.1727	26.8970	0.0000	0.0000	0.00
trichloromonofluoromethane R-11	75-69-4	5841	58.41	5.8408	14.6019	29.2038	43.8056	58.4075	0.0000	0.0000	0.00
ethanol	64-17-5	1733	17.33	1.7328	4.3320	8.6640	12.9960	17.3280	0.0000	0.0000	0.00
1,1,2-trichloro-1,2,2-trifluoroethane R-113	76-13-1	7890	78.90	7.8905	19.7262	39.4525	59.1787	78.9049	0.0000	0.0000	0.00
1,1-dichloroethene	75-35-4	4161	41.61	4.1614	10.4034	20.8068	31.2102	41.6137	0.0000	0.0000	0.00
acetone	67-64-1	2517	25.17	2.5170	6.2924	12.5848	18.8772	25.1696	0.0000	0.0000	0.00
isopropanol	67-63-0	2850	28.50	2.8502	7.1255	14.2510	21.3765	28.5020	0.0000	0.0000	0.00
carbon disulfide	75-15-0	3237	32.37	3.2374	8.0934	16.1868	24.2801	32.3735	0.0000	0.0000	0.00
methylene chloride	75-09-2	3611	36.11	3.6111	9.0277	18.0554	27.0832	36.1109	0.0000	0.0000	0.00
1,2-dichloroethene (trans)	156-60-5	4161	41.61	4.1614	10.4034	20.8068	31.2102	41.6137	0.0000	0.0000	0.00
methyl tert butyl ether	1634-04-4	3856	38.56	3.8561	9.6403	19.2806	28.9208	38.5611	0.0000	0.0000	0.00
hexane	110-54-3	3770	37.70	3.7699	9.4248	18.8497	28.2745	37.6993	0.0000	0.0000	0.00
1,1-dichloroethane	75-34-3	4208	42.08	4.2076	10.5191	21.0381	31.5572	42.0762	0.0000	0.0000	0.00
vinyl acetate	108-05-4	3132	31.32	3.1325	7.8312	15.6623	23.4935	31.3247	0.0000	0.0000	0.00
2-butanone (methyl ethyl ketone)	78-93-3	3213	32.13	3.2134	8.0335	16.0670	24.1005	32.1341	0.0000	0.0000	0.00
1,2-dichloroethene(cis)	156-59-2	4201	42.01	4.2010	10.5025	21.0050	31.5075	42.0100	0.0000	0.0000	0.00
ethyl acetate	141-78-6	3782	37.82	3.7823	9.4558	18.9116	28.3674	37.8232	0.0000	0.0000	0.00
chloroform	67-66-3	5125	51.25	5.1247	12.8116	25.6233	38.4349	51.2465	0.0000	0.0000	0.00
tetrahydrofuran	109-99-9	3243	32.43	3.2429	8.1072	16.2144	24.3216	32.4289	0.0000	0.0000	0.00
Internal standard				11.6400	11.6400	11.6400	11.6400	11.6400	11.64	11.64	11.64
1,1,1-trichloroethane	71-55-6	5617	56.17	5.6174	14.0435	28.0871	42.1306	56.1742	0.0000	0.0000	0.00
cyclohexane	110-82-7	3682	36.82	3.6816	9.2039	18.4078	27.6118	36.8157	0.0000	0.0000	0.00
carbon tetrachloride	56-23-5	6414	64.14	6.4144	16.0360	32.0720	48.1081	64.1441	0.0000	0.0000	0.00
1,2-dichloroethane	107-06-2	4289	42.89	4.2885	10.7213	21.4427	32.1640	42.8854	0.0000	0.0000	0.00
benzene	71-43-2	3385	33.85	3.3850	8.4624	16.9249	25.3873	33.8498	0.0000	0.0000	0.00
heptane	142-82-5	4383	43.83	4.3832	10.9581	21.9162	32.8743	43.8324	0.0000	0.0000	0.00
trichloroethylene	79-01-6	5640	56.40	5.6402	14.1005	28.2010	42.3016	56.4021	0.0000	0.0000	0.00
1,2-dichloropropane	78-87-5	4850	48.50	4.8503	12.1259	24.2517	36.3776	48.5035	0.0000	0.0000	0.00
1,4-dioxane	123-91-1	3782	37.82	3.7823	9.4558	18.9116	28.3674	37.8232	0.0000	0.0000	0.00
bromodichloromethane	75-27-4	7033	70.33	7.0328	17.5819	35.1638	52.7458	70.3277	0.0000	0.0000	0.00
1,3-dichloro-1-propene(cis)	10061-01-5	4673	46.73	4.6729	11.6822	23.3645	35.0467	46.7290	0.0000	0.0000	0.00
4-methyl-2-penatanone (methyl isobutyl keto	108-10-1	4586	45.86	4.5862	11.4656	22.9312	34.3967	45.8623	0.0000	0.0000	0.00
toluene	108-88-3	3993	39.93	3.9930	9.9825	19.9649	29.9474	39.9298	0.0000	0.0000	0.00
1,3-dichloro-1-propene(trans)	10061-02-6	4809	48.09	4.8090	12.0225	24.0450	36.0675	48.0900	0.0000	0.0000	0.00
1,1,2-trichloroethane	79-00-5	5726	57.26	5.7265	14.3162	28.6325	42.9487	57.2649	0.0000	0.0000	0.00
tetrachloroethylene	127-18-4	7119	71.19	7.1186	17.7966	35.5931	53.3897	71.1862	0.0000	0.0000	0.00
2-hexanone (methyl butyl ketone)	591-78-6	4504	45.04	4.5043	11.2608	22.5217	33.7825	45.0433	0.0000	0.0000	0.00
dibromochloromethane	124-48-1	9196	91.96	9.1963	22.9908	45.9817	68.9725	91.9634	0.0000	0.0000	0.00
1,2-dibromoethane	106-93-4	8141	81.41	8.1411	20.3528	40.7056	61.0583	81.4111	0.0000	0.0000	0.00
Internal standard				12.0200	12.0200	12.0200	12.0200	12.0200	12.02	12.02	12.02
chlorobenzene	108-90-7	4924	49.24	4.9239	12.3098	24.6196	36.9294	49.2392	0.0000	0.0000	0.00
ethylbenzene	100-41-4	4601	46.01	4.6010	11.5025	23.0049	34.5074	46.0099	0.0000	0.0000	0.00
M+P xylene	179601-23-1	9028	90.28	9.0284	22.5709	45.1418	67.7127	90.2836	0.0000	0.0000	0.00
O xylene	95-47-6	4644	46.44	4.6444	11.6110	23.2220	34.8330	46.4439	0.0000	0.0000	0.00
styrene	100-42-5	4513	45.13	4.5135	11.2836	22.5673	33.8509	45.1345	0.0000	0.0000	0.00
bromoform	75-25-2	10746	107.46	10.7457	26.8642	53.7284	80.5926	107.4567	0.0000	0.0000	0.00
Surrogate standard				17.8800	17.8800	17.8800	17.8800	17.8800	17.88	17.88	17.88
1,1,2,2-tetrachloroethane	79-34-5	7343	73.43	7.3426	18.3564	36.7129	55.0693	73.4258	0.0000	0.0000	0.00
4-ethyltoluene	622-96-8	5258	52.58	5.2577	13.1442	26.2885	39.4327	52.5770	0.0000	0.0000	0.00
1,3,5-trimethylbenzene	108-67-8	5209	52.09	5.2086	13.0214	26.0428	39.0642	52.0856	0.0000	0.0000	0.00
1,2,4-trimethylbenzene	95-63-6	5258	52.58	5.2577	13.1442	26.2885	39.4327	52.5770	0.0000	0.0000	0.00
1,3-dichlorobenzene	541-73-1	6491	64.91	6.4906	16.2265	32.4530	48.6795	64.9060	0.0000	0.0000	0.00
1,4-dichlorobenzene	106-46-7	6370	63.70	6.3704	15.9260	31.8520	47.7780	63.7040	0.0000	0.0000	0.00
benzyl chloride	100-44-7	5589	55.89	5.5894	13.9735	27.9471	41.9206	55.8942	0.0000	0.0000	0.00
1,2-dichlorobenzene	95-50-1	6370	63.70	6.3704	15.9260	31.8520	47.7780	63.7040	0.0000	0.0000	0.00
1,2,4-trichlorobenzene	120-82-1	7789	77.89	7.7891	19.4729	38.9457	58.4186	77.8915	0.0000	0.0000	0.00
hexachlorobutadiene	87-68-3	11300	113.00	11.3003	28.2508	56.5016	84.7523	113.0031	0.0000	0.0000	0.00
naphthalene	91-20-3	5607	56.07	5.6068	14.0170	28.0339	42.0509	56.0678	0.0000	0.0000	0.00

NG cal levels #24447 / syringe dilution 10 ppb page1 of 1 3/9/2011 4:00 PM

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0.1 ppb sheet (columns 1–2) · 1.0 ppb sheet (columns 3–5) · 10 ppb sheet (columns 6–10)

			mL nominal volume		1000							
			Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL	Sample Volume mL
volume		ml	100	200	95	200	500	100	250	500	750	1000
Nom conc		ppbv	0.01	0.02	0.1	0.2	0.5	1	2.5	5	7.5	10
cmpd#			PPBV	PPBV	PPBV	PPBV	PPBV	PPBV	PPBV	PPBV	PPBV	PPBV
level #	Compound Name	cas#	1	2	3	4	5	6	7	8	9	10
1	Internal standard	74-97-5	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200	13.2200
2	propylene	115-07-1	0.0184	0.0368	0.1749	0.3682	0.9204	1.8408	4.6020	9.2039	13.8059	18.4078
3	dichlorodifluoromethane R-12	75-71-8	0.0494	0.0989	0.4696	0.9886	2.4716	4.9432	12.3579	24.7159	37.0738	49.4317
4	dichlorotetrafluoroethane R-114	76-14-2	0.0706	0.1412	0.6705	1.4115	3.5288	7.0576	17.6440	35.2881	52.9321	70.5761
5	chloromethane	74-87-3	0.0213	0.0425	0.2020	0.4252	1.0631	2.1261	5.3153	10.6306	15.9458	21.2611
6	chloroethene (vinyl chloride)	75-01-4	0.0261	0.0521	0.2476	0.5213	1.3031	2.6063	6.5157	13.0315	19.5472	26.0630
7	1,3-butadiene	106-99-0	0.0232	0.0464	0.2206	0.4644	1.1610	2.3219	5.8048	11.6097	17.4145	23.2193
8	bromomethane	74-83-9	0.0392	0.0784	0.3723	0.7837	1.9593	3.9186	9.7965	19.5930	29.3895	39.1860
9	ethyl chloride	75-00-3	0.0269	0.0538	0.2555	0.5379	1.3448	2.6897	6.7242	13.4485	20.1727	26.8970
10	trichloromonofluoromethane R-11	75-69-4	0.0584	0.1168	0.5549	1.1682	2.9204	5.8408	14.6019	29.2038	43.8056	58.4075
11	ethanol	64-17-5	0.0173	0.0347	0.1646	0.3466	0.8664	1.7328	4.3320	8.6640	12.9960	17.3280
12	1,1,2-trichloro-1,2,2-trifluoroethane R-113	76-13-1	0.0789	0.1578	0.7496	1.5781	3.9452	7.8905	19.7262	39.4525	59.1787	78.9049
13	1,1-dichloroethene	75-35-4	0.0416	0.0832	0.3953	0.8323	2.0807	4.1614	10.4034	20.8068	31.2102	41.6137
14	acetone	67-64-1	0.0252	0.0503	0.2391	0.5034	1.2585	2.5170	6.2924	12.5848	18.8772	25.1696
15	isopropanol	67-63-0	0.0285	0.0570	0.2708	0.5700	1.4251	2.8502	7.1255	14.2510	21.3765	28.5020
16	carbon disulfide	75-15-0	0.0324	0.0647	0.3075	0.6475	1.6187	3.2374	8.0934	16.1868	24.2801	32.3735
17	methylene chloride	75-09-2	0.0361	0.0722	0.3431	0.7222	1.8055	3.6111	9.0277	18.0554	27.0832	36.1109
18	1,2-dichloroethene (trans)	156-60-5	0.0416	0.0832	0.3953	0.8323	2.0807	4.1614	10.4034	20.8068	31.2102	41.6137
19	methyl tert butyl ether	1634-04-4	0.0386	0.0771	0.3663	0.7712	1.9281	3.8561	9.6403	19.2806	28.9208	38.5611
20	hexane	110-54-3	0.0377	0.0754	0.3581	0.7540	1.8850	3.7699	9.4248	18.8497	28.2745	37.6993
21	1,1-dichloroethane	75-34-3	0.0421	0.0842	0.3997	0.8415	2.1038	4.2076	10.5191	21.0381	31.5572	42.0762
22	vinyl acetate	108-05-4	0.0313	0.0626	0.2976	0.6265	1.5662	3.1325	7.8312	15.6623	23.4935	31.3247
23	2-butanone (methyl ethyl ketone)	78-93-3	0.0321	0.0643	0.3053	0.6427	1.6067	3.2134	8.0335	16.0670	24.1005	32.1341
24	1,2-dichloroethene(cis)	156-59-2	0.0420	0.0840	0.3991	0.8402	2.1005	4.2010	10.5025	21.0050	31.5075	42.0100
25	ethyl acetate	141-78-6	0.0378	0.0756	0.3593	0.7565	1.8912	3.7823	9.4558	18.9116	28.3674	37.8232
26	chloroform	67-66-3	0.0512	0.1025	0.4868	1.0249	2.5623	5.1247	12.8116	25.6233	38.4349	51.2465
27	tetrahydrofuran	109-99-9	0.0324	0.0649	0.3081	0.6486	1.6214	3.2429	8.1072	16.2144	24.3216	32.4289
28	Internal standard	540-36-3	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400	11.6400
29	1,1,1-trichloroethane	71-55-6	0.0562	0.1123	0.5337	1.1235	2.8087	5.6174	14.0435	28.0871	42.1306	56.1742
30	cyclohexane	110-82-7	0.0368	0.0736	0.3497	0.7363	1.8408	3.6816	9.2039	18.4078	27.6118	36.8157
31	carbon tetrachloride	56-23-5	0.0641	0.1283	0.6094	1.2829	3.2072	6.4144	16.0360	32.0720	48.1081	64.1441
32	1,2-dichloroethane	107-06-2	0.0429	0.0858	0.4074	0.8577	2.1443	4.2885	10.7213	21.4427	32.1640	42.8854
33	benzene	71-43-2	0.0338	0.0677	0.3216	0.6770	1.6925	3.3850	8.4624	16.9249	25.3873	33.8498
34	heptane	142-82-5	0.0438	0.0877	0.4164	0.8766	2.1916	4.3832	10.9581	21.9162	32.8743	43.8324
35	trichloroethylene	79-01-6	0.0564	0.1128	0.5358	1.1280	2.8201	5.6402	14.1005	28.2010	42.3016	56.4021
36	1,2-dichloropropane	78-87-5	0.0485	0.0970	0.4608	0.9701	2.4252	4.8503	12.1259	24.2517	36.3776	48.5035
37	1,4-dioxane	123-91-1	0.0378	0.0756	0.3593	0.7565	1.8912	3.7823	9.4558	18.9116	28.3674	37.8232
38	bromodichloromethane	75-27-4	0.0703	0.1407	0.6681	1.4066	3.5164	7.0328	17.5819	35.1638	52.7458	70.3277

This table of values is generated with a new standard to calculate Ng on column values for chemstation.

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39	1,3-dichloro-1-propene(cis)	10061-01-5	0.0467	0.0935	0.4439	0.9346	2.3364	4.6729	11.6822	23.3645	35.0467	46.7290	
40	4-methyl-2-penatanone (methyl isobutyl ketone	108-10-1	0.0459	0.0917	0.4357	0.9172	2.2931	4.5862	11.4656	22.9312	34.3967	45.8623	
41	toluene	108-88-3	0.0399	0.0799	0.3793	0.7986	1.9965	3.9930	9.9825	19.9649	29.9474	39.9298	
42	1,3-dichloro-1-propene(trans)	10061-02-6	0.0481	0.0962	0.4569	0.9618	2.4045	4.8090	12.0225	24.0450	36.0675	48.0900	
43	1,1,2-trichloroethane	79-00-5	0.0573	0.1145	0.5440	1.1453	2.8632	5.7265	14.3162	28.6325	42.9487	57.2649	
44	tetrachloroethylene	127-18-4	0.0712	0.1424	0.6763	1.4237	3.5593	7.1186	17.7966	35.5931	53.3897	71.1862	
45	2-hexanone (methyl butyl ketone)	591-78-6	0.0450	0.0901	0.4279	0.9009	2.2522	4.5043	11.2608	22.5217	33.7825	45.0433	
46	dibromochloromethane	124-48-1	0.0920	0.1839	0.8737	1.8393	4.5982	9.1963	22.9908	45.9817	68.9725	91.9634	
47	1,2-dibromoethane	106-93-4	0.0814	0.1628	0.7734	1.6282	4.0706	8.1411	20.3528	40.7056	61.0583	81.4111	
48	Internal standard	3114-55-4	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	12.0200	
49	chlorobenzene	108-90-7	0.0492	0.0985	0.4678	0.9848	2.4620	4.9239	12.3098	24.6196	36.9294	49.2392	
50	ethylbenzene	100-41-4	0.0460	0.0920	0.4371	0.9202	2.3005	4.6010	11.5025	23.0049	34.5074	46.0099	
51	M+P xylene	179601-23-1	0.0903	0.1806	0.8577	1.8057	4.5142	9.0284	22.5709	45.1418	67.7127	90.2836	
52	O xylene	95-47-6	0.0464	0.0929	0.4412	0.9289	2.3222	4.6444	11.6110	23.2220	34.8330	46.4439	
53	styrene	100-42-5	0.0451	0.0903	0.4288	0.9027	2.2567	4.5135	11.2836	22.5673	33.8509	45.1345	
54	bromoform	75-25-2	0.1075	0.2149	1.0208	2.1491	5.3728	10.7457	26.8642	53.7284	80.5926	107.4567	
55	Surrogate standard	460-00-4	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	17.8800	
56	1,1,2,2-tetrachloroethane	79-34-5	0.0734	0.1469	0.6975	1.4685	3.6713	7.3426	18.3564	36.7129	55.0693	73.4258	
57	4-ethyltoluene	622-96-8	0.0526	0.1052	0.4995	1.0515	2.6288	5.2577	13.1442	26.2885	39.4327	52.5770	
58	1,3,5-trimethylbenzene	108-67-8	0.0521	0.1042	0.4948	1.0417	2.6043	5.2086	13.0214	26.0428	39.0642	52.0856	
59	1,2,4-trimethylbenzene	95-63-6	0.0526	0.1052	0.4995	1.0515	2.6288	5.2577	13.1442	26.2885	39.4327	52.5770	
60	1,3-dichlorobenzene	541-73-1	0.0649	0.1298	0.6166	1.2981	3.2453	6.4906	16.2265	32.4530	48.6795	64.9060	
61	1,4-dichlorobenzene	106-46-7	0.0637	0.1274	0.6052	1.2741	3.1852	6.3704	15.9260	31.8520	47.7780	63.7040	
62	benzyl chloride	100-44-7	0.0559	0.1118	0.5310	1.1179	2.7947	5.5894	13.9735	27.9471	41.9206	55.8942	
63	1,2-dichlorobenzene	95-50-1	0.0637	0.1274	0.6052	1.2741	3.1852	6.3704	15.9260	31.8520	47.7780	63.7040	
64	1,2,4-trichlorobenzene	120-82-1	0.0779	0.1558	0.7400	1.5578	3.8946	7.7891	19.4729	38.9457	58.4186	77.8915	
65	hexachlorobutadiene	87-68-3	0.1130	0.2260	1.0735	2.2601	5.6502	11.3003	28.2508	56.5016	84.7523	113.0031	
66	naphthalene	91-20-3	0.0561	0.1121	0.5326	1.1214	2.8034	5.6068	14.0170	28.0339	42.0509	56.0678	

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ATTACHMENT D

CLEANING AND CALIBRATION OF FLOW CONTROLLERS

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Cleaning of Flow Controllers

A manual batch processing system is used to clean flow controllers, where they are placed in an oven at 70°C on a cleaning manifold and purged with high quality nitrogen for a minimum of 2 hours. One flow controller-cleaning manifold is maintained which is capable of handling up to twelve controllers per cycle. The controllers are affixed to the outlets with a Swaglok nut and a 7/16" wrench. The toggle valve must now be opened in order to start the flow of compressed nitrogen through the controllers. If a full set of twelve controllers is not being cleaned, any unused manifold position must be capped off with a Swagelok cap in order to prevent the compressed nitrogen from bypassing the controllers and escaping from the open position.

Following the 2 hour cleaning cycle, close the toggle valve, open the oven door and remove flow controllers from cleaning manifold with a 7/16" wrench. The flow controllers must then be placed in a bin, labeled "Clean/Ready for Calibration".

The cleaning of each flow controller is tracked in the LIMS cleaning module. Flow controller barcode IDs, final oven temperature, start and stop times are all documented in LIMS.

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Calibration Calculations and Explanations

Clients have the option to have samples taken in durations of 30 minutes to 24-hours. This is accomplished by calibrating the flow controllers up to the duration of the requested sampling procedure. This will let a linear amount of sample air into the Summa canister for a specified time. Once the client has selected a time (in hours) for sampling, the flow controller may be set appropriately. Occasionally a customer may request a set flow rate rather than an exact sampling time such as 200mL/min. for soil vapor sampling.

Flow controllers are set to sample at a rate to result in 5"Hg vacuum remaining in a canister at the end of the sampling period. The flow rate may be calculated as follows.

$$F = \frac{V}{T} * \frac{(29.9 - 5)"Hg}{29.9"Hg}$$

Where:
F = flow rate in mLmin.
V= canister volume in mL
T= sample duration in minutes

Sampling time (hour) For a 6 L canister	**Flow (mL/min)**
0.5	167
1	83.3
2	41.6
3	27.8
4	20.8
6	13.9
8	10.4
12	6.94
24	3.47

To correct for pressure differences at higher elevations (above sea level), substitute the actual barometric pressure for the standard barometric pressure of 29.9"Hg in the previous equation.

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Flow Controller Calibration

The Restek and Entech flow controllers must be calibrated under vacuum conditions rather than through pressurization. These styles of controllers utilize an orifice to adjust the controller to the desired flow range. The orifice size is selected and installed as per manufacture instructions. Attach the outlet of the controller to an evacuated canister with a minimum of 15 "Hg of vacuum. Connect the line from the appropriate range digital flow meter to the inlet of the controller. The digital flow meter has been calibrated to indicate actual flow at room temperature and normal barometric pressure. Apply vacuum to the flow controller with the inlet valve closed. Close the canister valve and observe the controller vacuum gauge. Minimal fluctuation in the gauge indicates that the controller assembly is leak tight. Compare the controller vacuum gauge to the canister gauge. The controller gauge is used as an indicator only. It should read reasonably close to the vacuum of the canister gauge. Open both valves and set the flow by turning the set screw on the controller to achieve the desired flow. Detach the controller from the canister and replace the Swagelok and Teflon ferrule. Replace the Teflon ferrule as needed. The set point of the controller is recorded in the pre shipping module in LIMS.

Corrective Action - Unable to Calibrate

Check for blockage in the filter by removing the filter and checking for flow through the flow controller without the filter. If the controller flows freely then there is a blockage in the filter. Take the controller out of service and put on maintenance hold in container tracking until which time the filter may be replaced. All maintenance performed on a controller must be documented in the log for flow controllers (container tracking in LIMS).

Post Calibration Failure

If the calibration of the flow controller after receipt from the client differs from the original calibration by more than 20%, the Project Manager must be contacted as soon as possible. However, prior to any notification, check for blockage in the filter, and check that all fittings are securely tightened. Determine the possible cause and document in the associated job file. Contact the Project Manager in order for the client to be contacted to determine the fate of the sample(s). The resulting decision must also be documented. If the filter is obviously blocked by dirt the controller shall be placed in maintenance and the filter replaced. If the controller has been flooded by water it is placed in maintenance and manually cleaned, including disassembly if required. All maintenance is documented in LIMS.

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Flow Controller QC Failure

When individually certified flow controllers are required by a customer they are set to sample clean humidified air into a clean canister from a source of humidified UHP air. The flow controller and canister are QC checked as a pair. If the controller fails QC trace the history of the flow controller in question by looking at previous maintenance activities, calibration, quality control checks, clients, and sample type (ambient or source). Re-clean the controller and perform a new quality control checked. If the QC still does not pass, take the flow controller out of service (put it on "maintenance hold" in container tracking and make notation as to reason), replace filter, clean tubing, and check again. The canister must also be cleaned.
Flow controller and canister QC pairs are evaluated on a project by project basis for the client target list.

SOP CHANGE FORM

SOP Title: Volatile organic compounds by gc/ms
SOP Code: VOC-8260
SOP Revision No.: 12
SOP Date: 8/20/12
SOP Section(s) Affected by Change: all referencing BFB tune

Description of Change:
Sec 3.14, 11.3.2, 11.5.1, change "50 ng" to "50 ng or less"
Sec 9.5.2.2.1 and .2 and .4 change 50 ug/mL to 100 ug/mL and 500uL to 1mL
Add to sec 9.5.2.2.4 "Used if centurion performing addition from one standard reservoir."
Sec 9.5.2.2.3 Delete

9.6.1 change to
For Waters – (50 ng/mL) – dilute 5 uL of 500 ug/mL Working Surrogate Standard (the Surrogate standard contains the BFB needed for the Tune) to 50 mL with DI. Place the whole vial on the system.

9.6.2 change to
For Soils – (100 ng/mL) – dilute 10 uL of 500 ug/mL Working Surrogate Standard (the Surrogate standard contains the BFB needed for the Tune) to 50 mL with DI. Place 5 mL of the solution into a vial and place on the system.

Add section 9.6.3
For tune evaluation from a blank allow the auto sampler to inject the combined internal surrogate mixture in to a water or soil blank and analyze as a normal sample.

Add to section 11.3.1 after the first sentence.
Perform the tune check by purging either a standard prepared as described in section 9.6 or a blank sample allowing the auto sampler to add the combined internal standard/surrogate mix. In either case less than 50 ng of BFB is injected on column.

Reason(s) for Change(s):
As per 8260C, revision 3, section 11.3.1, allowing the injection of 50 ng or less of BFB on column allowing for the effect of sample split ratio.
Allowing the injection of BFB tune by the auto sampler.
Update preparation of IS/Surr working standard for Centurion auto sampler.

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Change(s) Submitted by: Tom Walton	Date: 7/2/13

Approvals:

Technical Reviewer Signature: Tom Walton	Date: 7/2/13
QA Signature:	Date: 7/3/13
Laboratory Director Signature:	Date: 7/8/13

Change(s) Effective Date: 7/3/13

88

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SOP CHANGE FORM

SOP Title: Volatile organic compounds by gc/ms
SOP Code: VOC-8260
SOP Revision No.: 12
SOP Date: 8/20/12
SOP Section(s) Affected by Change: 11.5.2.4

Description of Change: Add to end of section the following:

If the CCV fails with low bias, any samples that are associated with that CCV must be flagged or analyzed under a compliant CCV.

Reason(s) for Change(s):

To clarify current flagging and reporting practices.

Change(s) Submitted by: Tom Walton	Date: 4\22\13

Approvals:

Technical Reviewer Signature: Tom Walton	Date: 4/22/13
QA Signature:	Date: 4/22/13
Laboratory Director Signature:	Date: 4/23/13

Change(s) Effective Date: 4/22/13

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ALS Environmental

DOCUMENT TITLE:	*VOLATILE ORGANIC COMPOUNDS BY GC/MS*
REFERENCED METHOD:	*8260C*
SOP ID:	*VOC-8260*
REV. NUMBER:	*12*
EFFECTIVE DATE:	*08/20/2012*

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VOLATILE ORGANIC COMPOUNDS BY GC/MS

SOPID:	VOC-8260	Rev. Number:	12	Effective Date:	08/20/2012

Approved By: Tom Walton Date: 8-6-2012
Department Supervisor – Tom Walton

Approved By: Lisa Reyes Date: 8/24/2012
QA Manager – Lisa Reyes

Approved By: Michael K Perry Date: 8/7/12
Technical Director – Michael Perry

Archival Date: _____ Doc Control ID#: 12-VOC-01 Editor: _____
QA 8/24/12

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1. SCOPE AND APPLICATION

This SOP uses USEPA SW-846 method 8260C to determine the concentration of volatile organic compounds (VOCs) in water and soil, sediment and sludge. The preparation of solids by Method 5035 is discussed in a separate SOP (VOC-5035). Sample introduction by Method 5030 (purge and trap) is discussed in this SOP. The base chromatography, QC, and calibration method used is USEPA SW-846 method 8000C. The use of this method for low concentrations by SIM Mode is discussed in Attachment I. This method may also be applicable to various types of aqueous and nonaqueous waste samples. Samples may be analyzed after a leachate procedure (MET-TZHE or MET-SPLPZHE). The Data Quality Objectives Table lists the compounds that are routinely determined by this method with the associated Reporting Limits and Quality Control Limits. The reported compound list and reporting limits may be adjusted if required for specific project requirements and supported by current detection and quantitation studies. The method can quantitate most volatile organic compounds with a boiling point <200°C. This SOP may be used for work requiring DOD QSM, Massachusetts CAM, or Connecticut RCP by following the special conditions in the Quality Control Summary (Table 3).

2. METHOD SUMMARY

2.1. This method gives gas chromatographic/mass spectrometric (GC/MS) conditions for the detection of parts per billion (ppb) levels of volatile organic compounds. A sample aliquot is injected into the gas chromatograph (GC) by the purge and trap method. The compounds are separated on a small bore fused silica capillary column. The compounds are detected by a mass selective detector (MSD), which gives both qualitative as well as quantitative information.

2.2. In the purge and trap process an inert gas, helium, is bubbled through the sample aliquot, at room temperature. This gas stream sweeps the volatile organic compounds out of the aqueous phase and into the gas stream - it purges the compounds out of the sample. The gas stream then passes through a sorbent column which selectively adsorbs (traps) these compounds out of the helium. After the purging sequence is done, the sorbent column (the trap) is heated and backflushed onto the GC column. The GC column separates the compounds and passes them onto the MSD for identification and quantification.

2.3. Method Summary for SIM mode is discussed in Attachment I.

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3. DEFINITIONS

3.1. **Analysis Window** - Samples are analyzed in a set referred to as "a window". The window begins with the injection of the tune verification standard. Standards, required QC samples and samples may be run for 12-hours in this window. A new window must be opened to continue analysis.

3.2. **Initial Calibration Curve** – analysis of analytical standards for a series of different specified concentrations; used to define the linearity and dynamic range of the response of the detector to the target compounds.

3.3. **Laboratory Control Sample (LCS) or Reference Standard** – An aliquot of analyte-free water or other blank matrix to which known quantities of analytes of interest from a second source are added in the laboratory. The LCS is analyzed the same as a sample. Its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate measurements. The LCS contains a full list of compounds. The LCS is evaluated for all client targets in the batch, however only a subset of compounds designated to represent the targets is typically reported.

3.4. **Matrix Spike/ Matrix Spike Duplicate Analysis (MS/MSD)** – An aliquot of a sample to which known amounts of compounds of interest from a second source are added in the laboratory prior to analysis. The MS/MSD are analyzed the same as a sample. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the compounds determined by the analysis. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision. The LCS is evaluated for all of the targets for which the system is calibrated. Corrective action is taken if acceptance criteria is not met for targets in the client's target list.

3.5. **Method Blank (MB)** - A volume of analyte-free water treated and analyzed exactly the same as a sample. The purpose of the blank is to determine if any of the analytes of interest or other interferences are present in the analytical system, particularly in regards to carry-over of analytes from highly contaminated samples into other analyses.

3.6. **Percent Drift or Percent Difference (%D) -** Used to compare two values, the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference).

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3.7. **% Relative Standard Deviation (%RSD):** statistical measure of variation. Used in this method to measure the relative variation of initial calibration standards. Calculated by dividing the standard deviation of the individual response factors by the average response factor and multiplying by 100 to express as a percentage.

3.8. **Relative Percent Difference (RPD)** – The absolute value of the difference of two values divided by the average of the same two values. Used to compare the precision of the analysis. The result is always a positive number.

3.9. **Surrogate** - Surrogates are organic compounds which are similar to the analytes of interest in chemical composition, and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to help determine matrix effects and to evaluate the preparation and analysis of samples. These compounds were spiked into all blanks, standards, and samples prior to analysis. Percent recovery is calculated for each surrogate.

3.10. **Internal Standards** - Internal standards are organic compounds which are similar to the analytes of interest but which are not found in the samples. The chosen internal standards are used to calibrate the instrument's response.

3.11. **Batch** – group of samples (not to exceed 20) of the same matrix analyzed together within sequence. See ADM-BATCH for further discussion.

3.12. **Independent Calibration Verification (ICV)** - Verification of the ratio of instrument response to analyte amount. ICV solutions (also referred to as laboratory control samples or reference samples) are made from a stock solution which is different from the stock used to prepare calibration standards (Second Source).

3.13. **Continuing Calibration Verification Standard (CCV)** - A standard injected into the instrument at specified intervals and is used to verify the initial calibration. The source of this standard is the same as that used for calibration purposes.

3.14. **4-Bromofluorobenzene (BFB) Tune Standard** – 50 ng (on-column) of BFB (a solution in methanol) is analyzed to open an analysis window.

3.15. **Limit of Quantitation (LOQ) –** The minimum levels, concentrations, or quantities of a target that can be reported with a specified degree of confidence. For DOD, the lowest concentration that produces a quantitative result within specified limits of precision and bias. The LOQ shall be set at or above the concentration of the lowest initial calibration standard.

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3.16. **Limit of Detection (LOD) –** An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory – dependent. For DOD, the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.

3.17. **Target Analyte –** a compound of interest for which the method is capable of measuring. The compounds that the client requests to be reported.

4. INTERFERENCES

Interferences include but are not limited to impurities in the inert purge gas, dirty plumbing/purge vessels, cross contamination of highly contaminated samples, in transport and storage, and carry over from one analysis to subsequent ones.

Avoid using non-PTFE thread sealants, plastic tubing, and rubber components, since such materials out-gas organic compounds, which will concentrate in the trap during, purge operation.

If a sample containing low concentration of VOCs is analyzed immediately after a sample containing high concentration of VOCs, a blank may be analyzed between samples to rinse the system and avoid carry-over. If samples are being injected using a syringe, the syringe should also be rinsed with sufficient volumes of methanol or DI between samples. Screening samples using the PID or Hnu (see VOC-SCREEN) may also be used to avoid injecting sample with high VOC concentration.

Storage blanks (cooler blanks) are placed in the walk-in coolers containing samples to be tested for VOCs. These blanks are prepared, held/sampled, and analyzed according to VOC-BLANK.

Trip blanks are collected with aqueous samples and carried through the sampling, handling, and storage to check for contamination of volatile compounds capable of diffusion such as methylene chloride and fluorocarbons.

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5. SAFETY

Chemicals, reagents and standards must be handled as described in the company safety policies, approved methods and in MSDSs where available. Refer to the Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp at all times. Sources of flammable gases (e.g., pressurized hydrogen) should be clearly labeled.

The proper use of syringes should be part of employee training. Care should be taken to avoid personal injury as a result of improper handling techniques.

Refer to the Safety Manual for further discussion of general safety procedures and information.

6. SAMPLE CONTAINERS, COLLECTION, PRESERVATIONS, AND STORAGE

6.1. All sample containers for VOC analysis are purchased precleaned and certified from major lab equipment suppliers. All containers should be of glass or amber glass and equipped with a screw top cap and PFTE (Teflon) lined septa and capable of containing a minimum of 40 mL of aqueous sample or 2-4 oz. of soil sample. New lots of vials are routinely checked for cleanliness and target compound contamination.

6.2. Aqueous Samples

6.2.1. Field personnel are to slowly fill sample vials to just overflowing, taking care not to flush out the preservative or to trap air bubbles in the samples. The bottles are sealed with PFTE lined septa toward the sample and are to be inverted to check for air bubbles. The laboratory will also check for air bubbles upon receipt.

6.2.2. Aqueous Samples should be collected (received) in 40 mL VOA vials with zero headspace. Samples should be preserved to pH <2 with hydrochloric acid (Because 2-chloroethylvinyl ether degrades in the presence of acid, it is recommended that samples are not preserved if this is compound of concern). Ideally, three VOA vials will be received for each sample. Samples will be refrigerated to 0-6^{o}C upon sample login. Aqueous samples that are not prepreserved with HCl must be analyzed within 7 days of collection. Preserved samples must be analyzed within 14 days of collection.

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6.3 Soil Samples

Soil samples are collected per individual state, agency, or QAP requirements. See State Summary spreadsheet in VOA lab office for details. The following options are available:

6.3.1 Option 1: Soil Jar – this is not a 5035 allowed collection option, but is required by New York State.

Soil jars with PFTE lined septa are used to collect soil samples. The soil is pressed into the jar to the top to eliminate any headspace. Samples are stored at 0-6 ºC. Holding time is 14 days from sample collection to analysis. No chemical preservatives are used.

6.3.2 Option 2. Encores

Soil plugs (5g or 25g) are captured and simultaneously encapsulated in Encore style sampler. Field personnel should collect three plugs for each sampling location. Encores are to be shipped back to the laboratory with ice, chilled to 0-6°C while in transit. Upon receipt, SMO delivers the Encores to personnel in the VOA laboratory to be stored in the freezer. The VOA laboratory has 48 hrs from sampling to transfer the soil fractions to VOA vials containing DI or methanol. Two are transferred to separate VOA vials containing 5 mL DI water and a stir bar (for the low concentration fractions). One is transferred to a VOA vial containing Methanol (for the medium level fraction). These vials are then stored in the freezer (on their sides) until analysis. Holding time is 14 days from sample collection to analysis. See VOC-5035 for further details. Note: upon client request, a sodium bisulfate solution may be used instead of DI.

6.3.3 Option 3. Terracore kits (preferred over Encores to avoid potential problems with 48 hour transfer)

Terracore kits include 3 VOA vials with stir bars (2 with DI and one with methanol as described for Encores). The field personnel put the soil plugs directly into the vials. The laboratory may send out pre-prepared vials or the client may purchase Terracore kits. Once the sample is closed in the vial, the sample will not be opened again. Upon receipt, SMO delivers the vials to personnel in the VOA laboratory to be stored in the freezer. Holding time is 14 days from sample collection to analysis. See VOC-5035 for further details. Note: upon client request, a sodium bisulfate solution may be used instead of DI.

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6.4 Oily Waste samples - When oily waste samples are known to be soluble in methanol, sample vials may be prepared as described for soils. However, when the solubility of the waste is unknown, the sample should be collected in a vial without the use of a preservative.

6.5 See VOC-5035, SMO-GEN and SMO-ICOC for further discussion of sample handling, storage, and custody procedures

7. APPARATUS AND EQUIPMENT

7.1. Gas chromatograph/Mass Selective Detector Systems

Instrument ID	Instrument Configuration	Manufacturer Part	Serial Number	Year Acquired
GC/MS #5 (R-MS-05)	Gas Chromatograph	HP 5890II	3121A35679	1991
	Mass Spec Detector	HP 5971	3118A02532	
	AutoSampler	Archon	12727	
	Concentrator	Tekmar 3000	98125008	
	Computer Workstation	Gateway P5-133	5360356	
	Computer Workstation	Dell Optiplex GX280	5M7KM71	
	Analytical Software Gateway	Enviroquant Chemstation G1032C v.c.01.00		
	Analytical Software Dell	Enviroquant Chemstation E.01.00.237		
GC/MS #6 (R-MS-06)	Gas Chromatograph	HP 6890	US00023178	1998
	Mass Spec Detector	HP 5973	US82311143	
	AutoSampler	Archon		
	Concentrator	EST Encon	261043003	
	Computer Workstation	Gateway GP6-400	0013029323	
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00		

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GC/MS #7 (R-MS-07)	Gas Chromatograph	HP 5890II	3235A43994	2001
	Mass Spec Detector	HP 5971	323A03964	
	AutoSampler	Archon	13589	
	Concentrator	Tekmar 2000	91267022	
	Computer Workstation	Compaq DeskPro	6124FR4ZD257	
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00		

GC/MS #8 (R-MS-08)	Gas Chromatograph	HP 5890II	3126A36850	2004
	Mass Spec Detector	HP 5972	3435A01975	
	AutoSampler	EST Centurion	CENT145061104	
	Concentrator	EST Encon	374062504	
	Computer Workstation	Compaq DeskPro	6946CJM7M878	
	Analytical Software	Enviroquant Chemstation G1701BA v.B.01.00		

GC/MS #10 (R-MS-10)	Gas Chromatograph	Agilent 6890N	CN10633045	2006
	Mass Spec Detector	Agilent 5975B	US62723782	
	Purge and Trap	EST-Varian Archon	14702	
	Concentrator	EST Encon	ELEC-523103006E PATH-523103006P	
	Computer Workstation	Dell E520	8PT52C1	
	Analytical Software	Chemstation	D.03.00.552	

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GC/MS #12 (R-MS-12)	Gas Chromatograph	Agilent 6890	US00026365	2008
	Mass Spec Detector	Agilent 5973	US71191002	
	Purge & Trap	Archon	15104	
	Concentrator	EST Encon	Elec-444071905E Path-444071905P	
	Computer Workstation	Dell	**B78K571**	
	Analytical Software	Chemstation	W6G86-222ZT-YK65P-N82JA	

7.1.1. Gas Chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for splitless injection and all required accessories, including syringes, analytical columns, and gases.

7.1.2. GC Column Options:

Type	Internal Diameter (mm)	Length (meters)	Film Thickness (µ)
HP-624	0.20	25	1.12
DB624	0.32	60	1.8
DB624	0.25	60	1.0
DB624	0.18	20	1.0
DB-VRX	0.18	20	1.0

7.2. Appropriate analytical balance (0.0001 g recommended for standard preparation and 0.01 g for sample weighing), volumetric flasks, syringes, vials, and bottles for standards preparation. Calibrate the balance according to ADM-DALYCK.

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7.3. Purge and Trap with Autosampler

7.3.1. Each volatile GC/MS analytical system uses a purge and trap concentrator system to introduce the sample onto the GC column. Each purge and trap has an autosampler (A/S) attached to run multiple samples, one at a time, and run unattended for extended periods of time.

7.3.2. Varian Archon autosamplers – these autosamplers add both Internal Standards and Surrogate Standards automatically from one receptacle.

7.3.3. Centurian autosamplers – these autosamplers add both Internal Standards and Surrogate Standards automatically from two individual receptacles.

7.3.4. Adsorbent Traps: Supelco K-Traps Carboxen Vocarb 3000.

7.4. PH indicator Paper – wide range – examples: pHydrion by Mikro 1-12 or EMD colorpHast 0-14.

7.5. Appropriate volume gas tight syringes with certificate of accuracy.

7.6. Appropriate volume glassware (50 mL graduated cylinders) for diluting standards, soil extracts, etc. Cleaned according to section 8.

7.7. See VOC-5035 for further equipment related to soil sample collection, preservation, and extraction.

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8. PREVENTATIVE MAINTANENCE

Typical preventive maintenance measures include, but are not limited to, the following items:

- Check gas supply
- Change in-line filters, septum, gold seal, and injection port liner, as needed
- Clip column as needed
- Clean source

Specific instructions for these maintenance activities and other troubleshooting activities are found in the appropriate instrument manuals.

Maintenance log - All Preventive maintenance, as well as instrument repair, should be documented in the appropriate instrument maintenance log. Most routine maintenance and troubleshooting are performed by staff. Other maintenance or repairs may, or may not require factory service, depending upon the nature of the task. Any maintenance performed by outside services must also be documented – either through notes in the log or through documents provided by the service. The log entries will include the date maintenance was performed, symptoms of the problem, serial numbers of major equipment upgrades or replacements. The datafile name of the first acceptable run after maintenance is to be documented in the maintenance log.

All syringes used for sample and standard preparation are monitored by the analyst for wear. Parts are replaced as needed to insure all syringes remain gas tight.

All glassware must be cleaned prior to use and includes the use of Liquinox detergent, rinse 8-10 times with hot tap water, rinse 3 times with Millipore DI and 3 times with Purge and Trap grade Methanol.

Troubleshooting – see maintenance log or instrument manual for help solving specific analytical or instrument problems.

9. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

9.1. Solvents must be of sufficient purity to permit usage without lessening the accuracy of the determination or introducing interferences. Solvents are to be checked for contamination before use. See ADM-CTMN.

- Methanol, purge and trap grade or equivalent. Purchased commercially. Store at room temperature. Expires per Expiration Policy.

9.2. See VOC-5035 for preservatives.

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9.3. **Standards storage and expiration** – All of the standards in this SOP are stored in the freezer and are allowed to warm to room temperature before using. Standards expire per the Expiration policy. Protect all standards from light. Samples and standards must be stored separately.

9.4. **Standards Preparation General Information and Disclaimers**

All of the preparation instructions are general guidelines. Other technical recipes may be used to achieve the same results. Example – a 20 mg/L standard may be made by adding 1 mL of 200 mg/L to 10 mL or may be made by adding 4 mL of 50 mg/L to 10 mL. The preparation depends upon the final volume needed and the initial concentration of the stock. Reasonable dilution technique is used.

The initial calibration curves given are typical, but also subject to variation due to targets and detection levels needed. The curves will always be at least 5 points (typically more). The lowest concentration level shall be at the method reporting level. The remaining levels should define the working linear range of the analytical system.

Vendors and vendors' products are sometimes listed for the ease of the analyst using this SOP, but products and purchased concentrations are examples only and subject to change at any time. All purchased standards are certified by the vendor. Certificates of Analysis are kept in the department until the standards are no longer being used – at which time they are archived with QA. Certificates of Analysis are available upon request. Purchased standards are routinely checked against an independent source for both analyte identification and analyte concentration.

All Standards must be traceable using the lab lot system (ADM-DATANTRY).

All targets are routinely spiked in the LCS, MS, and MSD.

9.5. **Internal Standards and Surrogates** - The surrogates used are Dibromofluoromethane, toluene-d_8, 4-bromofluorobenzene, and 1,2-dichloroethane-d_4. The internal standards are pentafluorobenzene, 1,4-difluorobenzene, 1,4-dichlorobenzene-d_4 and chlorobenzene-d_5. All surrogates and internal standards are added to every standard, sample, blank and spike at 50 ug/L (5 uL of a 50 ppm working standard mix to 5.0 mL sample volume) for water and soils. 1,2-Dichlorethane-d_4 is reported and evaluated only if requested, even though it is always added.

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9.5.1. **Stock standards** (purchased) – used for both Archon and Centurian systems

9.5.1.1. Internal Standard Mix (2500 ug/mL) - Supelco 8260B Equity IS Mix.

9.5.1.2. Surrogate Mix (2500 ug/mL) –Ultra 8260B Surrogate Mix

9.5.2. **Centurion Intermediate and Working Standards (prepared)**

9.5.2.1. Centurion IS and Surr Intermediate Standards

9.5.2.1.1. Internal Standard Mix (500 ug/mL) – Dilute 1.0 mL of 2500 ug/mL Stock Internal Standard Mix to 5.0 mL with Methanol.

9.5.2.1.2. Surrogate Mix (500 ug/mL) – Dilute 1.0 mL of 2500 ug/mL Stock Surrogate Mix to 5.0 mL with Methanol.

9.5.2.2. Centurion IS and Surrogate Working standards (prepared)

9.5.2.2.1. Internal Standard Mix (50 ug/mL) – Dilute 500 uL of 500 ug/mL Internal Standard Mix to 5.0 mL with Methanol.

9.5.2.2.2. Surrogate Mix (50 ug/mL) – Dilute 500 uL of 500 ug/mL Surrogate Mix to 5.0 mL with Methanol.

9.5.2.2.3. Surrogate Mix (25 ug/mL) – Dilute 250 uL of 500 ug/mL Surrogate Mix to 5.0 mL with Methanol.

9.5.2.2.4. Combined Internal Standard/Surrogate Mix (50 ug/mL) – Dilute 500 uL of 500 ug/mL Intermediate Internal Standard Mix and 500 uL of 500 ug/mL Intermediate Surrogate Mix to 5.0 mL with Methanol.

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9.5.3. Archon IS/Surr Working Standard (prepared)

9.5.3.1. Combined Internal Standard/Surrogate Mix for soils (250 ug/mL) – Dilute 1 mL of 2500 ug/mL Internal Standard Stock and 1 mL of 2500 ug/mL Surrogate Stock to 10 mL with methanol.

9.5.3.2. Combined Internal Standard/Surrogate Mix for waters (500 ug/mL) – Dilute 1 mL of 2500 ug/mL Internal Standard Stock and 1 mL of 2500 ug/mL Surrogate Stock to 5 mL with methanol.

9.5.3.3. This solution is placed into an autosampler vial that acts as a reservoir for the autosampler. 1 uL is automatically added to each injection (5g soil or 10 mL purge for waters) for a concentration of 50 ppb.

9.6. **Tune Standard**.

9.6.1. For Waters – (5 ug/L) – dilute 1 uL of 500 ug/mL Working Surrogate Standard (the Surrogate standard contains the BFB needed for the Tune) to 100 mL with DI. Place the whole vial on the system.

9.6.2. For Soils – (10 ug/L) – dilute 1 uL of 500 ug/mL Working Surrogate Standard (the Surrogate standard contains the BFB needed for the Tune) to 50 mL with DI. Place 5 mL of the solution into a vial and place on the system.

9.7. **Preparation of Primary Stock and Working Standards for 8260C Full List Targets**

9.7.1. Targets/Gases Stock Standards - Dilute 1.25 mL of each of the three purchased Targets/Gases Stock solutions to 5.0 mL with methanol to create a working standard.

Purchased – analytes and concentrations attached

- Supelco 8-61339 (2000 ug/mL)
- Supelco 4-8799-0 (2000 ug/mL)
- O2si 120917-06-ss (various levels)

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	47509	Date Created:	7/26/12
Standard Name:	8260B Target/Gases Primary 500/1000/2500 pp	Expiration Date:	8/23/12
Standard Type:	Working Standard	Source:	IN HOUSE
CAS Lab:	ROCHESTER	Catalog #:	N/A
CAS Team:	VOA GCMS	Lot #:	
Container ID:	47509	Amount Prepared:	5.00 mL
Location:	Freezer		

Component Name	Amount	Units	Method / Test Name
1,1,1,2-Tetrachloroethane	500.00	ppm	8260B / VOC_FP
1,1,1-Trichloroethane (TCA)	500.00	ppm	8260B / VOC_FP
1,1,2,2-Tetrachloroethane	500.00	ppm	8260B / VOC_FP
1,1,2-Trichloroethane	500.00	ppm	8260B / VOC_FP
1,1,2-Trichlorotrifluoroethane	500.00	ppm	8260C / VOC FP
1,1-Dichloroethane (1,1-DCA)	500.00	ppm	8260B / VOC_FP
1,1-Dichloroethene (1,1-DCE)	500.00	ppm	8260B / VOC_FP
1,1-Dichloropropene	500.00	ppm	8260B / VOC_FP
1,2,3-Trichlorobenzene	500.00	ppm	8260B / VOC_FP
1,2,3-Trichloropropane	500.00	ppm	8260B / VOC_FP
1,2,4-Trichlorobenzene	500.00	ppm	8260B / VOC_FP
1,2,4-Trimethylbenzene	500.00	ppm	8260B / VOC_FP
1,2-Dibromo-3-chloropropane (DBCP)	500.00	ppm	8260B / VOC_FP
1,2-Dibromoethane	500.00	ppm	8260B / VOC_FP
1,2-Dichlorobenzene	500.00	ppm	8260B / VOC_FP
1,2-Dichloroethane	500.00	ppm	8260B / VOC_FP
1,2-Dichloroethene, Total	1000.0	ppm	8260B / VOC_FP
1,2-Dichloropropane	500.00	ppm	8260B / VOC_FP
1,3,5-Trimethylbenzene	500.00	ppm	8260B / VOC_FP
1,3-Dichlorobenzene	500.00	ppm	8260B / VOC_FP
1,3-Dichloropropane	500.00	ppm	8260B / VOC_FP
1,4-Dichlorobenzene	500.00	ppm	8260B / VOC_FP
1,4-Dioxane	10000	ppm	8260C / VOC FP
2,2-Dichloropropane	500.00	ppm	8260B / VOC_FP
2-Chlorotoluene	500.00	ppm	8260B / VOC_FP
2-Methyl-1-propanol	10000	ppm	8260C / VOC FP
2-Methyl-2-propanol	10000	ppm	8260C / VOC FP
2-Nitropropane	1000.0	ppm	8260C / VOC FP
3-Chloro-1-propene	500.00	ppm	8260C / VOC FP
4-Chlorotoluene	500.00	ppm	8260B / VOC_FP
4-Isopropyltoluene	500.00	ppm	8260B / VOC_FP
Acetonitrile	2500.0	ppm	8260C / VOC FP
Acrylonitrile	2500.0	ppm	8260C / VOC FP
Benzene	500.00	ppm	8260B / VOC_FP
Bromobenzene	500.00	ppm	8260B / VOC_FP
Bromochloromethane	500.00	ppm	8260B / VOC_FP
Bromodichloromethane	500.00	ppm	8260B / VOC_FP
Bromoform	500.00	ppm	8260B / VOC_FP
Bromomethane	500.00	ppm	8260B / VOC_FP
Carbon Tetrachloride	500.00	ppm	8260B / VOC_FP
Chlorobenzene	500.00	ppm	8260B / VOC_FP
Chloroethane	500.00	ppm	8260B / VOC_FP
Chloroform	500.00	ppm	8260B / VOC_FP
Chloromethane	500.00	ppm	8260B / VOC_FP
Cyclohexanone	10000	ppm	8260C / VOC FP
Dibromochloromethane	500.00	ppm	8260B / VOC_FP
Dibromomethane	500.00	ppm	8260B / VOC_FP
Dichlorodifluoromethane (CFC 12)	500.00	ppm	8260B / VOC_FP
Dichloromethane	500.00	ppm	8260B / VOC_FP
Diethyl Ether	500.00	ppm	8260C / VOC FP
Ethyl Methacrylate	500.00	ppm	8260C / VOC FP

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	47509	Date Created:	7/26/12
Standard Name:	8260B Target/Gases Primary 500/1000/2500 pp	Expiration Date:	8/23/12
Standard Type:	Working Standard	Source:	IN HOUSE
CAS Lab:	ROCHESTER	Catalog #:	N/A
CAS Team:	VOA GCMS	Lot #:	
Container ID:	47509	Amount Prepared:	5.00 mL
Location:	Freezer		

Component Name	Amount	Units	Method / Test Name
Ethylbenzene	500.00	ppm	8260B / VOC_FP
Hexachlorobutadiene	500.00	ppm	8260B / VOC_FP
Isopropylbenzene (Cumene)	500.00	ppm	8260B / VOC_FP
Methacrylonitrile	500.00	ppm	8260C / VOC FP
Methanol	25.000	ppm	TO-3 Modified / MEOH+ B
Methyl Methacrylate	500.00	ppm	8260C / VOC FP
Methyl tert-Butyl Ether	500.00	ppm	8260C / VOC FP
Naphthalene	500.00	ppm	8260B / VOC_FP
Nitrobenzene	1000.0	ppm	8260C / VOC FP
Propionitrile	2500.0	ppm	8260C / VOC FP
Styrene	500.00	ppm	8260B / VOC_FP
Tetrachloroethene (PCE)	500.00	ppm	8260B / VOC_FP
Tetrahydrofuran (THF)	500.00	ppm	8260C / VOC FP
Toluene	500.00	ppm	8260B / VOC_FP
Trichloroethene (TCE)	500.00	ppm	8260B / VOC_FP
Trichlorofluoromethane (CFC 11)	500.00	ppm	8260B / VOC_FP
Vinyl Chloride	500.00	ppm	8260B / VOC_FP
Xylenes, Total	1500.0	ppm	8260B / VOC_FP
cis-1,2-Dichloroethene	500.00	ppm	8260B / VOC_FP
cis-1,3-Dichloropropene	500.00	ppm	8260B / VOC_FP
m,p-Xylenes	1000.0	ppm	8260B / VOC_FP
m-Xylene	500.00	ppm	8260B / VOC_FP
n-Butylbenzene	500.00	ppm	8260B / VOC_FP
n-Heptane	500.00	ppm	8260C / VOC FP
n-Propylbenzene	500.00	ppm	8260B / VOC_FP
o-Xylene	500.00	ppm	8260B / VOC_FP
p-Xylene	500.00	ppm	8260B / VOC_FP
sec-Butylbenzene	500.00	ppm	8260B / VOC_FP
tert-Butylbenzene	500.00	ppm	8260B / VOC_FP
trans-1,2-Dichloroethene	500.00	ppm	8260B / VOC_FP
trans-1,3-Dichloropropene	500.00	ppm	8260B / VOC_FP
trans-1,4-Dichloro-2-butene	500.00	ppm	8260C / VOC FP

Ingredients (Inventory ID: 47509)

Amount	Solution Name	Inventory ID	Material Type
1.250 mL	Methanol Purge & Trap MeOH	40233	Reagent
1.250 mL	8260 Cal Mix 1 2000 ug/mL	44580	Stock Standard
1.250 mL	8260 Cal Mix 5 2/4/10/40,000 ug/mL	46138	Stock Standard
1.250 mL	8260B VOA Mix 6: 2000 ug/mL	46384	Stock Standard

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	44580	Date Received:	5/7/12
Standard Name:	8260 Cal Mix 1 2000 ug/mL	Expiration Date:	8/31/13
Standard Type:	Stock Standard	Source:	Supelco (Sigma-Aldrich)
CAS Lab:	ROCHESTER	Catalog #:	86-1339
CAS Team:	VOA GCMS	Lot #:	LB86713
Container ID:	44580A-E	Amount Prepared:	1.00 mL
Location:	FREEZER		

Component Name	Amount	Units	Method / Test Name
1,1,1,2-Tetrachloroethane	2000	µg/mL	8260B / VOC_FP
1,1,1-Trichloroethane (TCA)	2000	µg/mL	8260B / VOC_FP
1,1,2,2-Tetrachloroethane	2000	µg/mL	8260B / VOC_FP
1,1,2-Trichloroethane	2000	µg/mL	8260B / VOC_FP
1,1-Dichloroethane (1,1-DCA)	2000	µg/mL	8260B / VOC_FP
1,1-Dichloroethene (1,1-DCE)	2000	µg/mL	8260B / VOC_FP
1,1-Dichloropropene	2000	µg/mL	8260B / VOC_FP
1,2,3-Trichlorobenzene	2000	µg/mL	8260B / VOC_FP
1,2,3-Trichloropropane	2000	µg/mL	8260B / VOC_FP
1,2,4-Trichlorobenzene	2000	µg/mL	8260B / VOC_FP
1,2,4-Trimethylbenzene	2000	µg/mL	8260B / VOC_FP
1,2-Dibromo-3-chloropropane (DBCP)	2000	µg/mL	8260B / VOC_FP
1,2-Dibromoethane	2000	µg/mL	8260B / VOC_FP
1,2-Dichlorobenzene	2000	µg/mL	8260B / VOC_FP
1,2-Dichloroethane	2000	µg/mL	8260B / VOC_FP
1,2-Dichloroethene, Total	4000	µg/mL	8260B / VOC_FP
1,2-Dichloropropane	2000	µg/mL	8260B / VOC_FP
1,3,5-Trimethylbenzene	2000	µg/mL	8260B / VOC_FP
1,3-Dichlorobenzene	2000	µg/mL	8260B / VOC_FP
1,3-Dichloropropane	2000	µg/mL	8260B / VOC_FP
1,4-Dichlorobenzene	2000	µg/mL	8260B / VOC_FP
2,2-Dichloropropane	2000	µg/mL	8260B / VOC_FP
2-Chlorotoluene	2000	µg/mL	8260B / VOC_FP
4-Chlorotoluene	2000	µg/mL	8260B / VOC_FP
4-Isopropyltoluene	2000	µg/mL	8260B / VOC_FP
Benzene	2000	µg/mL	8260B / VOC_FP
Bromobenzene	2000	µg/mL	8260B / VOC_FP
Bromochloromethane	2000	µg/mL	8260B / VOC_FP
Bromodichloromethane	2000	µg/mL	8260B / VOC_FP
Bromoform	2000	µg/mL	8260B / VOC_FP
Carbon Tetrachloride	2000	µg/mL	8260B / VOC_FP
Chlorobenzene	2000	µg/mL	8260B / VOC_FP
Chloroform	2000	µg/mL	8260B / VOC_FP
Dibromochloromethane	2000	µg/mL	8260B / VOC_FP
Dibromomethane	2000	µg/mL	8260B / VOC_FP
Dichloromethane	2000	µg/mL	8260B / VOC_FP
Ethylbenzene	2000	µg/mL	8260B / VOC_FP
Hexachlorobutadiene	2000	µg/mL	8260B / VOC_FP
Isopropylbenzene (Cumene)	2000	µg/mL	8260B / VOC_FP
Naphthalene	2000	µg/mL	8260B / VOC_FP
Styrene	2000	µg/mL	8260B / VOC_FP
Tetrachloroethene (PCE)	2000	µg/mL	8260B / VOC_FP
Toluene	2000	µg/mL	8260B / VOC_FP
Trichloroethene (TCE)	2000	µg/mL	8260B / VOC_FP
Xylenes, Total	6000	µg/mL	8260B / VOC_FP
cis-1,2-Dichloroethene	2000	µg/mL	8260B / VOC_FP
cis-1,3-Dichloropropene	2000	µg/mL	8260B / VOC_FP
m,p-Xylenes	4000	µg/mL	8260B / VOC_FP
m-Xylene	2000	µg/mL	8260B / VOC_FP
n-Butylbenzene	2000	µg/mL	8260B / VOC_FP
n-Propylbenzene	2000	µg/mL	8260B / VOC_FP

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	44580	Date Received:	5/7/12
Standard Name:	8260 Cal Mix 1 2000 ug/mL	Expiration Date:	8/31/13
Standard Type:	Stock Standard	Source:	Supelco (Sigma-Aldrich)
CAS Lab:	ROCHESTER	Catalog #:	86-1339
CAS Team:	VOA GCMS	Lot #:	LB86713
Container ID:	44580A-E	Amount Prepared:	1.00 mL
Location:	FREEZER		

Component Name	Amount	Units	Method / Test Name
o-Xylene	2000	µg/mL	8260B / VOC_FP
p-Xylene	2000	µg/mL	8260B / VOC_FP
sec-Butylbenzene	2000	µg/mL	8260B / VOC_FP
tert-Butylbenzene	2000	µg/mL	8260B / VOC_FP
trans-1,2-Dichloroethene	2000	µg/mL	8260B / VOC_FP
trans-1,3-Dichloropropene	2000	µg/mL	8260B / VOC_FP

Standard Solution Logbook - Inventory ID Summary

Inventory ID:	46138	Date Received:	6/15/12
Standard Name:	8260 Cal Mix 5 2/4/10/40,000 ug/mL	Expiration Date:	5/8/14
Standard Type:	Stock Standard	Source:	o2si
CAS Lab:	ROCHESTER	Catalog #:	120917-06-SS
CAS Team:	VOA GCMS	Lot #:	189845
Container ID:	46138A-E	Amount Prepared:	5.00 mL
Location:	FREEZER		

Component Name	Amount	Units	Method / Test Name
1,1,2-Trichlorotrifluoroethane	2000	µg/mL	8260C / VOC FP
1,4-Dioxane	40000	µg/mL	8260C / VOC FP
2-Methyl-1-propanol	40000	µg/mL	8260C / VOC FP
2-Methyl-2-propanol	40000	µg/mL	8260C / VOC FP
2-Nitropropane	4000	µg/mL	8260C / VOC FP
3-Chloro-1-propene	2000	µg/mL	8260C / VOC FP
Acetonitrile	10000	µg/mL	8260C / VOC FP
Acrylonitrile	10000	µg/mL	8260C / VOC FP
Cyclohexanone	40000	µg/mL	8260C / VOC FP
Diethyl Ether	2000	µg/mL	8260C / VOC FP
Ethyl Methacrylate	2000	µg/mL	8260C / VOC FP
Methacrylonitrile	2000	µg/mL	8260C / VOC FP
Methyl Methacrylate	2000	µg/mL	8260C / VOC FP
Methyl tert-Butyl Ether	2000	µg/mL	8260C / VOC FP
Nitrobenzene	4000	µg/mL	8260C / VOC FP
Propionitrile	10000	µg/mL	8260C / VOC FP
Tetrahydrofuran (THF)	2000	µg/mL	8260C / VOC FP
n-Heptane	2000	µg/mL	8260C / VOC FP
trans-1,4-Dichloro-2-butene	2000	µg/mL	8260C / VOC FP

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	46384	Date Received:	6/21/12
Standard Name:	8260B VOA Mix 6: 2000 ug/mL	Expiration Date:	5/31/13
Standard Type:	Stock Standard	Source:	Supelco (Sigma-Aldrich)
CAS Lab:	ROCHESTER	Catalog #:	48799-U
CAS Team:	VOA GCMS	Lot #:	LB90657
Container ID:	45127A-E	Amount Prepared:	5.00 mL
Location:	FREEZER		

Component Name	Amount	Units	Method / Test Name
Bromomethane	2000	µg/mL	8260B / VOC_FP
Chloroethane	2000	µg/mL	8260B / VOC_FP
Chloromethane	2000	µg/mL	8260B / VOC_FP
Dichlorodifluoromethane (CFC 12)	2000	µg/mL	8260B / VOC_FP
Trichlorofluoromethane (CFC 11)	2000	µg/mL	8260B / VOC_FP
Vinyl Chloride	2000	µg/mL	8260B / VOC_FP

9.7.2. HSL Stock Standards

- First Prepare Acrolein (approximately 25,000 ppm) from neat (Sigma Aldrich 110221)- by diluting 0.68 g neat material to 25 mL with methanol. The exact concentration calculated from exact mass added (recorded to 0.1 mg).

- Dilute 1.25 mL of each of the two purchased solutions and ~0.5 mL (depending on prepared concentration) of the prepared Acrolein standard to 5.0 mL with methanol to create a working standard.

    - Chloroprene (2000 ug/mL) – Supelco 86-1145
    - 8260 Calibration Mix 2 (2000 ug/mL) - Supelco 46831-U

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	47295	Date Created:	7/20/12
Standard Name:	8260B HSL Primary Standard 500/2500ppm (A	Expiration Date:	8/17/12
Standard Type:	Working Standard	Source:	IN HOUSE
CAS Lab:	ROCHESTER	Catalog #:	N/A
CAS Team:	VOA GCMS	Lot #:	
Container ID:	47295	Amount Prepared:	5.00 mL
Location:	freezer		

Component Name	Amount	Units	Method / Test Name
2-Butanone (MEK)	500.00	ppm	8260B / VOC_FP
2-Chloro-1,3-butadiene	500.00	ppm	8260B / VOC_FP
2-Chloroethyl Vinyl Ether	500.00	ppm	8260B / VOC_FP
2-Hexanone	500.00	ppm	8260B / VOC_FP
4-Methyl-2-pentanone	500.00	ppm	8260B / VOC_FP
Acetone	500.00	ppm	8260B / VOC_FP
Acrolein	2495.1	ppm	8260B / VOC_FP
Carbon Disulfide	500.00	ppm	8260B / VOC_FP
Iodomethane	500.00	ppm	8260B / VOC_FP
Methanol	49.180	ppm	TO-3 Modified / MEOH+ B
Vinyl Acetate	500.00	ppm	8260B / VOC_FP

Ingredients (Inventory ID: 47295)

Amount	Solution Name	Inventory ID	Material Type
2.000 mL	Methanol Purge & Trap MeOH	40233	Reagent
0.459 mL	Acrolein 25,000 ppm (2-Propenal)	46813	Stock Standard
1.250 mL	Chloroprene 2000 ug/mL	46828	Stock Standard
1.250 mL	8260 Cal Mix 2 2000 ug/mL	46858	Stock Standard

Standard Solution Logbook - Inventory ID Summary

Inventory ID:	46858	Date Received:	7/9/12
Standard Name:	8260 Cal Mix 2 2000 ug/mL	Expiration Date:	2/28/14
Standard Type:	Stock Standard	Source:	Supelco (Sigma-Aldrich)
CAS Lab:	ROCHESTER	Catalog #:	46831-U
CAS Team:	VOA GCMS	Lot #:	LB83423
Container ID:	46858A-G	Amount Prepared:	5.00 mL
Location:	Freezer		

Component Name	Amount	Units	Method / Test Name
2-Butanone (MEK)	2000	µg/mL	8260B / VOC_FP
2-Chloroethyl Vinyl Ether	2000	µg/mL	8260B / VOC_FP
2-Hexanone	2000	µg/mL	8260B / VOC_FP
4-Methyl-2-pentanone	2000	µg/mL	8260B / VOC_FP
Acetone	2000	µg/mL	8260B / VOC_FP
Carbon Disulfide	2000	µg/mL	8260B / VOC_FP
Iodomethane	2000	µg/mL	8260B / VOC_FP
Vinyl Acetate	2000	µg/mL	8260B / VOC_FP

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9.7.3. Freons Plus Special Stock Standard

- First Prepare n-Butyl Acetate (approximately 10,000 ppm) from neat (TCI America TCA0024)- by diluting 0.25 g neat material to 25 mL with methanol. The exact concentration is calculated from exact mass added (recorded to 0.1 mg).

- Dilute 1.25 mL of each of the two purchased solutions and 250 uL of the prepared n-Butyl Acetate standard (volume adjusted based on actual concentration of prepared stock) to 5.0 mL with methanol to create a working standard.

    - Accustandard Primary Freons Custom 5-9219 (2000 ug/mL)
    - 8260 Extra Compounds Mix - Absolute 94237 (500-40000 ug/mL)

Standard Solution Logbook - Inventory ID Summary

Inventory ID:	47508	Date Created:	7/26/12
Standard Name:	8260B Freon Plus Std 500/1000 ppm	Expiration Date:	8/23/12
Standard Type:	Working Standard	Source:	IN HOUSE
CAS Lab:	ROCHESTER	Catalog #:	N/A
CAS Team:	VOA GCMS	Lot #:	
Container ID:	47508	Amount Prepared:	5.00 mL
Location:	Freezer		

Component Name	Amount	Units	Method / Test Name
1,2-Dichloro-1,1,2-trifluoroethane (CFC 123a)	500.00	ppm	8260B / VOC_FP
2,2-Dichloro-1,1,1-trifluoroethane (CFC 123)	500.00	ppm	8260B / VOC_FP
2-Propanol	10000	ppm	8260B / VOC_FP
Cyclohexane	500.00	ppm	8260B / VOC_FP
Dichlorofluoromethane (CFC 21)	500.00	ppm	8260B / VOC_FP
Methanol	45.000	ppm	TO-3 Modified / MEOH÷ B
Methyl Acetate	500.00	ppm	8260B / VOC_FP
Methylcyclohexane	500.00	ppm	8260B / VOC_FP
n-Butyl Acetate	498.60	ppm	8260B / VOC_FP

Ingredients (Inventory ID: 47508)

Amount	Solution Name	Inventory ID	Material Type
2.250 mL	Methanol Purge & Trap MeOH	40233	Reagent
1.250 mL	8260B Primary Freon Std 2000ppm	42117	Stock Standard
250.000 uL	n-Butyl Acetate 10,000 ppm	44606	Stock Standard
1.250 mL	8260B Extra Compds Mix 2000/4000 ppm	45162	Stock Standard

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	42117	Date Received:	3/20/12
Standard Name:	8260B Primary Freon Std 2000ppm	Expiration Date:	11/1/16
Standard Type:	Stock Standard	Source:	Absolute Standards
CAS Lab:	ROCHESTER	Catalog #:	95241
CAS Team:	VOA GCMS	Lot #:	110111
Container ID:	42117A-E	Amount Prepared:	5.00 mL
Location:	FREEZER		

Component Name	Amount	Units	Method / Test Name
1,2-Dichloro-1,1,2-trifluoroethane (CFC 123a)	2000	µg/mL	8260B / VOC_FP
2,2-Dichloro-1,1,1-trifluoroethane (CFC 123)	2000	µg/mL	8260B / VOC_FP
Dichlorofluoromethane (CFC 21)	2000	µg/mL	8260B / VOC_FP

Standard Solution Logbook - Inventory ID Summary

Inventory ID:	45162	Date Received:	5/21/12
Standard Name:	8260B Extra Compds Mix 2000/4000 ppm	Expiration Date:	4/13/14
Standard Type:	Stock Standard	Source:	Absolute Standards
CAS Lab:	ROCHESTER	Catalog #:	94237
CAS Team:	VOA GCMS	Lot #:	041311
Container ID:	45162A-E	Amount Prepared:	5.00 mL
Location:	Freezer		

Component Name	Amount	Units	Method / Test Name
2-Propanol	40000	µg/mL	8260B / VOC_FP
Cyclohexane	2000	µg/mL	8260B / VOC_FP
Methyl Acetate	2000	µg/mL	8260B / VOC_FP
Methylcyclohexane	2000	µg/mL	8260B / VOC_FP

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9.7.4. HBO Stock Standard

- First Prepare n-Butyl Alcohol (approximately 100,000 ppm) from neat (Sigma Aldrich 34867)- by diluting 5 g neat material to 50 mL with methanol. The exact concentration is calculated from exact mass added (recorded to 0.1 mg).

- Dilute 1.25 mL of the purchased Oxygenate solution and 1.25 mL of the prepared n-Butyl Alcohol standard (volume adjusted based on actual concentration of prepared stock) to 5.0 mL with methanol to create a working standard.

Standard Solution Logbook - Inventory ID Summary

HBO

Inventory ID:	47245	Date Created:	7/19/12
Standard Name:	8260 Primary Hal/BA/Oxy	Expiration Date:	8/16/12
Standard Type:	Working Standard	Source:	IN HOUSE
CAS Lab:	ROCHESTER	Catalog #:	N/A
CAS Team:	VOA GCMS	Lot #:	
Container ID:	47245	Amount Prepared:	5.00 mL
Location:	phreezer		

Component Name	Amount	Units	Method / Test Name
1-Butanol	25103	ppm	8015B / SVO
Diisopropyl Ether	500.00	ppm	8260B / VOC_FP
Ethyl tert-Butyl Ether	500.00	ppm	8260B / VOC_FP
Methanol	125.80	ppm	TO-3 Modified / MEOH+ B
tert-Amyl Methyl Ether	500.00	ppm	8260B / VOC_FP

Ingredients (Inventory ID: 47245)

Amount	Solution Name	Inventory ID	Material Type
5.000 mL	Methanol Purge & Trap MeOH	40233	Reagent
1.250 mL	8260B Oxygenates 2000ppm	45149	Stock Standard
1.290 mL	Primary 125,000 n-Butyl Alcohol	47244	Stock Standard

Standard Solution Logbook - Inventory ID Summary

Inventory ID:	45149	Date Received:	5/21/12
Standard Name:	8260B Oxygenates 2000ppm	Expiration Date:	5/31/17
Standard Type:	Stock Standard	Source:	Restek Corporation
CAS Lab:	ROCHESTER	Catalog #:	562518
CAS Team:	VOA GCMS	Lot #:	A088443
Container ID:	45149A-E	Amount Prepared:	3.00 mL
Location:	FREEZER		

Component Name	Amount	Units	Method / Test Name
Diisopropyl Ether	2000	ppm	8260B / VOC_FP
Ethyl tert-Butyl Ether	2000	ppm	8260B / VOC_FP
tert-Amyl Methyl Ether	2000	ppm	8260B / VOC_FP

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9.7.5. OCC Standard

- First Prepare 2,3,6-Trichlorotoluene (approximately 20,000 ppm) from neat (Ultra Scientific RCB-013)- by diluting 0.1 g neat material to 5 mL with methanol. The exact concentration is calculated from exact mass added (recorded to 0.1 mg).

- Dilute 500 uL of the purchased Chlorinated Aromatics Mix and 125 uL of the prepared 2,3,6-Trichlorotoluene standard (volume adjusted based on actual concentration of prepared stock) to 5.0 mL with methanol to create a working standard.

Standard Solution Logbook - Inventory ID Summary

Inventory ID:	47300	Date Created:	7/20/12
Standard Name:	8260 Primary OCC compounds Standard	Expiration Date:	8/17/12
Standard Type:	Working Standard	Source:	IN HOUSE
CAS Lab:	ROCHESTER	Catalog #:	N/A
CAS Team:	VOA GCMS	Lot #:	
Container ID:	47300	Amount Prepared:	5.00 mL
Location:	freezer		

Component Name	Amount	Units	Method / Test Name
1,3,5-Trichlorobenzene	500.00	ppm	8260C / VOC FP
1-Chloro-4-(trifluoromethyl)benzene	500.00	ppm	8260C / VOC FP
2,3,6-Trichlorotoluene	499.20	ppm	8260C / VOC FP
2,3-Dichlorotoluene	500.00	ppm	8260C / VOC FP
2,4,5-Trichlorotoluene	500.00	ppm	8260C / VOC FP
2,4-, 2,5-, and 2,6-Dichlorotoluene Coelution	1500.0	ppm	8260C / VOC FP
2,4-Dichlorobenzotrifluoride	500.00	ppm	8260C / VOC FP
2,4-Dichlorotoluene	500.00	ppm	8260C / VOC FP
2,5-Dichlorobenzotrifluoride	500.00	ppm	8260C / VOC FP
2,5-Dichlorotoluene	500.00	ppm	8260C / VOC FP
2,6-Dichlorotoluene	500.00	ppm	8260C / VOC FP
2-Chlorobenzotrifluoride	500.00	ppm	8260C / VOC FP
3,4- and 2,3-Dichlorotoluene Coelution	1000.0	ppm	8260C / VOC FP
3,4-Dichlorobenzotrifluoride	500.00	ppm	8260C / VOC FP
3,4-Dichlorotoluene	500.00	ppm	8260C / VOC FP
3-Chlorobenzotrifluoride	500.00	ppm	8260C / VOC FP
3-Chlorotoluene	500.00	ppm	8260C / VOC FP
Methanol	100.00	ppm	TO-3 Modified / MEOH+ B

Ingredients (Inventory ID: 47300)

Amount	Solution Name	Inventory ID	Material Type
5.000 mL	Methanol Purge & Trap MeOH	40233	Reagent
132.000 uL	8260 Primary 20,000 ppm 2,3,6 Trichlorotc	40586	Working Standard
500.000 uL	Chlorinated Aromatics Mix 5000ug/ml	45154	Stock Standard

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Standard Solution Logbook - Inventory ID Summary

Inventory ID:	42763	Date Received:	4/2/12
Standard Name:	Chlorinated Aromatics Mix 5000ug/ml	Expiration Date:	3/28/17
Standard Type:	Stock Standard	Source:	Absolute Standards
CAS Lab:	ROCHESTER	Catalog #:	94501
CAS Team:	VOA GCMS	Lot #:	032812
Container ID:	42763A-E secondary	Amount Prepared:	3.00 mL
Location:	Freezer		

Component Name	Amount	Units	Method / Test Name
1,3,5-Trichlorobenzene	5000	µg/mL	8260C / VOC FP
1-Chloro-4-(trifluoromethyl)benzene	5000	µg/mL	8260C / VOC FP
2,3-Dichlorotoluene	5000	µg/mL	8260C / VOC FP
2,4,5-Trichlorotoluene	5000	µg/mL	8260C / VOC FP
2,4-, 2,5-, and 2,6-Dichlorotoluene Coelution	15000	µg/mL	8260C / VOC FP
2,4-Dichlorobenzotrifluoride	5000	µg/mL	8260C / VOC FP
2,4-Dichlorotoluene	5000	µg/mL	8260C / VOC FP
2,5-Dichlorobenzotrifluoride	5000	µg/mL	8260C / VOC FP
2,5-Dichlorotoluene	5000	µg/mL	8260C / VOC FP
2,6-Dichlorotoluene	5000	µg/mL	8260C / VOC FP
2-Chlorobenzotrifluoride	5000	µg/mL	8260C / VOC FP
3,4- and 2,3-Dichlorotoluene Coelution	10000	µg/mL	8260C / VOC FP
3,4-Dichlorobenzotrifluoride	5000	µg/mL	8260C / VOC FP
3,4-Dichlorotoluene	5000	µg/mL	8260C / VOC FP
3-Chlorobenzotrifluoride	5000	µg/mL	8260C / VOC FP
3-Chlorotoluene	5000	µg/mL	8260C / VOC FP

9.7.6. Low Level Combined Working Solution – Dilute 10 uL of each of the above working solutions to 1.0 mL with methanol.

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9.8. Preparation of Initial Calibration Standards

9.8.1. Calibration Level Standards for waters by Archon (Example-varies by instrument)

Concentration of standard (VSTD)	0.5	1	2	5	10	20	50	100	150	200
Vol. Of low level combined working std.	5	10	20	0	0	0	0	0	0	0
Vol. of target/gases working std. (uL)	0	0	0	0.5	1	2	5	10	15	20
Vol. Of HSL working Std (uL)	0	0	0	0.5	1	2	5	10	15	20
Vol. Of Freons Special Std (uL)	0	0	0	0.5	1	2	5	10	15	20

Dilute the above volumes to 50 mL with DI. Place each standard in its own vial. The Archon draws 5.0 mL of the standard from the vial and adds 1 uL of the combined 50 ppm IS/Surr standard. Not all of the points are always used. As per 11.3.3 of EPA 8260C, surrogates are not required to have a multipoint calibration, but the responses of the surrogates from each analyte level are averaged to create a single point calibration.

9.8.2. Calibration Level Standards for Soils by Archon (Example-varies by instrument)

Concentration of standard (VSTD)	5	10	20	50	100	150	200
Vol. Of low level combined working std.without Freons (uL)	50	100	0	0	0	0	0
Vol. of target/gases working std. (uL)	0	0	2	5	10	15	20
Vol. Of HSL working Std (uL)	0	0	2	5	10	15	20

Dilute the above volumes to 50 mL with DI. Transfer 5.0 mL each standard to separate vials. The Archon adds 1 uL of the combined 50 ppm IS/Surr standard to the vial of the aqueous standard and purges directly in the vial. Not all of the points are always used. As per 11.3.3 of EPA 8260C, surrogates are not required to have a multipoint calibration, but the responses of the surrogates from each analyte level are averaged to create a single point calibration.

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9.9. Preparation of Secondary Standards for 8260C Full List Targets

9.9.1. Secondary Stock Standards

9.9.1.1. Secondary Targets/Gases - purchased

- Supelco 8-S61298
- Supelco 4-S8799
- Supelco 8-S61339

9.9.1.2. Secondary HSL

- Supelco 4S6831-U- purchased
- Supelco 8SS-61145 – purchased
- Acrolein - made from Restek 30645.

9.9.1.3. Secondary Freons - purchased

- Restek 563598
- Absolute 94236 8260B Extra Compound SS (2000-40,000).
- Absolute 70440

9.9.1.4. Secondary HBO –

- Accustandard S-16927
- n-Butyl Alcohol – same as Primary except prepared by a different analyst.

9.9.1.5. Secondary OCC

- Absolute 94501
- 2,3,6-Trichlorotoluene – same as Primary except prepared by a different analyst.

9.9.2. Working Standards

- Secondary Targets/Gases (500-10,000 ppm)- Dilute 1.25 mL of each of the Target/Gases purchased standards to 5.0 mL with methanol.

- Secondary HSL (500-2500 ppm) –Dilute 1.25 mL of each of the purchased HSL standards and 1.0 mL of the 5000 ppm acrolein standard to 5.0 mL with methanol.

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- Secondary Freons Plus – Dilute 1.0 mL each of 93034 (SS Freons – 1000 ppm) purchased standard, 94236 (SS Extras 2000-40000 ppm), and n-butyl acetate standard to 5.0 mL with methanol.

- Secondary OCC – Dilute 125 uL of Secondary 2,3,6-trichlorotoluene (volume adjusted based on actual concentration of prepared stock) and 500 uL of Absolute 94501 to 5.0 mL with methanol.

- Secondary HBO – Dilute 1.0 mL (volume adjusted based on actual concentration of prepared stock) of Secondary n-Butyl Alcohol and 1.25 mL of Accustandard S-16927 to 5 mL with methanol.

9.9.3. **ICV (50 ppb)**– Dilute to 50.0 mL with DI:
5.0 uL of Secondary Target/Gases Working stock,
5.0 uL of Secondary HSL Working Stock,
12.5 uL of Secondary Freons Plus working stock,
5.0 uL of Secondary HBO working stock, and
5.0 uL of Secondary OCC Working Stock.

9.9.4. **LCS (20 ppb)**- Dilute to 50.0 mL with DI :
2.0 uL of Secondary Target/Gases Working stock,
2.0 uL of Secondary HSL Working Stock,
5.0 uL of Secondary Freons Plus working stock,
2.0 uL of Secondary HBO working stock, and
2.0 uL of Secondary OCC Working Stock.

9.9.5. **MS/MSD (50 ppb)**- Add to 42.5 mL sample:
4.2 uL of Secondary Target/Gases Working stock,
4.2 uL of Secondary HSL Working Stock,
10.5 uL of Secondary Freons Plus working stock,
4.2 uL of Secondary HBO working stock, and
4.2 uL of Secondary OCC working stock.

9.9.6. **Method Blank** – Analyze DI as a sample.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to the instructions in this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with

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the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

11. PROCEDURE

11.1. Be sure the system has a current LOD and the analyst has a current Demonstration of Capability.

11.2. Sample Preparation –allow samples to come to room temperature. Samples are screened according to VOC-SCREEN.

11.2.1. Water Samples

11.2.1.1. No preparation is generally required, other than dilution with reagent water to bring analytes into the upper half of the calibration range. Thus, a 10.0 mL sample volume is run straight from the sample vial for a 10.0 mL purge.

11.2.1.2. After analysis, the pH of all water samples are to be checked with pH paper. The pH shall be noted in the run log. If the pH is not <2, file a pH discrepancy form and give to the Project Manager.

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11.2.1.3. Samples requiring dilutions due to targets above the linear range of the instruments are prepared as follows according to ADM-DIL:

11.2.1.3.1. (1/5) = 10 mL sample adjusted to 50 mL in a 50 mL ground glass graduated cylinder inverted once and transferred to a 40 mL VOA vial.

11.2.1.3.2. (1/25) = 2.0 mL sample adjusted to 50 mL in a 50 mL ground glass graduated cylinder inverted once and transferred to a 40 mL VOA vial.

11.2.1.3.3. (1/50) = 1.0 mL sample adjusted to 50 mL in a 50 mL ground glass graduated cylinder inverted once and transferred to a 40 mL VOA vial.

11.2.1.4. Samples requiring preparation by way of compositing multiple aliquots or grab samples into one representative composite sample shall be prepared using the same techniques as discussed in SOPs for Preparing Dilutions (ADM-DIL) and Sample Preparation, Compositing and Subsampling (ADM-SPLPREP) using equal portions of each grab sample or other instructions provided by the client. Detailed volumes used for each composite sample preparation must be documented and retained with the submission in the run log book or other instruction sheet(s) provided. The vial identification number shall be referenced with a "C" to indicate it as a composite sample. Documentation must be provided to ensure the composite sample is traceable to the grab samples and total volumes used to create the composite.

11.2.1.5. Internal standards and surrogates are added to the diluted sample by the autosampler.

Note: At no time should less than 1 mL of the original sample fraction be used for the preparation of the diluted sample. This insures a representative fraction of sample is diluted.

11.2.2. Soil samples

11.2.2.1. For Encores, Terracores, and soils received in bulk in vials or jars, follow VOC-5035 for preparation of soils by 5035.

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11.3. Instrument Performance Check –Tuning

11.3.1. Verify than the MS meets standard mass spectral abundance criteria prior to initiation of any samples by injecting the 4-bromofluorobenzene (BFB) tune standard. The tune standard must be analyzed at the beginning of the analytical sequence and every 12-hours of continuous analysis. The 12-hour clock starts at the time of the BFB injection. Evaluate the ion abundance using the following scenarios:

- Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- Use one scan at the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- Use the average across the entire peak up to a total of 5 scans. Peak integration must be consistent with standard operating procedure. If the peak is wider than 5 scans, the tune will consist of the peak apex scan and the two scans immediately preceding and following the apex. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- Use the average across the entire peak. Peak integration must be consistent with standard operating procedure. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

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11.3.2. Each volatile GC/MS system must meet the BFB ion abundance criteria shown in Table 1 for a 50 ng injection of BFB.

11.3.3. If tuning criteria cannot be met, the source may need cleaning, filaments replaced or other maintenance. Record the corrective action taken in the run log or maintenance log and re-inject the tune standard. Sample analysis may not proceed until the tune meets these criteria.

11.4. Initial Calibration – follow policies and practices in ADM-ICAL unless otherwise stated in this SOP.

11.4.1. Tune the instrument according to 11.3.

11.4.2. Run an instrument blank to demonstrate that the instrument is free of contamination before analyzing the standards.

11.4.3. Calibrate the instrument initially before sample analysis and whenever calibration criteria cannot be maintained. At least 5 calibration points must be analyzed. More points can be used, and more are required if non-linear regression is used. The standards must be analyzed the same as the samples (example: if samples are to be heated, the standards are to be heated). Typical calibration levels are given in Section 9, but may be modified to meet client requirements. Analyze each calibration standard and tabulate the area response of the characteristic quantitation ions versus concentration for each compound, internal standards and surrogate. The low level standard used during calibration shall be at or below the reporting level for the analysis. The midpoint standard of the initial calibration curve establishes the retention time window position for each analyte and surrogate.

11.4.4. The internal standards should permit most of the components of interest in a chromatogram to have retention times of 0.80 - 1.20, relative to one of the internal standards. Use the base peak ion from the specific internal standard as the primary ion for quantitation (see instrument specific addendum - attached). If interferences are noted, use the next most intense ion as the quantitation ion.

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11.4.5. Calculate the response factors (RF) for each compound and surrogate relative to the specified internal standard by:

$$RF_x = \frac{(A_x)(C_{ISTD})}{(A_{ISTD})(C_x)}$$

Where:

A_x = Area of the characteristic quantitation ion for compound x.
A_{ISTD} = Area of the characteristic quantitation ion for the specified internal standard.
C_x = The concentration of the compound added (ppb).
C_{ISTD} = The concentration of the specified internal standard (ppb).

11.4.6. Calculate the mean response factor $(\overline{RF_x})$ for each analyte and surrogate from the calibration levels. Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(RF_i - \overline{RF})^2}{N - 1}}$$

where:
$\underline{RF}_i$= RF for each of the calibration levels
RF= mean of initial RFs for a compound.
N = Number of RF values

$$\%RSD = \frac{(SD)}{(\overline{RF_x})} 100.$$

where:
RSD = relative standard deviation.
RF = mean of initial RFs for a compound.
SD = standard deviation of average RFs for a compound.

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11.4.7. Initial Calibration criteria and corrective action

11.4.7.1. The % RSD should be less than 20% for each target compound. If ≥10% of the target compounds in the ICAL do not meet criteria, the curve is invalid and may not be used for quantitation. (For DOD, all targets must be <20%). Any target compounds >20%RSD must be <40%RSD if the curve is to be used for quantitation. Samples which historically do not have results above the reporting limit for the failing compound may be analyzed under a failing curve if a refit of the MRL standard is within 70-130%. If the samples do quantitate above the reporting limit, they must be repeated under a compliant curve. If failing compounds are known to be sensitive to a project, the samples in that project must be analyzed under an ICAL which meets 20%RSD (or >0.99 as described below).

11.4.7.2. If the % RSD for any target compound is 20% or less, linearity can be assumed over the calibration range, and the average relative response factor for each analyte and surrogate is used to quantitate sample analytes.

11.4.7.3. If the % RSD of any target compound is > 20%, construct a linear regression calibration curve of area ratio (A/A_{is}) versus concentration, or the inverse of the concentration, using the equation of a line (*see below*). The origin (0,0) may not be used as a calibration point, but the regression may be forced through zero. The Correlation Coefficient must be ≥ 0.99 (≥0.995 for DOD) and a refit of the low standard into the curve should produce a result which meets 70-130% recovery. If the Calibration Correlation is not met, linear regression may not be used to quantitate the target. Non-linear calibrations may be used if they meet the requirements of 8000C. It is good lab practice to mark all target compounds on a curve to identify target compounds calculated using linear regression.

The equation of a line: $y=mx+b$
where:

y = Instrument response (peak area or height)
m = Slope of the line (also called the coefficient of x)
x = Concentration of the calibration standard
b = The intercept

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11.4.7.4. The response factor for each compound should meet the Minimum Relative Response Factor in Table 4. If minimum relative response factors are not met and sensitivitiy and accuracy can be demonstrated for the initial calibration, no further qualification is required and the curve is acceptable.

11.4.7.5. Initial Calibration Verification Standard (ICV)- inject and analyze the ICV to verify the initial calibration immediately after the calibration. The % recovery must meet 70-130% (80-120% for DOD) for all targets.

11.4.7.6. All targets which do not meet 20%RSD or 0.99 must be flagged and narrated in the report.

11.4.8. Only after the calibration has passed all of the above criteria shall samples be analyzed.

11.5. Daily GC/MS Calibration Verification and Analytical Sequence

11.5.1. The start of a 12-hour analysis window requires a check of the Mass Spec Detector's tune via an injection of 50 ng of BFB. The acceptance criteria must be met before proceeding with analysis.

11.5.2. CCV –

11.5.2.1. Frequency - After the tuning criteria have been verified, the initial calibration must be checked and verified by analyzing a midrange Continuing Calibration Verification Standard (CCV).

11.5.2.2. Concentration - The 50 ppb level is recommended. NELAC requires this calibration check standard to vary in concentration over time. An injection of the CCV and LCS standards shall satisfy this requirement as long as the standards are two different concentrations.

11.5.2.3. Limits and Corrective Action-

11.5.2.3.1. Each compound should meet it's Minimum Relative Response Factor (Table 4). This is the same check that is applied to the initial calibration. If the minimum RRF is not met, the CCV may still be acceptable when sensitivity and accuracy can be demonstrated. Use professional judgement.

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11.5.2.3.2. Calculate the %D for each compound using the calculations below.

11.5.2.3.2.1. For **linear regression calibrations** , calculate the percent drift using:

$$\%\ Drift = \frac{C_c - C_T}{C_T} x\ 100$$

where:

C_c = Calculated concentration of standard.

C_T = Theoretical concentration of prepared standard.

11.5.2.3.2.2. For **calibrations based on RF**, calculate the percent difference using:

$$\%\ Difference = \frac{RF_v - \overline{RF}}{\overline{RF}} x\ 100$$

where RF_v is the response factor from the analysis of the verification standard and $\overline{RF}$ is the mean response factor from the initial calibration.

11.5.2.4. For target compounds, the %D should (must for DOD) meet ≤20%. Analysis may continue if up to 20% of the compounds are >20%D,. Those that fail must be within 40%D. If failing compounds are known to be sensitive to a project, those samples must be repeated under a compliant CCV. If the CCV fails with a high bias, all associated non-detect samples may be reported, even if the MB or LCS fails high or if >20% of the compounds failed. Any samples with hits that are associated with a CCV>20%D must be flagged or analyzed under a compliant CCV.

11.5.2.5. If a CCV fails, corrective actions must be performed. If routine corrective action procedures fail to immediately produce an acceptable CCV, then either the lab has to demonstrate acceptable performance after documented corrective action with two consecutive CCVs, or a new ICAL must be performed. For DOD, the lab shall reanalyze CCVs and all samples analyzed since the last successful CCV.

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11.5.3. When any data is reported with a non-compliant CCV, the CCV is flagged in the report and explained in the case narrative. Associated sample results are to be considered less reliable. For DOD, the laboratory must notify the client prior to reporting data associated with a noncompliant CCV. For DOD, data reported with a non-compliant CCV must be Q-flagged and explained in the case narrative. Reporting samples with an unacceptable CCV is only appropriate in cases where the samples cannot be reanlyzed.

11.5.4. Internal Standards - If the tune criteria and the continuing calibration criteria are met, then evaluate the retention times of all compounds, surrogates, and internal standards against the initial calibration. If the retention time for any internal standard changes by more than 30 seconds from the current initial calibration mid-point standard, the system must be inspected for malfunctions and corrections must be made, as required. If the area for any of the internal standards changes by a factor of 2 (-50% to +100%) from the current initial calibration mid-point std., corrections must be made to the system. Reanalyze any samples associated with malfunctioning system.

11.5.5. Analyze the LCS. Evaluate the LCS according to the instructions in 12.

11.5.6. Analyze a method blank to check the system for contamination. Evaluate the MB according to the instructions in 12.

11.5.7. When all of the above criteria are met, client sample analysis may begin. Follow sequence requirement in ADM-BATCH.

11.6. Identification of Analytes and Data Interpretation, and Client Sample Analysis

11.6.1. Note that medium soils (prepared by method 5035) are run on water curves on any autosampler. Client samples are analyzed on an instrument running an appropriate calibration for the target compound list needed for the sample.

11.6.2. The qualitative identification of compounds determined by this method is based on retention time, and comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds should be identified as present when the criteria below are met. If there is no peak found for an analyte in the

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expected retention time window and the mass spectra does not match according to the below, then the analyte is "not found".

11.6.2.1. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

11.6.2.2. The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component. If the RRT has changed by more than 0.06 RRT units since the last update, this indicates a significant change in system performance and corrective action must be taken and the ICAL must be rerun to reestablish the retention times. Calculate the RRT:

$$RRT = \frac{RT\ of\ analyte}{RT\ of\ Internal\ Stndard}$$

11.6.2.3. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

11.6.2.4. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

11.6.2.5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important.

11.6.2.6. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes coelute (i.e., only one chromatographic peak is apparent), the identification criteria can be

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met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

11.6.3. For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification.

11.6.4. If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, dilute the sample (from a fresh vial if available) according to section 11.2 and ADM-DIL. If a fresh vial is not available, the use of a compromised vial must be documented in the runlog and on the case narrative (by use of a NCAR – see ADM-CA).

11.6.5. If the detector becomes saturated from a high concentration sample run a blank after the sample to demonstrate the instrument is free from carry-over. If there is contamination, take corrective action. The instrument must be demonstrated to be free from contamination before analysis may continue.

12. QA/QC REQUIREMENTS

12.1. **Calibration** - The acceptance criteria for tuning verification, initial, and continuing calibration verification are discussed in the procedure (Section 11).

12.2. **Method Blank** - For every 12-hour analysis window and for each analytical batch, after meeting the tune and continuing calibration criteria, at least one method blank must be run and reportable for each matrix. All blanks reported must be free from target analytes with the exception of known common laboratory contaminants. Acetone and Methylene Chloride must not be present at a level greater than 5 times the LOQ (<LOQ for DOD) and all samples affected should be marked with the appropriate lab flag. Method blanks are considered free of contamination if the result is less than half of the reporting limit. Reanalyze the MB until the system is shown to meet these criteria. Reanalyze any samples associated with a non-compliant method blank.

Exception: if a target analyte is greater than five times (10 times for DOD) the method blank contaminant, the analysis may continue since the sample concentration is high enough that possible contamination has not significantly affected its concentration.

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12.3. **LCS-**

12.3.1. **Frequency** - With each batch of samples (20 samples maximum), a minimum of one LCS for each matrix must be analyzed to ensure instrument performance. When batches are less than 20 samples, the LCS is performed on a per batch basis. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis. An LCS duplicate (LCSD) may be required for certain projects or if there is not enough sample to demonstrate precision with an MSD.

12.3.2. Acceptance Criteria –

12.3.2.1. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where: X = Concentration of the analyte recovered
TV = True value of amount spiked

12.3.2.2. Acceptance criteria for lab control samples are listed in the Data Quality Objectives Table (see Attachment IV for DOD). If LCSD is performed, both LCS and LCSD must pass recovery criteria. The precision between the LCS and LCSD must meet RPD limits in the Data Quality Objectives Table.

Exceptions: Client-specific QAPP requirements also may supersede lab control limits listed in the Data Quality Objectives Table.

12.3.3. **Corrective Action** - If the LCS recovery for any target fails acceptance limits, corrective action is required except as described below. If instrument corrective action is not applicable or ineffective, re-analysis of the associated samples is required. If any other analyte fails the acceptance limits, the analyst must evaluate the impact on data quality and take any necessary corrective action, which may include re-analysis of the associated samples. Project-specific requirements may dictate use of project acceptance criteria.

12.3.4. Sample analysis may continue under the following circumstances when recoveries fall outside the control limits listed in The Data Quality Objectives Table of the Quality Assurance Manual.

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- High outlying recovery associated with a non-detect sample result since the high bias would have negligible effect on non-detect sample results.

- Reanalysis would result in a worse quality scenario such as holding time issues or insufficient sample volume.

12.4. **MS/MSD** –

12.4.1. **Frequency -** For each batch of samples (20 samples maximum), a minimum of one MS/MSD pair for each matrix must be analyzed to assess sample matrix and to ensure instrument performance. If there is not enough sample to process MS/MSD, an LCS/LCSD will be processed to show precision in the batch. See below.

12.4.2. **Precision and Recovery Limits -** The limits for MS recovery and MS/MSD RPD are given in The Data Quality Objectives Table. Acceptance criteria for DOD is Attachment IV of this SOP (MS criteria is the same as LCS criteria).

12.4.3. **Recovery Corrective Action** -

12.4.3.1. The results of the MS/MSD analysis is used for client assessment of sample matrix and is not used to control the analysis. Outlying MS/MSD recoveries associated with an acceptable LCS may indicate sample matrix interferences, but does not warrant reanalysis or confirmation. All data shall be reported with the appropriate flags or mentioned in the Case Narrative.

12.4.3.2. If the MS/MSD does not pass precision or accuracy requirements, evaluate the associated LCS. If the LCS passes QC requirements it is presumed that matrix has affected the spiked samples and the run may continue. If the concurrent LCS fails for the same compound or any other compound the validity of the LCS should be examined and any samples prior to the LCS and after the last CCV should be reanalyzed, including the MS/MSD.

12.4.4. **RPD Corrective Action -** if the RPD value between samples or MS/MSD results exceed limits listed in The Data Quality Objectives Table, examine the chromatograms and benchsheets for potential matrix interferences. Examples may include product layers on aqueous samples that may result in non-homogenous subsampling, non-homogenous soil samples, chromatographic interferences resulting in poor peak resolution and

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inconsistent integrations, or poor purging efficiencies (indicated by surrogate recovery). Reanalyze the pair if deemed appropriate. The outlying RPD should be mentioned in the Case Narrative so that data may be flagged appropriately.

12.5. **Surrogates and Internal Standards** –

12.5.1. **Frequency** – Added to all injections

12.5.2. **Acceptance Criteria** - The limits for surrogate recovery is given in The Data Quality Objectives Table. Dichlorethane-d4 is evaluated and reported only if requested. The limit for internal standards is (-50% to 100%).

12.5.3. **Corrective Action** - When instances of Surrogate or internal area count failures occur, the associated sample is repeated and the results are compared. If the questioned samples fail a second analysis, the first run is reported to the client and the sample flagged with an "*" indicating a probable matrix interference exists. In the case where Tier package work is required and the appropriate forms need to be generated, the second analytical analysis is also reported to the client. If the second analysis passes, report these data.

12.5.4. If a surrogate(s) fails acceptance, the sample must be evaluated for matrix interferences and "historical results". Reanalyze the sample to confirm the interference. If needed contact client and flag the data in the report. If surrogates are diluted more than 10 times, report as "D", diluted below calibration. For package reports, include initial and confirmation analysis results. High outlying recoveries associated with non-detect sample results need not be reanalyzed. They need only be noted in the case narrative as high bias with non-detect results.

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13. DATA REDUCTION AND REPORTING

13.1. Calculations

The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards $\overline{RF_x}$ values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions. The primary and secondary quantitation ions are given in Table 2. The internal standard with which the analytes are associated changes with each column and is documented in the Initial Calibration Summary Report. The current associations per instrument are attached to this SOP in the Instrument Specific Addendum.

13.1.1. The results for a water sample are calculated as follows when $\overline{RF_x}$ is used:

$$A_x = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})} \times DilFactor$$

Where:
A_x = the amount, in ppb, of the analytes in the sample;
$Resp_x$ = the peak area of the analytes of interest;
$Resp_{ISTD}$ = the peak area of the associated internal standard;
Amt_{ISTD} = the amount, in ppb, of internal standard added; and
$\overline{RF_x}$ the average response from the five-point for the analytes of interest.

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13.1.2. The results for a soil sample are broken into two types, the low-level type and the medium-level type. The medium level type are corrected for moisture in the methanol according to the calculation in 8000C.

13.1.2.1. The low-level type is a direct heated purge of soil and requires its own separate ICAL. For soil, 5 grams is weighed out into the sample vial, and is purged with 5 mL of blank reagent water at a temperature of 40°C ±2°. The results for low-level soil work are calculated by taking the normal print out, in ppb, (see the water results outlined above) and correcting for the total, dry soil sample actually purged (the dry weight is determined according to GEN-DWPS in the General Chemistry Department and the 8260 correction is made in LIMS):

$$(A_x) * \frac{(5\ grams)}{(ASW_t\ gr)(\%\ Solids)} = A_x\ Low\text{-}Level\ Soil$$

Where:
A_x = the amount, in ppb, from the data station;
5 grams = the nominal amount of soil that is heated and purged;
ASW_t = the actual soil wet weight, in grams, that is purged
% Solids = the correction factor for dry weight in decimal form.

13.1.2.2. The medium-level type is based on an extraction (see VOC-5035). A mass of soil (usually 4 g wet weight) is extracted with a volume (usually 10 mL) of purge-and-trap methanol. The extract is diluted 50 fold with DI and analyzed and calculated as follows:

$$(A_x)\left[\frac{(Dilution)(V_t)}{(ASW_t)(\%\ Solids)}\right] = High\text{-}Level\ Soil\ Amt(ug/kg).$$

Where:
A_x = the data station results, in ug/L;
Dilution = the dilution of the extract.
V_t = the amount (mL) of methanol used to extract the soil (usually 5 mL);
ASW_t = the actual wet weight of soil extracted (g)
% Solids = the dry soil correction in decimal form.

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It should be noted that some states and governing agencies require different amounts of soil and Methanol ratios be maintained. These ratios are generally, 1:2.5, 1:2, 1:1. The amount of extract added is never greater than 100 uL per 5 mL DI. As an example, the Archon autosampler would require the addition of 1.0 mL to 49 mL DI. This is then transferred to a 40 mL VOA vial.

13.1.3. Solid samples with a significant moisture content (>10%), designated for volatile organic analysis, that are extracted prior to analysis in a water miscible solvent such as methanol are diluted by not only the methanol, but also the water in the soil. The total mixture (MeOH + soil water) volume can only be calculated based on the sample moisture present as determined by the % moisture determination. This total volume is then expressed as V_t in the sample concentration calculations provided above. This total solvent and water volume is calculated as follows:

$$V_t = mL\ \ methanol + \left[(1 - \%solids) * ASW_t\right]$$

13.2. All sample data and QC data, including calibration verification must reference the name (date or filename) of the ICAL on the raw data report.

13.3. Manual Integration – When the data system incorrectly quanititates or identifies analytes, manual integration is necessary. Data must be integrated consistently between standards, samples, and QC. See ADM-INT.

13.4. Data Review and Reporting

Most reports are generated using STARLIMS. All data is transferred electronically from the instrument into STARLIMS. The data is reviewed by a qualified peer with applicable checklists (see ADM-DREV) before the data is acceptable and able to be reported to the client (see ADM-RG).

14. METHOD PERFORMANCE

Detection and Quantitation limits are determined according to the requirements in ADM-MDL. The supporting information is filed with the QA office.

Demonstration of Capability is performed upon instrument set-up , whenever a new analyst begins independent analysis, and annually thereafter according to ADM-TRANDOC and section 19 below. The documentation of this method performance is retained by the Quality Assurance office

Accuracy and Precision Data is available in SW-846 method 8260C.

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15. WASTE MANAGEMENT AND POLLUTION PREVENTION

15.1. It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

15.2. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the EH&S Manual.

15.3. Excess, unused sample and testing byproducts are disposed following the procedures in the *SMO-SPDIS*.

16. CORRECTIVE ACTION FOR OUT OF CONTROL DATA

If data is produced that is out of control, the samples are to be re-analyzed with in-control QA whenever possible. See corrective actions in Section 12 of this SOP.

17. CONTINGENCIES FOR HANDLING OUT OF CONTROL OR UNACCEPTABLE DATA

If data is produced that is out of control and is not to be re-analyzed due to sample volume restrictions, holding times, or QC controls can not be met, flag and narrate appropriately.

18. REFERENCES

18.1. Method 8260C *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, USEPA SW-846, August 2006.

18.2. Method 8000C *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, USEPA SW-846, March 2003.

18.3. *DOD Quality Systems Manual for Environmental Laboratories* – Version 4.2, October 2010

18.4. *Massachusetts Compendium of Analytical Methods (CAM), Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, July 1, 2010*

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18.5. *Connecticut Department of Energy and Environmental Protection Recommended Reasonable Confidence Protocols, Laboratory Quality Assurance and Quality Control Requirements, Volatile Organics by Method 8260 SW-846 version 3.0, July 2006.*

19. TRAINING OUTLINE

19.1. Read current SOP and applicable methodologies. Demonstrate a general understanding of the methodology and chemistry. Follow policies in ADM-TRANDOC.

19.2. Observe Sample Preparation and Analysis. Follow GC/MS Training Plan Form.

19.3. Participate in the methodology, documentation, and data reduction with guidance

19.4. Demonstrate Competency by performing the analysis independently. Analyze four replicates of the LCS. If recovery is within the limits of the LCS in The Data Quality Objectives Table, complete Training Plan Form, summary spreadsheet, and IDC certificate and file with QA. An IDC study must be acceptable before the new analyst may analyze samples independently. Continuing Demonstration of Capability is demonstrated annually with the acceptable performance of a Proficiency sample, or new four replicate study.

20. METHOD MODIFICATIONS

None

21. INSTRUMENT-SPECIFIC ADDENDUM

Attached are the printouts from the GC/MS instruments running 8260C showing which analytes are associated with which internal standard. The instrument is the third item in the first line (Data File) of the report. Example: Data File: J:\ACQUDATA\MSVOA**#**. The internal standards are the first compound in each section (always have an AvgRF and CCRF of 1.000) and the associated analytes are listed below the internal standard.

Attached are instrument specific operating conditions for this method.

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22. ATTACHMENTS

Table 1	BFB Tune QC Criteria
Table 2	Characteristic Masses for Purgeable Organic Compounds
Table 3	8260C Quality Control Summary
Table 4	Minimum Relative Response Factor Criteria for Initial and Continuing Calibration Verification
Attachment I	SIM MODE
Attachment II	CURRENT IS/ANALYTE ASSOCIATIONS PER INSTRUMENT
Attachment III	Current Specific Operating Conditions
Attachment IV	DOD Summary and QC Criteria
Attachment V	Modified 8260 Air Analysis

23. CHANGES FROM PREVIOUS REVISION

- Changed format of cover page, headers and footers to ALS throughout. Removed references to CAS.
- Incorporated SOP Change Forms including changing the min RF for 5 compounds from 0.100 to 0.050, tune scan selection, and address.
- Modified Section 6 for clarity. Deleted statement that all samples are held at 0-6. Added details regarding freezing.
- 7-Added instrument details from Appendix C of QAM. Formatted column options into a table. Deleted redundant and unnecessary wording.
- 9.5, 9.7.3, 9.7.4 – Removed curving surrogates
- 9-Added HBO and OCC standards. Changed concentrations of Acrolein. Added tables showing compounds and concentrations of various standards.
- 9-MS/MSD – changed spiking volumes to reflect 42.5 mL sample.
- 11.2 – Added need to allow samples to come to room temp
- 11.2.1.1 – Changed purge from 5 mL to 10 mL.
- 11.2.1.4 – Added new section on compositing
- 11.2.2 – deleted wording about preparation of LL soil and referenced VOC-5035
- 11.4.3 – added first sentence for frequency of ICAL
- 11.4.7.4 and 11.5.2.3.1 – modified corrective action for min RF limit
- 13.1.2 and 13.1.3– made moisture correction routine instead of upon client request
- 13 – removed reference to table for state requirements for soil to methanol ratios (obsolete)
- Added Attachment V
- Added CT RCP to Table 3 and Section 18.
- Added 1,4-dioxane to SIM MODE Table 1 (in Attachment I)

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TABLE 1

4-BROMOFLUOROBENZENE CHARACTERISTIC ION ABUNDANCE CRITERIA

Mass/é ratio	Ion Abundance Criteria
50	15 - 40% of mass/é 95
75	30 - 60% of mass/é 95
95	base peak, 100% relative abundance
96	5 - 9% of mass/é 95
173	<2% of mass/é 174
174	>50% of mass/é 95
175	5 - 9% of mass/é 174
176	>95%; <101% of mass/é 174
177	5 - 9% of mass/é 176

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Table2

CHARACTERISTIC MASSES (m/z) FOR PURGEABLE ORGANIC COMPOUNDS

Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Acetone	58	43
Acetonitrile	41	40, 39
Acrolein	56	55, 58
Acrylonitrile	53	52, 51
Allyl alcohol	57	58, 39
Allyl chloride	76	41, 39, 78
Benzene	78	-
Benzyl chloride	91	126, 65, 128
Bromoacetone	136	43, 138, 93, 95
Bromobenzene	156	77, 158
Bromochloromethane	128	49, 130
Bromodichloromethane	83	85, 127
Bromoform	173	175, 254
Bromomethane	94	96
iso-Butanol	74	43
n-Butanol	56	41
2-Butanone	72	43
n-Butylbenzene	91	92, 134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91, 134
Carbon disulfide	76	78
Carbon tetrachloride	117	119
Chloral hydrate	82	44, 84, 86, 111
Chloroacetonitrile	48	75
Chlorobenzene	112	77, 114
1-Chlorobutane	56	49
Chlorodibromomethane	129	208, 206
Chloroethane	64 (49*)	66 (51*)
2-Chloroethanol	49	44, 43, 51, 80
Bis(2-chloroethyl) sulfide	109	111, 158, 160
2-Chloroethyl vinyl ether	63	65, 106
Chloroform	83	85
Chloromethane	50 (49*)	52 (51*)
Chloroprene	53	88, 90, 51
3-Chloropropionitrile	54	49, 89, 91
2-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	75	155, 157
Dibromochloromethane	129	127
1,2-Dibromoethane	107	109, 188
Dibromomethane	93	95, 174

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Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
1,2-Dichlorobenzene	146	111, 148
1,2-Dichlorobenzene-d_4	152	115, 150
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
cis-1,4-Dichloro-2-butene	75	53, 77, 124, 89
trans-1,4-Dichloro-2-butene	53	88, 75
Dichlorodifluoromethane	85	87
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98
1,1-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	96	61, 98
1,2-Dichloropropane	63	112
1,3-Dichloropropane	76	78
2,2-Dichloropropane	77	97
1,3-Dichloro-2-propanol	79	43, 81, 49
1,1-Dichloropropene	75	110, 77
cis-1,3-Dichloropropene	75	77, 39
trans-1,3-Dichloropropene	75	77, 39
1,2,3,4-Diepoxybutane	55	57, 56
Diethyl ether	74	45, 59
1,4-Dioxane	88	58, 43, 57
Epichlorohydrin	57	49, 62, 51
Ethanol	31	45, 27, 46
Ethyl acetate	88	43, 45, 61
Ethylbenzene	91	106
Ethylene oxide	44	43, 42
Ethyl methacrylate	69	41, 99, 86, 114
Hexachlorobutadiene	225	223, 227
Hexachloroethane	201	166, 199, 203
2-Hexanone	43	58, 57, 100
2-Hydroxypropionitrile	44	43, 42, 53
Iodomethane	142	127, 141
Isobutyl alcohol	43	41, 42, 74
Isopropylbenzene	105	120
p-Isopropyltoluene	119	134, 91
Malononitrile	66	39, 65, 38
Methacrylonitrile	41	67, 39, 52, 66
Methyl acrylate	55	85
Methyl-t-butyl ether	73	57
Methylene chloride	84	86, 49
Methyl ethyl ketone	72	43
Methyl iodide	142	127, 141

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Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Methyl methacrylate	69	41, 100, 39
4-Methyl-2-pentanone	100	43, 58, 85
Naphthalene	128	-
Nitrobenzene	123	51, 77
2-Nitropropane	46	-
2-Picoline	93	66, 92, 78
Pentachloroethane	167	130, 132, 165, 169
Propargyl alcohol	55	39, 38, 53
β-Propiolactone	42	43, 44
Propionitrile (ethyl cyanide)	54	52, 55, 40
n-Propylamine	59	41, 39
n-Propylbenzene	91	120
Pyridine	79	52
Styrene	104	78
1,2,3-Trichlorobenzene	180	182, 145
1,2,4-Trichlorobenzene	180	182, 145
1,1,1,2-Tetrachloroethane	131	133, 119
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Toluene	92	91
1,1,1-Trichloroethane	97	99, 61
1,1,2-Trichloroethane	83	97, 85
Trichloroethene	95	97, 130, 132
Trichlorofluoromethane	151	101, 153
1,2,3-Trichloropropane	75	77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	106	91
m-Xylene	106	91
p-Xylene	106	91
Internal Standards/Surrogates:		
Benzene-d_6	84	83
Bromobenzene-d_5	82	162
Bromochloromethane-d_2	51	131
1,4-Difluorobenzene	114	
Chlorobenzene-d_5	117	
1,4-Dichlorobenzene-d_4	152	115, 150
1,1,2-Trichloroethane-d_3	100	
4-Bromofluorobenzene	95	174, 176
Chloroform-d_1	84	
Dibromofluoromethane	113	

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Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Internal Standards/Surrogates		
Dichloroethane-d_4	102	
Toluene-d_8	98	
Pentafluorobenzene	168	
Fluorobenzene	96	77

* Characteristic ion for an ion trap mass spectrometer (to be used when ion-molecule reactions are observed).

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TABLE 3

8260 C QUALITY CONTROL SUMMARY

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8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
Initial Demonstration of Capability (IDC)-	See ADM-TRANDOC				DOD Limits	Requirements met by ADM-TRANDOC.	No RCP requirements
Continuing Demonstration of Capability (DOC/CDC/CP)	See ADM-TRANDOC				Same.	No specific requirements-follow ADM-TRANDOC.	No RCP requirements
MDL study	See ADM-MDL				Same - ongoing verification thru LOD study	Special RL's 2µg/L for water; 5-10µg/kg for LL Soil and 100-200µg/kg for Medium soils.	No RCP requirements
LOD determination and verification	Verification is required for each instrument initially after the MDL study and annually thereafter.	The verification sample (concentration at >1 to 4 x MDL value) must meet qualitative identification criteria.	1. Determine and Document cause. Run 2 or more higher checks run to set higher LOD. OR 2. Run new MDL study and verification.	See ADM-MDL	Frequency - quarterly for all instruments running DOD, or if no DOD jobs, at least quarterly on one instrument.	No specific requirements-follow ADM-MDL	No RCP requirements
LOQ establishment and verification	Verification required annually in each applicable matrix - goes through any prep.	Recovery within limits (initially LCS limits). Must meet qualitative criteria.	Determine and Document cause. Run higher checks to set higher LOQ.	Initially set at low point of curve with adjustments for prep, if applicable. Verify with a check at 1-2x LOQ. See ADM-MDL	Frequency - quarterly on at least one instrument	Special RL's 2µg/L for water; 5-10µg/kg for LL Soil and 100-200µg/kg for Medium soils.	No RCP requirements

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8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
Tuning	Prior to ICAL and at the beginning of each 12-hour period. Select scans as described in SOP.	Ion criteria in SOP	Retune instrument and verify. If criteria cannot be met, maintenance may be required.	Problem must be corrected. No samples may be accepted without a valid tune.	Requirements met.	Requirements met (Table 4 of 8260B=same as 8260C).	Same
ICAL	Initially, when QC criteria cannot be maintained, after major maintenance. Instrument blank prior to 5 or more points with low point at or below reporting level. Point dropping policy and assignable causes defined in ADM-ICAL.	RSD for each ≤20% or another curve model such as linear regression ≥0.99, may force thru zero to improve low end accuracy, but not to include (0,0) as an extra point. For LR, refit low point within 70-130%recovery. Minimum RF required for all compounds. If >10% of compounds do not meet 20% or 0.99, curve is invalid. All outliers must be discussed in case narrative.	Correct problem then repeat ICAL	Problem must be corrected. No samples may be run until ICAL has passed. 5 or more points (6 if non-linear regression is used); Low standard ≤ to RL; must contain all analytes; performed under same conditions as samples.	Uses CCC and SPCC… RSD for RFs for CCCs<30% and each target<15% LR CC≥0.995 Cannot be forced through the origin. Non-LR r≥0.99 (6pt 2nd order; 7pt 3rd order) Flagging not appropriate. Must correct problem - no samples analyzed until ICAL passes.	If <10% compounds exceed criteria, recalibration is not required as long as %RSD <40, r<0.98 Data rejected if RF<0.05 MUST meet 70-130% refit for linear or non-linear. If not met, report RL as estimated or raise RL to the next cal std that meets refit.	RSD for each < 15% except CCCs <30%. Up to 20% allowed out up to 30%RSD, but note outliers in case narrative. Min RF for all compounds 0.05. If quadratic curve is used for quantitation, note compounds in case narrative.
ICV	Immediately after ICAL.	All target analytes within 70-130% CAS allows difficult compounds (ketones, 1,4-dioxane, bromomethane, and chloromethane) 40-160%	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Second source containing all targets. Concentration near midpoint.	80-120% Recovery. Flagging not appropriate. Must correct problem - no samples run until ICAL verification passes.	70-130% except 40-160% for difficult compounds. Recalibrate if >10% compounds outside criteria.	80-120%. Up to 20% of compounds allowed out as long as all compounds recover 65-135%

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8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
Retention time window position establishment for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed.	NA	NA	On days when ICAL is not performed, the initial CCV is used to set the retention time position.	No specific requirements	No RCP requirements
Analyte Identification and Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units of the standard component. Relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the refernce spectrum. Isomers to be identified individually if height of the valley between isomer peak is less than 25% of the sum of the two peak heights. Otherwise identify as isomeric pairs.	Correct problem, then rerun ICAL	TICs/library search	Laboratory may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping).	No specific requirements	No RCP requirements

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8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
CCV	Daily, all targets, after tuning and before sample analysis and every 12 hours of analysis time.	1. Minimum RFs as per SOP (Table 4 of method 8260C). 2.%Difference/Drift for all target compounds and surrogates: ≤20%D. Up to 20% of compounds may fail 20%D up to 40%D and be reported with a note in the case narrative. 3.EICP area within -50% to 100% of ICAL midpoint standard. 4.Internal standards must have retention time ± 30 seconds from retention time of the midpoint standard in the ICAL. Non-detect samples may be reported with a high-bias CCV.	Correct problem, then rerun CCV. If that fails, the lab may make further corrective action, but must demonstrate acceptable performance with 2 consecutve CCVs. If this fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Flag all results for the specific analytes in all samples since the last acceptable CCV.		Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. DOD must be notified PRIOR to reporting samples with an unacceptable CCV.	Conc near midpoint; %D≤20 except for 8 difficult compounds<60; Area counts for CCV must meet 50-200% of the mid level ICAL std.; If ≤20% of compounds exceed criteria recalibration is not requred as long as %D<40. Data rejected if RF<0.05.	%D<20 for CCCs and <30 for all others. Up to 10% of compounds may be >30.

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8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
Internal Standards verification	Every field sample, standard and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to 100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Sample results are not acceptable without a valid IS verification.	Same	Minimum of 3; 50-200% of assoc CCV; RT ±30 sec of CCV; if recovery is outside of the limits reanalyze or reanalyze at a dilution; lab must report both analyses; if second analysis is good report only second unless it is outside of HT. Then report both. If sample is not reanalyzed chromatogram must be included in report.	Same
MB	One per window or preparatory batch, whichever is more frequent.	No target analytes detected >RL. Common lab contaminants <5xRL. Samples ND or >5 times contamination are acceptable to report.	Correct problem, then reprep and reanalyze all samples processed with contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If reanalyzed out of HT, report both.	<1/2 RL. Common lab contaminants <RL. Samples >10x contamination are acceptable to report.	Every 20 samples prior to analysis and after Cal stds.; matrix and preservation specific; if hit in sample <10X blk-reanalyze; if hit in sample >10Xblank level or ND no corrective action needed.	Matrix and preservative specific. <RL except acetone, MeCl, and 2-butanone must be <3XRL.

8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
LCS/LCSD	One per 12-hour or 20-samples, whichever is more frequent. Containing all analytes to be reported, including surrogates	QC acceptance criteria per client QAP or as listed in DQO Table. RPD ≤30%	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available and reanalysis can be completed within HT. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	DOD Limits	Every 20 samples or 12 hours whichever is more frequent. Concentration near mid point of curve, all analytes, matrix and preservative specific, 70 130 or 40-160% for 8 difficult compounds; can be used as CCV if meets CCV criteria; recovery <10% affects ND's; if >10% of compounds are out reanalyze. if >10%are above 130% reanalysis is not required if ND in samples. Run LCSD immediately after LCS in sequence; RPDs must be <20 ***LCSD is required for MASS CAM work****	Matrix and preservative specific. 70-130% for targets. Up to 10% allowed out as long as within 40-160%. Note in Case Narrative.
MS/MSD	One pair per 12-hour window or 20-sample batch, whichever is more frequent.	Recovery acceptance criteria per client QAP or as listed in DQO Table. RPD ≤30%	Recovery - assume matrix interference if LCS is acceptable. Flag parent sample. RPD - Examine chromatogram for interferences. Examine sample for possible heterogeneity. Reanalyze pair if appropriate. Flag and narrate.	Outlying MS/MSD results with acceptable LCS results indicates matrix interferences are likely the cause.	LCS limits	Every 20 samples Matrix Specific; at midpoint of curve, all analytes 70-130%; RPD's <20 for water <30 for solids. <10% recovery affects ND's; if LCS is good narrate. MSD only required if requested since LCSD is required.	70-130%

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8260C Quality Control Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Comments	DOD QSM 4.2	MA CAM	CT RCP
Surrogate	Added to All field and QC samples	QC acceptance criteria per client QAP or as listed in DQO Table.	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, or historical results verify interference, reanalysis may not be necessary. If surrogates are diluted more than 10 times, report with flag.		DOD Limits	Min. of 3 across run; 70-130%; recovery <10% affects ND. If surr is out low reanalyze or reanalyze at a dilution; if out high and ND do not reanalyze. For methanol samples-if%moisure >25 and surr>10%re-analysis is not required; if sample is not analyzed provide chromatogram in report.	Min. of 3. 70-130% recovery. Methanol preserved not required to be repeated if moiture >25% and recoveries are >10%. Repeat not required if High surrogate recovery is associated with ND compounds.
Reporting					J-flag all results between the MDL and LOQ.	TIC's- section 3.3, MeOH correction 3.2.1; soils-dry weight basis, Appendix II A-1 for COC, temp sheet, HT's	Use "ND" at reporting limit.

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Table 4

MINIMUM RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION VERIFICATION

Compound	Minimum RF	Compound	Minimum RF
Dichlorodifluoromethane	0.100	Trans-1,3-Dichloroprepene	0.100
Chloromethane	0.100	4-Methyl-2-pentanone	0.050
Vinyl Chloride	0.100	Toluene	0.400
Bromomethane	0.100	1,1,2-Trichloroethane	0.100
Chloroethane	0.100	Tetrachlorethene	0.200
Trichlorofluoromethane	0.100	2-Hexanone	0.050
1,1-Dichloroethene	0.100	Dibromochloromethane	0.100
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100	1,2-Dibromoethane	0.100
Acetone	0.050	Chlorobenzene	0.500
Carbon disulfide	0.100	Ethylbenzene	0.100
Methyl Acetate	0.100	M,p-Xylene	0.100
Methylene Chloride	0.100	o-Xylene	0.300
Trans-1,2-Dichloroethene	0.100	Styrene	0.300
Cis-1,2-Dichloroethene	0.100	Bromoform	0.100
Methyl tert-Butyl Ether	0.100	Isopropylbenzene	0.100
1,1-Dichloroethane	0.200	1,1,2,2-Tetrachloroethane	0.300
2-Butanone	0.050	1,3-Dichlorobenzene	0.600
Chloroform	0.200	1,4-Dichlorobenzene	0.500
1,1,1-Trichloroethane	0.100	1,2-Dichlorobenzene	0.400
Cyclohexane	0.100	1,2-Dibromo-3-chloropropane	0.050
Carbon tetrachloride	0.050	1,2,4-Trichlorobenzene	0.200
Benzene	0.500		
1,2-Dichloroethane	0.100		
Trichloroethene	0.200		
Methylcyclohexane	0.100		
1,2-Dichloropropane	0.100		
Bromodichloromethane	0.200		
Cis-1,3-Dichloroprepene	0.200		

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ATTACHMENT I
SIM MODE

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SIM MODE

SCOPE

This SOP uses EPA method 8260C for the determination of low concentration levels of specific volatile organic compounds (VOCs) in aqueous, soil, sludge, sediment, and various types of waste. A mass spectrometer operating under the selective ion monitoring (SIM) mode is used for the analysis. The compounds that are routinely determined by this procedure are listed in SIM MODE Table 1. Other VOCs are available upon request. The list may be used in entirety or in part by meeting established method criteria for the compounds of interest. The reporting limit may be adjusted higher; however, the capability of achieving lower reporting limits for specific project requirements must be demonstrated.

METHOD SUMMARY

Gas chromatographic/mass spectrometric (GC/MS) conditions are detailed in the 8260 SOP. The compounds are detected by a mass selective detector (MSD) using the SIM mode. The retention time and the ratio of two characteristic ions of each analyte are used for identification. The response of either the primary ion or the secondary ion is used for quantitation. Additional ions may be used to confirm the presence of each compound.

PROCEDURE

All applicable procedure and quality control (QC) requirements discussed in the 8260 SOP apply, only the linear range reduces based upon level of quantitation requested. Thus associated QC (LCS, CCVs, MS/MSD, Internal Standards, and Surrogates) spiking concentrations also reduce in concentration. For example, a typical linear range may be 0.05-5.0ppb with internal and surrogate standards spiked at 1.0 ppb, the CCV spiked at 1.0ppb, and an LCS spiked at 0.5ppb. Preparation of standards need only to include the compounds of interest.

INTERFERENCES

Due to the low concentration levels being sought in SIM mode, cleanliness is extremely important to avoid laboratory contamination. Multiple instrument blanks are recommend to be analyzed prior to any SIM-mode analyses. Good laboratory practices must be maintained through out the preparation of standards and samples and analysis to avoid contamination.

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SIM MODE Table 1
List of Target Analytes, Reporting Levels, and Acquisition Details

SIM TARGET CPD.	Reporting Limit (ug/L)	IONS	DWELL TIME
(m+p) xylene	0.1	106,91	30
1,1-dichloroethene	0.1	96,61,98	30
1,2-dibromoethane	0.1	107,109	30
1,2-dichlorobenzene	0.1	146,111	30
1,2-dichloroethane	0.1	62,98	30
1,4-dioxane	5	88,58	30
Carbon tetrachloride	0.1	117,119	30
Ethylbenzene	0.1	91,106	30
Methylene Chloride	0.1	84,49,86	30
o-xylene	0.1	106,91	30
Tetrachloroethene	0.1	166,168	30
Trichloroethene	0.1	95,130,132	30
Vinyl Chloride	0.1	62,64	30

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ATTACHMENT II

CURRENT IS/ANALYTE ASSOCIATIONS PER INSTRUMENT

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Evaluate Continuing Calibration Report

Data Path : J:\ACQUDATA\MSVOA5\DATA\080112\
Data File : M0181.D
Acq On : 1 Aug 2012 10:56 am
Operator : T. Christ
Sample : CCV
Misc :
ALS Vial : 1 Sample Multiplier: 1

Quant Time: Aug 03 15:30:10 2012
Quant Method : J:\ACQUDATA\MSVOA5\METHODS\S051012.M
Quant Title : MS#5 - 8260B SOILS
QLast Update : Thu May 24 14:06:03 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.0000	1.0000	0.0	89	0.00
2	P	Dichlorodifluoromethane	0.5552	0.5155	7.2	75	0.00
3	P	Chloromethane	0.9502	1.0247	-7.8	94	0.00
4	P	Vinyl Chloride	0.7920	0.7406	6.5	78	0.00
5	P	Bromomethane	0.5735	0.4960	13.5	72	0.00
6	P	Chloroethane	0.5275	0.5336	-1.2	85	0.00
7		Freon 21	1.2685	1.2530	1.2	84	0.00
8	P	Trichlorofluoromethane	0.6817	0.5990	12.1	72	0.00
9		Diethyl Ether	0.5700	0.5204	8.7	75	0.00
10		Freon 123a	0.9025	0.8783	2.7	84	0.00
11		Freon 123	0.9062	0.8499	6.2	82	0.00
12		Acrolein	0.1152	0.1192	-3.5	86	0.00
13	P	1,1-Diclethene	0.5222	0.4325	17.2	72	0.00
14	P	Freon 113	0.5589	0.4819	13.8	71	0.00
15	P	Acetone	0.1860	0.1748	6.0	84	0.00
16		2-Propanol	0.0549	0.0548	0.2	84	0.00
17		Iodomethane	0.4431	0.4880	-10.1	98	0.00
18	P	Carbon Disulfide	2.1030	1.6539	21.4#	69	0.00
19		Acetonitrile	0.0459	0.0453	1.3	83	0.00
20		Allyl Chloride	0.3505	0.3446	1.7	82	0.00
21	P	Methyl Acetate	0.7801	0.7898	-1.2	86	0.00
22	P	Methylene Chloride	0.7216	0.6651	7.8	81	0.00
23		TBA	0.0759	0.0731	3.7	79	0.00
24		Acrylonitrile	0.2660	0.2463	7.4	76	0.01
25	P	Methyl-t-Butyl Ether	1.6592	1.5485	6.7	78	0.00
26	P	trans-1,2-Dichloroethene	0.6493	0.5625	13.4	75	0.01
27		Halothane	0.0000	0.0000	0.0	336#	-0.06
28	P	1,1-Diclethane	1.2179	1.1618	4.6	80	0.01
29		Vinyl Acetate	0.0768	0.0723	5.9	74	0.02
30		DIPE	2.9154	2.9306	-0.5	82	0.00
31		2-Chloro-1,3-Butadiene	0.8207	0.6448	21.4#	67	0.01
32		ETBE	2.2207	2.0759	6.5	77	0.00
33		2,2-Dichloropropane	0.7613	0.7264	4.6	78	0.02
34	P	cis-1,2-Dichloroethene	0.7307	0.6615	9.5	75	0.02
35	P	2-Butanone	0.4088	0.3912	4.3	83	0.03
36		Ethyl Acetate	0.0000	0.0000	0.0	75	0.02
37		Propionitrile	0.0996	0.0963	3.3	78	0.00
38		Bromochloromethane	0.4588	0.4160	9.3	77	0.00
39		Methacrylonitrile	0.2797	0.2555	8.7	74	0.02
40		Tetrahydrofuran	0.2691	0.2195	18.4	75	0.02
41	P	Chloroform	1.0057	0.9570	4.8	81	0.02
42	P	1,1,1-Trichloroethane	0.7166	0.6303	12.0	74	0.01
43		TAME	1.9457	1.8946	2.6	80	0.02
44	I	1,4-Difluorobenzene	1.0000	1.0000	0.0	88	0.00
45	P	Cyclohexane	0.3736	0.4029	-7.8	88	0.01
46	s	surr4,Dibrflmethane	0.3231	0.3157	2.3	87	0.02

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Evaluate Continuing Calibration Report

Data Path : J:\ACQUDATA\MSVOA5\DATA\080112\
Data File : M0181.D
Acq On : 1 Aug 2012 10:56 am
Operator : T. Christ
Sample : CCV
Misc :
ALS Vial : 1 Sample Multiplier: 1

Quant Time: Aug 03 15:30:10 2012
Quant Method : J:\ACQUDATA\MSVOA5\METHODS\S051012.M
Quant Title : MS#5 - 8260B SOILS
QLast Update : Thu May 24 14:06:03 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
47	P	Carbontetrachloride	0.0990	0.0874	11.7	73	0.01
48		1,1-Dichloropropene	0.4868	0.4394	9.7	74	0.01
49	s	surr1,1,2-dichloroethane-d4	0.2656	0.2566	3.4	87	0.02
50	P	Benzene	1.4015	1.3365	4.6	81	0.00
51	P	1,2-Dichloroethane	0.3519	0.3333	5.3	79	0.02
52		Iso-Butyl Alcohol	0.0220	0.0213	3.2	83	0.01
53		n-Heptane	0.5966	0.5791	2.9	76	0.02
54		1-Butanol	0.0137	0.0127	7.3	77	0.02
55	P	Trichloroethene	0.3370	0.3051	9.5	74	0.03
56	P	Methylcyclohexane	0.5501	0.5782	-5.1	86	0.01
57	P	1,2-Diclpropane	0.4094	0.3947	3.6	80	0.02
58		Dibromomethane	0.2076	0.1950	6.1	78	0.02
59		1,4-Dioxane	0.0041	0.0036	12.2	78	0.01
60		Methyl Methacrylate	0.2532	0.2331	7.9	76	0.02
61	P	Bromodichloromethane	0.3845	0.3876	-0.8	81	0.02
62		2-Nitropropane	0.0672	0.0682	-1.5	83	0.03
63		2-Chloroethylvinyl Ether	0.2210	0.2271	-2.8	85	0.03
64	P	cis-1,3-Dichloropropene	0.5568	0.5483	1.5	79	0.03
65	P	4-Methyl-2-pentanone	0.4421	0.4427	-0.1	85	0.03
66	s	SURR3,Toluene-d8	1.1121	1.1159	-0.3	89	0.02
67	P	Toluene	1.3586	1.2705	6.5	77	0.02
68	P	trans-1,3-Dichloropropene	0.4461	0.4437	0.5	79	0.03
69		Ethyl Methacrylate	0.4908	0.4756	3.1	82	0.03
70	P	1,1,2-Trichloroethane	0.2846	0.2647	7.0	77	0.02
71	s	SURR2,BFB	0.4006	0.3850	3.9	83	0.04
72	I	d5-Chlorobenzene	1.0000	1.0000	0.0	86	0.03
73	P	Tetrachloroethene	0.2711	0.2428	10.4	71	0.03
74	P	2-Hexanone	0.3565	0.3526	1.1	83	0.04
75		1,3-Dichloropropane	0.6079	0.6056	0.4	78	0.04
76	P	Dibromochloromethane	0.3295	0.3378	-2.5	80	0.04
77		N-Butyl Acetate	0.0000	0.0000	0.0	0#	-0.06
78	P	1,2-Dibromoethane	0.3385	0.3272	3.3	77	0.03
79	P	Chlorobenzene	1.0148	0.9889	2.6	78	0.03
80		1,1,1,2-Tetrachloroethane	0.3180	0.3159	0.7	78	0.03
81	P	Ethylbenzene	0.5073	0.4910	3.2	74	0.04
82	P	(m+p)Xylene	0.6168	0.6033	2.2	76	0.03
83	P	o-Xylene	0.6224	0.6071	2.5	76	0.04
84	P	Styrene	1.0448	0.9885	5.4	74	0.03
85	I	1,4-Dichlorobenzene-d4	1.0000	1.0000	0.0	77	0.03
86	P	Bromoform	0.5101	0.4993	2.1	73	0.03
87	P	Isopropylbenzene	3.7939	3.7767	0.5	72	0.04
88		Cyclohexanone	0.1992	0.2125	-6.7	76	0.03
89		trans-1,4-Dichloro-2-Butene	0.2675	0.2877	-7.6	80	0.04
90	P	1,1,2,2-Tetrachloroethane	1.1664	1.2339	-5.8	77	0.03
91		Bromobenzene	0.9140	0.9598	-5.0	77	0.04

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Evaluate Continuing Calibration Report

Data Path : J:\ACQUDATA\MSVOA5\DATA\080112\
Data File : M0181.D
Acq On : 1 Aug 2012 10:56 am
Operator : T. Christ
Sample : CCV
Misc :
ALS Vial : 1 Sample Multiplier: 1

Quant Time: Aug 03 15:30:10 2012
Quant Method : J:\ACQUDATA\MSVOA5\METHODS\S051012.M
Quant Title : MS#5 - 8260B SOILS
QLast Update : Thu May 24 14:06:03 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
92		4-Ethyltoulene	0.0000	0.0000	0.0	73	0.03
93		1,2,3-Trichloropropane	0.2947	0.2909	1.3	72	0.04
94		n-Propylbenzene	4.3418	4.5254	-4.2	74	0.03
95		2-Chlorotoluene	2.7252	2.7415	-0.6	73	0.03
96		4-Chlorotoluene	2.5043	2.7195	-8.6	78	0.04
97		1,3,5-Trimethylbenzene	2.7876	2.8455	-2.1	73	0.03
98		tert-Butylbenzene	2.4184	2.4280	-0.4	73	0.04
99		1,2,4-Trimethylbenzene	2.6427	2.6834	-1.5	72	0.04
100		sec-Butylbenzene	3.7759	3.7331	1.1	71	0.04
101		p-Isopropyltoluene	2.8235	2.8245	-0.0	72	0.04
102	P	1,3-Dclbenz	1.6079	1.6527	-2.8	75	0.04
103	P	1,4-Dclbenz	1.5547	1.6369	-5.3	77	0.04
104		Benzyl Chloride	0.0000	0.0000	0.0	0#	0.04
105		n-Butylbenzene	2.4719	2.5452	-3.0	72	0.04
106	P	1,2-Dclbenz	1.4968	1.5402	-2.9	75	0.04
107	T	1,2-Dibromo-3-chloropropane	0.1709	0.1655	3.2	71	0.04
108		Nitrobenzene	0.0000	0.0000	0.0	82	0.03
109	P	1,2,4-Tcbenzene	0.7185	0.7886	-9.8	78	0.05
110		Hexachlorobt	0.3941	0.3651	7.4	64	0.04
111		Naphthalen	1.8326	1.9482	-6.3	75	0.04
112		1,2,3-Tclbenzene	0.6443	0.6574	-2.0	73	0.05

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

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA6\DATA\112310\X3195.D Vial: 7
Acq On : 23 Nov 2010 11:34 am Operator: D.LIPANI
Sample : CCV Inst : MS#6
Misc : 8260C Multiplr: 1.00
MS Integration Params: CPD4.P

Method : J:\ACQUDATA\MSVOA6\METHODS\W082410C.M (RTE Integrator)
Title : 8260C WATERS
Last Update : Thu Sep 30 09:33:51 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.0000	1.0000	0.0	114	0.00
2	T	Dichlorodifluoromethane	0.7188	0.7336	-2.1	115	0.00
3	P	Chloromethane	0.8179	0.9093	-11.2	130	0.00
4	C	Vinyl Chloride	0.7573	0.8257	-9.0	132	0.00
5	T	Bromomethane	0.4341	0.4538	-4.5	134	0.00
6	T	Chloroethane	0.4483	0.4677	-4.3	121	0.00
7		Freon 21	1.1826	1.2226	-3.4	123	0.00
8		Freon 123	0.8820	0.9368	-6.2	129	0.00
9		Freon 123a	0.7431	0.8023	-8.0	129	0.00
10		Acrolein	0.0771	0.0686	11.0	99	0.00
11	T	Trichlorofluoromethane	0.9901	0.9583	3.2	108	0.00
12		Acetonitrile	0.0711	0.0815	-14.6	131	0.00
13		2-Propanol	0.0330	0.0332	-0.6	114	0.00
14	T	Acetone	0.1468	0.1486	-1.2	110	0.00
15		Diethyl Ether	0.5020	0.4739	5.6	104	0.00
16	C	1,1-Diclethene	0.5868	0.5642	3.9	109	0.00
17		Iodomethane	0.6129	0.7903	-28.9#	109	0.00
18		TBA	0.0473	0.0493	-4.2	111	0.00
19		Acrylonitrile	0.1936	0.1842	4.9	107	0.00
20	T	Methylene Chloride	0.7586	0.7004	7.7	108	0.00
21	T	Freon 113	0.5713	0.5248	8.1	106	0.00
22	T	Methyl Acetate	0.4712	0.4812	-2.1	117	0.00
23		Allyl Chloride	0.3500	0.3362	3.9	107	0.00
24	T	Carbon Disulfide	2.0072	2.1269	-6.0	114	0.00
25	T	Halothane	0.4687	0.0001	100.0#	0#	0.00
26	T	trans-1,2-Dichloroethene	0.6943	0.6624	4.6	107	0.00
27	T	Methyl-t-Butyl Ether	1.6624	1.6254	2.2	107	0.00
28	P	1,1-Diclethane	1.2641	1.1493	9.1	105	0.00
29		Propionitrile	0.0715	0.0678	5.2	104	0.00
30		Vinyl Acetate	0.9973	0.9655	3.2	94	0.00
31		2-Chloro-1,3-Butadiene	1.0635	0.9439	11.2	93	0.00
32	T	2-Butanone	0.2389	0.2392	-0.1	110	0.00
33		Methacrylonitrile	0.3310	0.3149	4.9	103	0.00
34	T	cis-1,2-Dichloroethene	0.7299	0.7207	1.3	110	0.00
35		Bromochloromethane	0.3301	0.3358	-1.7	116	0.00
36	C	Chloroform	1.1695	1.1117	4.9	109	0.00
37		2,2-Dichloropropane	0.9290	0.9349	-0.6	113	0.00
38		Tetrahydrofuran	0.1664	0.1423	14.5	96	0.00
39	T	1,1,1-Trichloroethane	0.8322	0.8445	-1.5	114	0.00
40	I	1,4-Difluorobenzene	1.0000	1.0000	0.0	120	0.00
41	s	surr4,Dibrflmethane	0.4026	0.3671	8.8	112	0.00
42		Iso-Butyl Alcohol	0.0171	0.0165	3.5	106	0.00
43	s	surr1,1,2-dichloroethane-d4	0.4235	0.3580	15.5	105	0.00
44	T	1,2-Dichloroethane	0.5362	0.4783	10.8	106	0.00
45		1,1-Dichloropropene	0.5467	0.5203	4.8	112	0.00
46	T	Cyclohexane	0.6536	0.6575	-0.6	124	0.00
47	T	Carbontetrachloride	0.4893	0.4988	-1.9	119	0.00
48	T	Benzene	1.5836	1.5547	1.8	120	0.00
49		Dibromomethane	0.2295	0.2249	2.0	120	0.00

(#) = Out of Range
X3195.D W082410C.M Fri Dec 03 09:54:04 2010 Page 1

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA6\DATA\112310\X3195.D Vial: 7
Acq On : 23 Nov 2010 11:34 am Operator: D.LIPANI
Sample : CCV Inst : MS#6
Misc : 8260C Multiplr: 1.00
MS Integration Params: CPD4.P

Method : J:\ACQUDATA\MSVOA6\METHODS\W082410C.M (RTE Integrator)
Title : 8260C WATERS
Last Update : Thu Sep 30 09:33:51 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
50	C	1,2-Diclpropane	0.4046	0.4073	-0.7	124	0.00
51		n-Heptane	0.4400	0.4098	6.9	112	0.00
52	T	Trichloroethene	0.4298	0.4228	1.6	121	0.00
53	T	Bromodichloromethane	0.5386	0.5245	2.6	115	0.00
54		2-Nitropropane	0.0599	0.0605	-1.0	121	0.00
55		1,4-Dioxane	0.0037	0.0035	5.4	118	0.00
56		Methyl Methacrylate	0.2012	0.2048	-1.8	119	0.00
57	T	Methylcyclohexane	0.4837	0.4772	1.3	119	0.00
58		2-Chloroethylvinyl Ether	0.2045	0.2229	-9.0	125	0.00
59	T	cis-1,3-Dichloropropene	0.6149	0.6137	0.2	117	0.00
60	T	4-Methyl-2-pentanone	0.2819	0.3020	-7.1	122	0.00
61	T	trans-1,3-Dichloropropene	0.5218	0.5433	-4.1	119	0.00
62	T	1,1,2-Trichloroethane	0.3160	0.3184	-0.8	120	0.00
63	s	SURR3,Toluene-d8	1.2263	1.2122	1.1	120	0.00
64	C	Toluene	1.6809	1.6285	3.1	118	0.00
65	I	d5-Chlorobenzene	1.0000	1.0000	0.0	121	0.00
66		1,3-Dichloropropane	0.5972	0.5758	3.6	117	0.00
67		Ethyl Methacrylate	0.4328	0.4582	-5.9	116	0.00
68	T	Dibromochloromethane	0.4104	0.4428	-7.9	125	0.00
69	T	2-Hexanone	0.2184	0.2330	-6.7	123	0.00
70	T	1,2-Dibromoethane	0.3588	0.3559	0.8	119	0.00
71		n-Butyl Acetate	0.4116	0.4727	-14.8	135	0.00
72	T	Tetrachloroethene	0.3987	0.3732	6.4	116	0.00
73		1,1,1,2-Tetrachloroethane	0.4055	0.4259	-5.0	121	0.00
74	P	Chlorobenzene	1.2156	1.1683	3.9	117	0.00
75	C	Ethylbenzene	0.6321	0.6523	-3.2	121	0.00
76	P	Bromoform	0.2440	0.2863	-17.3	128	0.00
77	T	(m+p)Xylene	0.7762	0.7989	-2.9	118	0.00
78	T	o-Xylene	0.7799	0.8037	-3.1	120	0.00
79		Cyclohexanone	0.0494	0.0507	-2.6	116	0.00
80	T	Styrene	1.2496	1.2896	-3.2	120	0.00
81		trans-1,4-Dichloro-2-Butene	0.0968	0.1315	-35.8#	142	0.00
82	T	Isopropylbenzene	1.8761	1.9072	-1.7	115	0.00
83	s	SURR2,BFB	0.5610	0.5151	8.2	112	0.00
84	I	1,4-Dichlorobenzene-d4	1.0000	1.0000	0.0	116	0.00
85	P	1,1,2,2-Tetrachloroethane	0.7318	0.7743	-5.8	120	0.00
86		1,2,3-Trichloropropane	0.5678	0.5416	4.6	112	0.00
87		Bromobenzene	0.9698	0.9534	1.7	114	0.00
88		n-Propylbenzene	3.9773	4.2206	-6.1	117	0.00
89		2-Chlorotoluene	2.4586	2.4457	0.5	111	0.00
90		4-Chlorotoluene	2.6103	2.6221	-0.5	113	0.00
91		1,3,5-Trimethylbenzene	2.8570	3.0039	-5.1	116	0.00
92		tert-Butylbenzene	2.3951	2.4704	-3.1	113	0.00
93		1,2,4-Trimethylbenzene	2.9569	3.1041	-5.0	112	0.00
94		sec-Butylbenzene	3.4530	3.6676	-6.2	116	0.00
95	T	1,3-Dclbenz	1.8520	1.8685	-0.9	117	0.00
96	T	1,4-Dclbenz	1.8724	1.8588	0.7	115	0.00
97		p-Isopropyltoluene	2.9937	3.0748	-2.7	110	0.00

(#) = Out of Range

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA6\DATA\112310\X3195.D Vial: 7
Acq On : 23 Nov 2010 11:34 am Operator: D.LIPANI
Sample : CCV Inst : MS#6
Misc : 8260C Multiplr: 1.00
MS Integration Params: CPD4.P

Method : J:\ACQUDATA\MSVOA6\METHODS\W082410C.M (RTE Integrator)
Title : 8260C WATERS
Last Update : Thu Sep 30 09:33:51 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
98	T	1,2-Dclbenz	1.7738	1.7642	0.5	116	0.00
99		n-Butylbenzene	2.7250	2.9249	-7.3	117	0.00
100	T	1,2-Dibromo-3-chloropropane	0.1313	0.1374	-4.6	124	0.00
101		Nitrobenzene	0.0000	0.0000	0.0	0#	0.00
102	T	1,2,4-Tcbenzene	1.2724	1.2452	2.1	108	0.00
103		Naphthalen	2.2047	2.3124	-4.9	108	0.00
104		Hexachlorobt	0.5411	0.4821	10.9	105	0.00
105		1,2,3-Tclbenzene	1.0985	1.0806	1.6	110	0.00

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA7\DATA\120210\H8589.D Vial: 22
Acq On : 2 Dec 2010 7:02 pm Operator: B.Bush
Sample : test ccv Inst : MS #7
Misc : Multiplr: 1.00
MS Integration Params: INTP2.P

Method : J:\ACQUDATA\MSVOA7\METHODS\W100410.M (RTE Integrator)
Title : 8260C.WATERS
Last Update : Tue Oct 12 09:18:14 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.0000	1.0000	0.0	108	0.01
2	P	Dichlorodifluoromethane	0.4138	0.4907	-18.6	119	0.00
3	P	Chloromethane	0.5131	0.7664	-49.4#	172	0.00
4	P	Vinyl Chloride	0.4740	0.5352	-12.9	117	0.00
5	P	Bromomethane	0.4466	0.4120	7.7	94	0.00
6	P	Chloroethane	0.4050	0.4067	-0.4	105	0.00
7		FREON 21	1.0085	1.0574	-4.8	113	0.00
8	P	Trichlorofluoromethane	0.5917	0.6319	-6.8	112	0.00
9		Diethyl Ether	0.4055	0.4290	-5.8	110	0.00
10		FREON 123A	0.6585	0.7957	-20.8#	138	0.00
11		FREON 123	0.6838	0.6663	2.6	109	0.00
12		Acrolein	0.0849	0.0549	35.3#	72	0.00
13	P	FREON 113	0.4204	0.3785	10.0	99	0.00
14	P	1,1-Diclethene	0.4294	0.4220	1.7	106	0.00
15	P	Acetone	0.1758	0.1779	-1.2	120	0.00
16		2-Propanol	0.0300	0.0284	5.3	101	0.00
17		Iodomethane	0.7491	0.6775	9.6	92	0.00
18	P	Carbon Disulfide	1.3392	1.5303	-14.3	132	0.01
19		Acetonitrile	0.0647	0.0618	4.5	104	0.00
20		Allyl Chloride	0.8824	0.8944	-1.4	104	0.01
21	P	Methyl Acetate	0.4740	0.5511	-16.3	132	0.01
22	P	Methylene Chloride	0.5749	0.5536	3.7	108	0.00
23		TBA	0.0409	0.0409	0.0	109	0.00
24		Acrylonitrile	0.1705	0.1802	-5.7	110	0.01
25	P	Methyl-t-Butyl Ether	1.2394	1.3002	-4.9	110	0.01
26	P	trans-1,2-Dichloroethene	0.5303	0.5031	5.1	101	0.01
27		Halothane	0.3687	0.3614	2.0	110	0.00
28	P	1,1-Diclethane	0.9394	0.9556	-1.7	104	0.00
29		Vinyl Acetate	0.0697	0.0530	24.0#	84	0.00
30		DIPE	2.1691	2.3530	-8.5	115	0.00
31		2-Chloro-1,3-butadiene	0.6850	0.7316	-6.8	119	0.00
32		ETBE	1.6121	1.7570	-9.0	117	0.00
33		2,2-Dichloropropane	0.5946	0.5851	1.6	108	0.01
34	P	2-Butanone	0.2707	0.2867	-5.9	121	0.01
35	P	cis-1,2-Dichloroethene	0.5607	0.5548	1.1	106	0.00
36		Propionitrile	0.0630	0.0637	-1.1	108	0.00
37		Methacrylonitrile	0.1854	0.1809	2.4	106	0.00
38		Bromochloromethane	0.2903	0.2592	10.7	99	0.00
39	P	Chloroform	0.8304	0.8488	-2.2	109	0.01
40		Tetrahydrofuran	0.1604	0.1538	4.1	110	0.00
41	P	1,1,1-Trichloroethane	0.6076	0.6677	-9.9	118	0.00
42	I	1,4 - Difluorobenzene	1.0000	1.0000	0.0	109	0.00
43	P	Cyclohexane	0.5516	0.5770	-4.6	114	0.00
44	S	surr4,Dibrflmethane	0.3605	0.3610	-0.1	108	0.00
45	P	Carbontetrachloride	0.3301	0.3427	-3.8	112	0.00
46		1,1-Dichloropropene	0.4253	0.4264	-0.3	108	0.00
47		Iso-Butyl Alcohol	0.0198	0.0184	7.1	110	0.00
48	S	surr1,1,2-Diclethane	0.3180	0.3459	-8.8	119	0.00
49	P	Benzene	1.2509	1.2037	3.8	108	0.01

(#) = Out of Range
H8589.D W100410.M Fri Dec 03 08:43:07 2010 Page 1

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA7\DATA\120210\H8589.D Vial: 22
Acq On : 2 Dec 2010 7:02 pm Operator: B.Bush
Sample : test ccv Inst : MS #7
Misc : Multiplr: 1.00
MS Integration Params: INTP2.P

Method : J:\ACQUDATA\MSVOA7\METHODS\W100410.M (RTE Integrator)
Title : 8260C.WATERS
Last Update : Tue Oct 12 09:18:14 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
50	P	1,2-Dichloroethane	0.3816	0.4111	-7.7	117	0.00
51		TAME	0.8902	0.9034	-1.5	114	0.00
52		N-Heptane	0.3692	0.3310	10.3	107	0.01
53		1-Butanol	0.0081	0.0076	6.2	104	0.00
54	P	Trichloroethene	0.3082	0.3097	-0.5	109	0.00
55	P	Methylcyclohexane	0.3861	0.4032	-4.4	114	0.00
56	P	1,2-Diclpropane	0.3591	0.3644	-1.5	105	0.00
57		Methyl Methacrylate	0.0872	0.0845	3.1	103	0.00
58		1,4-Dioxane	0.0028	0.0021	25.0#	87	0.01
59		Dibromomethane	0.2094	0.2019	3.6	104	0.00
60	P	Bromodichloromethane	0.4128	0.4245	-2.8	108	0.00
61		2-Nitropropane	0.0692	0.0755	-9.1	109	0.00
62		2-Chloroethylvinyl Ether	0.2091	0.1773	15.2	94	0.00
63	P	cis-1,3-Dichloropropene	0.5292	0.5249	0.8	105	0.00
64	I	d5 - Chlorobenzene	1.0000	1.0000	0.0	106	0.00
65	P	4-Methyl-2-Pentanone	0.4328	0.4908	-13.4	123	0.00
66	P	Toluene	1.4216	1.4174	0.3	107	0.00
67		trans-1,3-Dichloropropene	0.5325	0.5468	-2.7	108	0.00
68		Ethyl Methacrylate	0.4973	0.5099	-2.5	106	0.00
69	P	1,1,2-Trichloroethane	0.2729	0.2647	3.0	104	0.00
70	S	surr3,Toluene-d8	1.3571	1.3789	-1.6	106	0.00
71	S	surr2,bfb	0.5009	0.5137	-2.6	108	0.00
72	P	Tetrachloroethene	0.3560	0.3396	4.6	104	0.00
73	P	2-Hexanone	0.3130	0.3452	-10.3	119	0.00
74		1,3-Dichloropropane	0.5773	0.5901	-2.2	109	0.00
75		Butyl Acetate	0.6974	0.7012	-0.5	109	0.00
76	P	Dibromochloromethane	0.3647	0.3664	-0.5	105	0.00
77	P	1,2-Dibromoethane	0.3449	0.3283	4.8	105	0.00
78	P	Chlorobenzene	0.9334	0.9007	3.5	103	0.00
79		1,1,1,2-Tetrachloroethane	0.3229	0.3270	-1.3	110	0.00
80	P	Ethylbenzene	1.5155	1.5253	-0.6	106	0.00
81	P	(m+p)Xylene	0.5803	0.5668	2.3	105	0.00
82	P	o-Xylene	0.5708	0.5547	2.8	104	0.00
83	P	Styrene	1.0057	0.9957	1.0	103	0.00
84	P	Bromoform	0.2316	0.2339	-1.0	104	0.00
85	P	Isopropylbenzene	1.2566	1.2239	2.6	105	0.00
86		Cyclohexanone	0.0454	0.0478	-5.3	112	0.00
87	I	d4 - Dichlorobenzene	1.0000	1.0000	0.0	103	0.00
88	P	1,1,2,2-Tetrachloroethane	0.8418	0.8050	4.4	100	0.00
89		Trans-1,4-Dichloro-2-butene	0.1753	0.1813	-3.4	107	0.00
90		1,2,3-Trichloropropane	0.2539	0.2530	0.4	111	0.00
91		n-Propylbenzene	3.3983	3.4726	-2.2	106	0.00
92		Bromobenzene	0.8330	0.8249	1.0	104	0.00
93		1,3,5-Trimethylbenzene	2.2217	2.2802	-2.6	106	0.00
94		2-Chlorotoluene	2.2074	2.2244	-0.8	108	0.00
95		4-Chlorotoluene	2.2404	2.3306	-4.0	109	0.00
96		tert-Butylbenzene	1.7272	1.7358	-0.5	105	0.00
97		1,2,4-Trimethylbenzene	2.3222	2.3662	-1.9	105	0.00

(#) = Out of Range
H8589.D W100410.M Fri Dec 03 08:43:09 2010 Page 2

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA7\DATA\120210\H8589.D Vial: 22
Acq On : 2 Dec 2010 7:02 pm Operator: B.Bush
Sample : test ccv Inst : MS #7
Misc : Multiplr: 1.00
MS Integration Params: INTP2.P

Method : J:\ACQUDATA\MSVOA7\METHODS\W100410.M (RTE Integrator)
Title : 8260C.WATERS
Last Update : Tue Oct 12 09:18:14 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
98		sec-Butylbenzene	2.7059	2.6502	2.1	105	0.00
99		p-Isopropyltoluene	2.0724	2.0951	-1.1	105	0.00
100	P	1,3-Dclbenz	1.3794	1.3461	2.4	100	0.00
101	P	1,4-Dclbenz	1.4193	1.3741	3.2	101	0.00
102		n-Butylbenzene	1.9232	1.9366	-0.7	105	0.00
103	P	1,2-Dclbenz	1.3089	1.2626	3.5	100	0.00
104	P	1,2-Dibromo-3-chloropropane	0.1568	0.1391	11.3	98	0.00
105		Nitrobenzene	0.0000	0.0000	0.0	79	0.00
106	P	1,2,4-Tcbenzene	0.7222	0.7066	2.2	101	0.00
107		Hexachlorobt	0.2608	0.2412	7.5	102	0.00
108		Naphthalen	1.7116	1.6300	4.8	99	0.00
109		1,2,3-Tclbenzene	0.6343	0.5875	7.4	98	0.00

(#) = Out of Range SPCC's out = 0 CCC's out = 0
H8589.D W100410.M Fri Dec 03 08:43:09 2010 Page 3

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA8\DATA\120210\L3160.D Vial: 5
Acq On : 2 Dec 2010 9:50 am Operator:
Sample : CCV Inst : MS #8
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA8\METHODS\W110510.M (RTE Integrator)
Title : 8260voa
Last Update : Fri Nov 12 10:23:20 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.0000	1.0000	0.0	134	-0.02
2	P	Dichlorodifluoromethane	0.5895	0.5505	6.6	123	0.00
3		Freon 114	0.0000	0.0000	0.0	122	0.00
4	P	Chloromethane	0.5378	0.4636	13.8	121	-0.01
5	P	Vinyl Chloride	0.4723	0.4237	10.3	122	-0.01
6	P	Bromomethane	0.3436	0.2854	16.9	130	-0.01
7	P	Chloroethane	0.2983	0.2617	12.3	119	-0.01
8		FREON 21	0.9110	0.8112	11.0	130	-0.01
9	P	Trichlorofluoromethane	0.8220	0.7407	9.9	122	-0.02
10		Diethyl Ether	0.2488	0.2396	3.7	127	-0.01
11		FREON 123A	0.2214	0.1965	11.2	134	-0.01
12		FREON 123	0.3549	0.3125	11.9	118	-0.01
13		Acrolein	0.0372	0.0226	39.2#	83	-0.02
14	P	FREON 113	0.2045	0.1745	14.7	127	-0.02
15	P	1,1-Dicletheene	0.3728	0.3309	11.2	123	-0.02
16	P	Acetone	0.0750	0.0790	-5.3	142	-0.02
17		2-Propanol	0.0137	0.0088	35.8#	92	-0.01
18		Iodomethane	0.3132	0.3446	-10.0	133	-0.02
19	P	Carbon Disulfide	1.1448	1.0707	6.5	130	-0.01
20		Acetonitrile	0.0137	0.0139	-1.5	122	-0.02
21		Allyl Chloride	0.2408	0.2118	12.0	123	-0.02
22	P	Methyl Acetate	0.2337	0.2479	-6.1	148	-0.02
23	P	Methylene Chloride	0.4641	0.4016	13.5	123	-0.02
24		TBA	0.0223	0.0158	29.1#	99	-0.02
25		Acrylonitrile	0.0817	0.0818	-0.1	132	-0.02
26	P	Methyl-t-Butyl Ether	0.9645	0.9148	5.2	126	-0.02
27	P	trans-1,2-Dichloroethene	0.4315	0.3974	7.9	124	-0.02
28		Halothane	0.3132	0.0000	100.0#	0#	-2.74#
29	P	1,1-Diclethane	0.8042	0.7770	3.4	133	-0.02
30		DIPE	1.5414	0.0000	100.0#	0#	-2.79#
31		Vinyl Acetate	0.0541	0.0400	26.1#	102	-0.02
32		2-Chloro-1,3-butadiene	0.8164	0.7395	9.4	121	-0.02
33		ETBE	1.2656	0.0000	100.0#	0#	-3.01#
34		2,2-Dichloropropane	0.8275	0.7574	8.5	123	-0.02
35	P	2-Butanone	0.1146	0.1191	-3.9	136	-0.02
36	P	cis-1,2-Dichloroethene	0.4775	0.4328	9.4	122	-0.02
37		Propionitrile	0.0298	0.0271	9.1	121	-0.02
38		Methacrylonitrile	0.1009	0.0914	9.4	124	-0.02
39		Bromochloromethane	0.2191	0.1931	11.9	123	-0.02
40	P	Chloroform	0.8948	0.8167	8.7	123	-0.02
41		Tetrahydrofuran	0.0643	0.0649	-0.9	135	-0.02
42	P	1,1,1-Trichloroethane	0.8253	0.7677	7.0	128	-0.02
43	I	1,4 - Difluorobenzene	1.0000	1.0000	0.0	127	-0.02
44	S	surr4,Dibrflmethane	0.3155	0.3436	-8.9	135	-0.02
45	P	cyclohexane	0.4894	0.4899	-0.1	133	-0.02
46	P	Carbontetrachloride	0.4376	0.4232	3.3	127	-0.02
47		1,1-Dichloropropene	0.4323	0.3936	9.0	123	-0.02
48		Iso-Butyl Alcohol	0.0063	0.0045	28.6#	98	-0.02
49	S	surr1,1,2-Diclethane	0.3402	0.3671	-7.9	133	-0.02

(#) = Out of Range

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA8\DATA\120210\L3160.D Vial: 5
Acq On : 2 Dec 2010 9:50 am Operator:
Sample : CCV Inst : MS #8
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA8\METHODS\W110510.M (RTE Integrator)
Title : 8260voa
Last Update : Fri Nov 12 10:23:20 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
50	P	Benzene	1.0982	1.0322	6.0	122	-0.02
51	P	1,2-Dichloroethane	0.3637	0.3769	-3.6	130	-0.02
52		TAME	0.6469	0.0000	100.0#	0#	-3.76#
53		N-Heptane	0.4031	0.4164	-3.3	134	-0.02
54		1-Butanol	0.0036	0.0000	100.0#	0#	-4.05#
55	P	Trichloroethene	0.3215	0.2943	8.5	123	-0.02
56	P	methylcyclohexane	0.4266	0.4128	3.2	133	-0.02
57	P	1,2-Diclpropane	0.2748	0.2657	3.3	122	-0.02
58		Methyl Methacrylate	0.1253	0.1184	5.5	122	-0.02
59		1,4-Dioxane	0.0014	0.0007	50.0#	59	-0.02
60		Dibromomethane	0.1685	0.1560	7.4	122	-0.02
61	P	Bromodichloromethane	0.4088	0.3986	2.5	124	-0.02
62		2-Nitropropane	0.0000	0.0000	0.0	141	-0.02
63		2-Chloroethylvinyl Ether	0.1254	0.1303	-3.9	138	-0.02
64	P	cis-1,3-Dichloropropene	0.4625	0.4167	9.9	117	-0.02
65	I	d5 - Chlorobenzene	1.0000	1.0000	0.0	121	-0.03
66	P	4-Methyl-2-Pentanone	0.1852	0.2074	-12.0	140	-0.03
67	P	Toluene	1.3387	1.2843	4.1	118	-0.02
68	P	trans-1,3-Dichloropropene	0.3994	0.4034	-1.0	122	-0.02
69		Ethyl Methacrylate	0.2906	0.2892	0.5	120	-0.02
70	P	1,1,2-Trichloroethane	0.1809	0.1751	3.2	120	-0.02
71	S	surr3,Toluene-d8	1.1794	1.2586	-6.7	123	-0.03
72	S	surr2,bfb	0.4993	0.5487	-9.9	127	-0.03
73	P	Tetrachloroethene	0.3509	0.3307	5.8	118	-0.02
74	P	2-Hexanone	0.1240	0.1415	-14.1	140	-0.02
75		N-Butyl Acetate	0.3328	0.3112	6.5	132	-0.02
76		1,3-Dichloropropane	0.3961	0.3912	1.2	121	-0.02
77	P	Dibromochloromethane	0.2799	0.2813	-0.5	121	-0.02
78	P	1,2-Dibromoethane	0.2223	0.2199	1.1	122	-0.02
79	P	Chlorobenzene	0.8559	0.8114	5.2	117	-0.03
80		1,1,1,2-Tetrachloroethane	0.3107	0.2852	8.2	113	-0.03
81	P	Ethylbenzene	1.5547	1.5249	1.9	119	-0.03
82	P	(m+p)Xylene	0.5468	0.5417	0.9	120	-0.03
83	P	o-Xylene	0.5338	0.5177	3.0	117	-0.03
84	P	Styrene	0.8878	0.8803	0.8	117	-0.02
85	I	d4 - Dichlorobenzene	1.0000	1.0000	0.0	121	-0.04
86	P	Bromoform	0.3144	0.3239	-3.0	121	-0.02
87	P	Isopropylbenzene	2.9224	2.9031	0.7	119	-0.03
88		Cyclohexanone	0.0461	0.0314	31.9#	87	-0.03
89	P	1,1,2,2-Tetrachloroethane	0.5034	0.5063	-0.6	125	-0.02
90		Trans-1,4-Dichloro-2-butene	0.1191	0.1296	-8.8	135	-0.03
91		1,2,3-Trichloropropane	0.1608	0.1500	6.7	124	-0.03
92		n-Propylbenzene	3.7086	3.7647	-1.5	119	-0.03
93		Bromobenzene	0.7207	0.6733	6.6	114	-0.03
94		4-Ethyltoluene	0.0000	0.0000	0.0	124	-0.03
95		1,3,5-Trimethylbenzene	2.4401	2.5312	-3.7	124	-0.03
96		2-Chlorotoluene	2.1260	2.1841	-2.7	123	-0.03
97		4-Chlorotoluene	2.4427	2.5314	-3.6	123	-0.03

(#) = Out of Range
L3160.D W110510.M Fri Dec 03 09:40:22 2010 Page 2

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Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA8\DATA\120210\L3160.D Vial: 5
Acq On : 2 Dec 2010 9:50 am Operator:
Sample : CCV Inst : MS #8
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA8\METHODS\W110510.M (RTE Integrator)
Title : 8260voa
Last Update : Fri Nov 12 10:23:20 2010
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
98		tert-Butylbenzene	2.1671	2.1259	1.9	120	-0.03
99		1,2,4-Trimethylbenzene	2.4060	2.5171	-4.6	123	-0.03
100		sec-Butylbenzene	3.2077	3.3183	-3.4	123	-0.03
101		p-Isopropyltoluene	2.5078	2.6378	-5.2	124	-0.03
102	P	1,3-Dclbenz	1.3087	1.2318	5.9	115	-0.03
103	P	1,4-Dclbenz	1.2867	1.2312	4.3	114	-0.04
104		Benzyl Chloride	0.0000	0.0000	0.0	123	-0.03
105		n-Butylbenzene	2.2932	2.4781	-8.1	123	-0.03
106	P	1,2-Dclbenz	1.1599	1.1257	2.9	118	-0.03
107	P	1,2-Dibromo-3-chloropropane	0.0865	0.0818	5.4	110	-0.04
108		Nitrobenzene	0.0000	0.0000	0.0	71	-0.04
109	P	1,2,4-Tcbenzene	0.6421	0.7156	-11.4	129	-0.03
110		Hexachlorobu	0.2940	0.3822	-30.0#	139	-0.04
111		Naphthalen	1.4126	1.3903	1.6	116	-0.04
112		1,2,3-Tclbenzene	0.5746	0.6338	-10.3	128	-0.03

(#) = Out of Range SPCC's out = 0 CCC's out = 0
L3160.D W110510.M Fri Dec 03 09:40:23 2010 Page 3

If this SOP is accessed electronically outside of the CAS Rochester Intranet website, it is an uncontrolled-copy and will not be updated.

Evaluate Continuing Calibration Report

Sample : CCV
Data File : J:\ACQUDATA\msvoa10\data\112910\C9251.D Vial: 2
Acq On : 29 Nov 2010 11:10 am
Operator : F. NAEGLER
InstName : MSVOA10
Misc :

Quant Time: Nov 29 11:29:59 2010
Quant Method : J:\ACQUDATA\MSVOA10\METHODS\W112210.M
Quant Title : MS#10 - 8260B WATERS 10mL Purge
QLast Update : Tue Nov 23 09:47:02 2010
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	i	Pentafluorobenzene	1.0000	1.0000	0.0	92	0.00
2	P	Dichlorodifluoromethane	0.4218	0.4675	-10.8	91	0.00
3		Freon 114	0.0000	0.0000	0.0	91	0.00
4	P	Chloromethane	0.5435	0.6085	-12.0	96	0.00
5	P	Vinyl Chloride	0.4397	0.4568	-3.9	89	0.00
6	P	Bromomethane	0.2349	0.2141	8.9	83	0.00
7	P	Chloroethane	0.2129	0.2221	-4.3	88	0.00
8		Freon 21	0.6171	0.6538	-5.9	96	0.00
9	P	Trichlorofluoromethane	0.5195	0.5580	-7.4	93	0.00
10		Diethyl Ether	0.2450	0.2445	0.2	87	0.00
11		Freon 123a	0.4053	0.4070	-0.4	89	0.00
12		Freon 123	0.4459	0.4377	1.8	85	0.00
13		Acrolein	0.0421	0.0370	12.1	74	0.00
14		1,1-Diclethene	0.3509	0.3393	3.3	84	0.00
15	P	Freon 113	0.3216	0.3230	-0.4	87	0.00
16	P	Acetone	0.0736	0.0693	5.8	81	0.00
17		2-Propanol	0.0128	0.0108	15.6	82	0.00
18		Iodomethane	0.2993	0.3416	-14.1	80	0.00
19	P	Carbon Disulfide	1.2065	1.1923	1.2	86	0.00
20		Acetonitrile	0.0116	0.0111	4.3	84	0.00
21		Allyl Chloride	0.2005	0.1912	4.6	84	0.00
22	P	Methyl Acetate	0.2628	0.2735	-4.1	91	0.00
23	P	Methylene Chloride	0.4237	0.3800	10.3	84	0.00
24		TBA	0.0210	0.0176	16.2	74	0.00
25		Acrylonitrile	0.1098	0.1090	0.7	86	0.00
26	P	Methyl-t-Butyl Ether	0.9022	0.8288	8.1	81	0.00
27	P	trans-1,2-Dichloroethene	0.3949	0.3772	4.5	82	0.00
28		Halothane	0.2935	0.2929	0.2	86	0.00
29	P	1,1-Diclethane	0.7363	0.7271	1.2	86	0.00
30		Vinyl Acetate	0.0486	0.0433	10.9	84	0.00
31		DIPE	1.4388	1.5399	-7.0	92	0.00
32		2-Chloro-1,3-Butadiene	0.6144	0.6698	-9.0	95	0.00
33		ETBE	1.2360	1.2279	0.7	86	0.00
34		2,2-Dichloropropane	0.4962	0.4887	1.5	87	0.00
35	P	cis-1,2-Dichloroethene	0.4354	0.4013	7.8	81	0.00
36	P	2-Butanone	0.1407	0.1291	8.2	87	0.00
37		Ethyl Acetate	0.0000	0.0000	0.0	87	0.00
38		Propionitrile	0.0361	0.0350	3.0	82	0.00
39		Bromochloromethane	0.2574	0.2338	9.2	80	0.00
40		Methacrylonitrile	0.1155	0.1005	13.0	78	0.00
41		Tetrahydrofuran	0.0785	0.0767	2.3	89	0.00
42	P	Chloroform	0.6588	0.6512	1.2	86	0.00
43	P	1,1,1-Trichloroethane	0.5670	0.5665	0.1	86	0.00
44		TAME	0.9095	0.8517	6.4	80	0.00
45	i	1,4-Difluorobenzene	1.0000	1.0000	0.0	91	0.00
46	P	Cyclohexane	0.2628	0.2772	-5.5	95	-0.01
47	s	surr4,Dibrflmethane	0.2875	0.2946	-2.5	85	0.00

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Evaluate Continuing Calibration Report

Sample : CCV
Data File : J:\ACQUDATA\msvoa10\data\112910\C9251.D Vial: 2
Acq On : 29 Nov 2010 11:10 am
Operator : F. NAEGLER
InstName : MSVOA10
Misc :

Quant Time: Nov 29 11:29:59 2010
Quant Method : J:\ACQUDATA\MSVOA10\METHODS\W112210.M
Quant Title : MS#10 - 8260B WATERS 10mL Purge
QLast Update : Tue Nov 23 09:47:02 2010
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
48	P	Carbontetrachloride	0.1031	0.1069	-3.7	87	0.00
49		1,1-Dichloropropene	0.3472	0.3385	2.5	84	0.00
50	s	surr1,1,2-dichloroethane-d4	0.2608	0.2926	-12.2	93	0.00
51	P	Benzene	1.0492	0.9906	5.6	81	0.00
52	P	1,2-Dichloroethane	0.3116	0.3162	-1.5	90	0.00
53		Iso-Butyl Alcohol	0.0068	0.0054	20.6#	72	0.00
54		n-Heptane	0.2691	0.2980	-10.7	94	0.00
55		1-Butanol	0.0036	0.0029	19.4	73	0.00
56	P	Trichloroethene	0.2852	0.2728	4.3	82	0.00
57	P	Methylcyclohexane	0.3581	0.3695	-3.2	89	0.00
58	P	1,2-Diclpropane	0.2858	0.2755	3.6	83	0.00
59		Dibromomethane	0.1349	0.1299	3.7	85	0.00
60		1,4-Dioxane	0.0013	0.0009	30.8#	67	0.00
61		Methyl Methacrylate	0.1222	0.1120	8.3	75	0.00
62	P	Bromodichloromethane	0.3213	0.3244	-1.0	87	0.00
63		2-Nitropropane	0.0000	0.0000	0.0	88	0.00
64		2-Chloroethylvinyl Ether	0.1598	0.1510	5.5	80	0.00
65	P	cis-1,3-Dichloropropene	0.3375	0.3539	-4.9	85	0.00
66	P	4-Methyl-2-pentanone	0.2041	0.1982	2.9	84	0.00
67	s	SURR3,Toluene-d8	1.0162	1.1091	-9.1	91	0.00
68	P	Toluene	1.0974	1.0274	6.4	81	0.00
69	P	trans-1,3-Dichloropropene	0.2766	0.2920	-5.6	84	0.00
70		Ethyl Methacrylate	0.2458	0.2310	6.0	76	0.00
71	P	1,1,2-Trichloroethane	0.2018	0.1844	8.6	80	0.00
72	s	SURR2,BFB	0.4070	0.4546	-11.7	97	0.00
73	i	d5-Chlorobenzene	1.0000	1.0000	0.0	93	0.00
74	P	Tetrachloroethene	0.2559	0.2457	4.0	84	0.00
75	P	2-Hexanone	0.1545	0.1478	4.3	83	0.00
76		1,3-Dichloropropane	0.3683	0.3426	7.0	83	0.00
77	P	Dibromochloromethane	0.2605	0.2614	-0.3	84	0.00
78		N-Butyl Acetate	0.3417	0.3258	4.7	83	0.00
79	P	1,2-Dibromoethane	0.1968	0.1994	-1.3	84	0.00
80	P	Chlorobenzene	0.8548	0.7779	9.0	82	0.00
81		1,1,1,2-Tetrachloroethane	0.2809	0.2762	1.7	84	0.00
82	P	Ethylbenzene	0.4409	0.4148	5.9	82	0.00
83	P	(m+p)Xylene	0.5232	0.5088	2.8	83	0.00
84	P	o-Xylene	0.5208	0.4968	4.6	82	0.00
85	P	Styrene	0.8598	0.8323	3.2	82	0.00
86	P	Bromoform	0.1536	0.1522	0.9	83	0.00
87	P	Isopropylbenzene	1.1472	1.1125	3.0	84	0.00
88		Cyclohexanone	0.0267	0.0220	17.6	74	0.00
89		trans-1,4-Dichloro-2-Butene	0.0409	0.0482	-17.8	97	0.00
90	i	1,4-Dichlorobenzene-d4	1.0000	1.0000	0.0	97	0.00
91	P	1,1,2,2-Tetrachloroethane	0.5461	0.4798	12.1	82	0.00
92		Bromobenzene	0.7411	0.6633	10.5	85	0.00
93		4-Ethyltoulene	0.0000	0.0000	0.0	85	0.00

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Evaluate Continuing Calibration Report

Sample : CCV
Data File : J:\ACQUDATA\msvoa10\data\112910\C9251.D Vial: 2
Acq On : 29 Nov 2010 11:10 am
Operator : F. NAEGLER
InstName : MSVOA10
Misc :

Quant Time: Nov 29 11:29:59 2010
Quant Method : J:\ACQUDATA\MSVOA10\METHODS\W112210.M
Quant Title : MS#10 - 8260B WATERS 10mL Purge
QLast Update : Tue Nov 23 09:47:02 2010
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
94		1,2,3-Trichloropropane	0.1483	0.1302	12.2	84	0.00
95		n-Propylbenzene	2.8229	2.6854	4.9	85	0.00
96		2-Chlorotoluene	1.7836	1.6885	5.3	85	0.00
97		4-Chlorotoluene	2.1086	1.9857	5.8	86	0.00
98		1,3,5-Trimethylbenzene	2.0589	1.9746	4.1	86	0.00
99		tert-Butylbenzene	1.6324	1.5304	6.2	88	0.00
100		1,2,4-Trimethylbenzene	2.1647	2.0346	6.0	86	0.00
101		sec-Butylbenzene	2.2963	2.1805	5.0	87	0.00
102		p-Isopropyltoluene	1.9956	1.8903	5.3	87	0.00
103	P	1,3-Dclbenz	1.3085	1.2108	7.5	86	0.00
104	P	1,4-Dclbenz	1.3539	1.2118	10.5	86	0.00
105		Benzyl Chloride	0.0000	0.0000	0.0	66	0.00
106		n-Butylbenzene	1.7008	1.6262	4.4	84	0.00
107	P	1,2-Dclbenz	1.1959	1.0927	8.6	85	0.00
108	P	1,2-Dibromo-3-chloropropane	0.0822	0.0794	3.4	87	0.00
109		Nitrobenzene	0.0000	0.0000	0.0	65	0.00
110	P	1,2,4-Tcbenzene	0.7537	0.6886	8.6	83	0.00
111		Hexachlorobt	0.2689	0.2708	-0.7	94	0.00
112		Naphthalen	1.4783	1.3063	11.6	79	0.00
113		1,2,3-Tclbenzene	0.6320	0.5796	8.3	84	0.00

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

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Evaluate Continuing Calibration Report

Sample : CCV
Data File: J:\ACQUDATA\MSVOA12\DATA\120210\U4088.D
Misc :
Acq On : 2 Dec 2010 11:15 am
Operator : T. CHRIST
InstName : MSVOA-12

Quant Method : J:\ACQUDATA\MSVOA12\METHODS\W083110C.M
Quant Title : MS#12 - 8260B WATERS 10mL Purge
Quant Time: Dec 02 11:31:10 2010
QLast Update : Mon Nov 15 07:45:32 2010
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.0000	1.0000	0.0	81	0.00
2	P	Dichlorodifluoromethane	0.3754	0.4528	-20.6#	86	0.00
3	P	Chloromethane	0.5556	0.6004	-8.1	86	0.00
4	P	Vinyl Chloride	0.5504	0.5913	-7.4	81	0.00
5	P	Bromomethane	0.3187	0.3093	2.9	87	0.00
6	P	Chloroethane	0.3529	0.3466	1.8	77	0.00
7		Freon 21	0.8590	0.9591	-11.7	93	0.00
8	P	Trichlorofluoromethane	0.6222	0.6718	-8.0	83	0.00
9		Diethyl Ether	0.3593	0.3524	1.9	82	0.00
10		Freon 123a	0.5568	0.6087	-9.3	91	0.00
11		Freon 123	0.5899	0.6656	-12.8	93	0.00
12		Acrolein	0.0419	0.0375	10.5	73	0.00
13	P	1,1-Diclethene	0.3812	0.3847	-0.9	78	0.00
14	P	Freon 113	0.3397	0.3552	-4.6	78	0.00
15	P	Acetone	0.0967	0.1084	-12.1	96	0.00
16		2-Propanol	0.0214	0.0215	-0.5	79	0.00
17		Iodomethane	0.3548	0.4674	-31.7#	84	0.00
18	P	Carbon Disulfide	1.2136	1.3018	-7.3	86	0.00
19		Acetonitrile	0.0154	0.0191	-24.0#	101	0.00
20		Allyl Chloride	0.2363	0.2408	-1.9	78	0.00
21	P	Methyl Acetate	0.3145	0.3450	-9.7	94	0.00
22	P	Methylene Chloride	0.5641	0.4673	17.2	83	0.00
23		TBA	0.0327	0.0306	6.4	73	0.00
24		Acrylonitrile	0.1205	0.1252	-3.9	85	0.00
25	P	Methyl-t-Butyl Ether	1.1672	1.1589	0.7	79	0.00
26	P	trans-1,2-Dichloroethene	0.4405	0.4476	-1.6	80	0.00
27		Halothane	0.3068	0.3019	1.6	78	0.00
28	P	1,1-Diclethane	0.8041	0.8968	-11.5	86	0.00
29		Vinyl Acetate	0.0531	0.0529	0.4	75	0.00
30		DIPE	1.5948	1.7889	-12.2	90	0.00
31		2-Chloro-1,3-Butadiene	0.7184	0.6796	5.4	74	0.00
32		ETBE	1.4242	1.4903	-4.6	84	0.00
33		2,2-Dichloropropane	0.6167	0.6729	-9.1	85	0.00
34	P	cis-1,2-Dichloroethene	0.4900	0.5009	-2.2	83	0.00
35	P	2-Butanone	0.1586	0.1746	-10.1	98	0.00
36		Propionitrile	0.0444	0.0479	-7.9	86	0.00
37		Bromochloromethane	0.2721	0.2778	-2.1	81	0.00
38		Methacrylonitrile	0.1456	0.1416	2.7	83	-0.01
39		Tetrahydrofuran	0.1104	0.1040	5.8	86	0.00
40	P	Chloroform	0.7321	0.8064	-10.1	88	0.00
41	P	1,1,1-Trichloroethane	0.6356	0.6584	-3.6	83	0.00
42		TAME	1.2406	1.2382	0.2	79	-0.01
43	I	1,4-Difluorobenzene	1.0000	1.0000	0.0	85	0.00
44	P	Cyclohexane	0.2824	0.3092	-9.5	97	0.00
45	s	surr4,Dibrflmethane	0.2622	0.2816	-7.4	88	0.00
46	P	Carbontetrachloride	0.0918	0.1004	-9.4	85	0.00
47		1,1-Dichloropropene	0.3852	0.3711	3.7	80	0.00

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Evaluate Continuing Calibration Report

Sample : CCV
Data File: J:\ACQUDATA\MSVOA12\DATA\120210\U4088.D
Misc :
Acq On : 2 Dec 2010 11:15 am
Operator : T. CHRIST
InstName : MSVOA-12

Quant Method : J:\ACQUDATA\MSVOA12\METHODS\W083110C.M
Quant Title : MS#12 - 8260B WATERS 10mL Purge
Quant Time: Dec 02 11:31:10 2010
QLast Update : Mon Nov 15 07:45:32 2010
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
48	s	surr1,1,2-dichloroethane-d4	0.2928	0.3273	-11.8	92	0.00
49	P	Benzene	1.2037	1.1438	5.0	83	0.00
50	P	1,2-Dichloroethane	0.3429	0.3598	-4.9	92	-0.01
51		Iso-Butyl Alcohol	0.0102	0.0089	12.7	78	-0.01
52		n-Heptane	0.3033	0.3011	0.7	85	0.00
53		1-Butanol	0.0059	0.0051	13.6	71	0.00
54	P	Trichloroethene	0.2961	0.2774	6.3	80	0.00
55	T	Methylcyclohexane	0.3340	0.3588	-7.4	92	0.00
56	P	1,2-Diclpropane	0.3023	0.3115	-3.0	87	0.00
57		Dibromomethane	0.1415	0.1447	-2.3	87	0.00
58		1,4-Dioxane	0.0025	0.0024	4.0	80	0.00
59		Methyl Methacrylate	0.1562	0.1454	6.9	78	0.00
60	P	Bromodichloromethane	0.3413	0.3695	-8.3	90	0.00
61		2-Nitropropane	0.0000	0.0000	0.0	123	0.00
62		2-Chloroethylvinyl Ether	0.1450	0.1685	-16.2	96	0.00
63	P	cis-1,3-Dichloropropene	0.4531	0.4578	-1.0	84	0.00
64	P	4-Methyl-2-pentanone	0.2097	0.2268	-8.2	90	0.00
65	s	SURR3,Toluene-d8	1.1843	1.2417	-4.8	84	0.00
66	P	Toluene	1.2705	1.2147	4.4	81	0.00
67	P	trans-1,3-Dichloropropene	0.3789	0.3872	-2.2	84	0.00
68		Ethyl Methacrylate	0.3170	0.3029	4.4	79	0.00
69	P	1,1,2-Trichloroethane	0.2165	0.2129	1.7	84	0.00
70	s	SURR2,BFB	0.4577	0.4917	-7.4	87	0.00
71	I	d5-Chlorobenzene	1.0000	1.0000	0.0	87	0.00
72	P	Tetrachloroethene	0.2425	0.2215	8.7	77	0.00
73	P	2-Hexanone	0.1643	0.1608	2.1	86	0.00
74		1,3-Dichloropropane	0.4391	0.4414	-0.5	88	0.00
75	P	Dibromochloromethane	0.2536	0.2667	-5.2	89	0.00
76		N-Butyl Acetate	0.3131	0.3545	-13.2	98	0.00
77	P	1,2-Dibromoethane	0.2285	0.2261	1.1	87	0.00
78	P	Chlorobenzene	0.8787	0.8429	4.1	83	0.00
79		1,1,1,2-Tetrachloroethane	0.2784	0.2848	-2.3	87	0.00
80	P	Ethylbenzene	0.4680	0.4511	3.6	80	0.00
81	P	(m+p)Xylene	0.5983	0.5648	5.6	79	0.00
82	P	o-Xylene	0.5838	0.5525	5.4	79	0.00
83	P	Styrene	0.9731	0.9495	2.4	80	0.00
84	I	1,4-Dichlorobenzene-d4	1.0000	1.0000	0.0	86	0.00
85	P	Bromoform	0.2649	0.2737	-3.3	89	0.00
86	P	Isopropylbenzene	2.3811	2.2526	5.4	77	0.00
87		Cyclohexanone	0.0495	0.0531	-7.3	104	0.00
88		trans-1,4-Dichloro-2-Butene	0.1132	0.1075	5.0	83	0.00
89	P	1,1,2,2-Tetrachloroethane	0.5212	0.5161	1.0	85	0.00
90		Bromobenzene	0.6523	0.6307	3.3	83	0.00
91		4-Ethyltoulene	0.0000	0.0000	0.0	78	0.00
92		1,2,3-Trichloropropane	0.1481	0.1434	3.2	85	0.00
93		n-Propylbenzene	3.0668	2.9782	2.9	80	0.00

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Evaluate Continuing Calibration Report

Sample : CCV
Data File: J:\ACQUDATA\MSVOA12\DATA\120210\U4088.D
Misc :
Acq On : 2 Dec 2010 11:15 am
Operator : T. CHRIST
InstName : MSVOA-12

Quant Method : J:\ACQUDATA\MSVOA12\METHODS\W083110C.M
Quant Title : MS#12 - 8260B WATERS 10mL Purge
Quant Time: Dec 02 11:31:10 2010
QLast Update : Mon Nov 15 07:45:32 2010
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
94		2-Chlorotoluene	1.8468	1.7957	2.8	82	0.00
95		4-Chlorotoluene	2.2336	2.1777	2.5	83	0.00
96		1,3,5-Trimethylbenzene	2.1980	2.0832	5.2	78	0.00
97		tert-Butylbenzene	1.7611	1.6860	4.3	77	0.00
98		1,2,4-Trimethylbenzene	2.2747	2.2092	2.9	80	0.00
99		sec-Butylbenzene	2.5449	2.4424	4.0	78	0.00
100		p-Isopropyltoluene	2.2405	2.1341	4.7	78	0.00
101	P	1,3-Dclbenz	1.2925	1.2182	5.7	82	0.00
102	P	1,4-Dclbenz	1.3445	1.2718	5.4	83	0.00
103		Benzyl Chloride	0.0000	0.0000	0.0	79	0.00
104		n-Butylbenzene	2.0116	1.9977	0.7	82	0.00
105	P	1,2-Dclbenz	1.2270	1.2001	2.2	83	0.00
106	P	1,2-Dibromo-3-chloropropane	0.1032	0.0959	7.1	81	0.00
107		Nitrobenzene	0.0000	0.0000	0.0	294#	0.00
108	P	1,2,4-Tcbenzene	0.8347	0.7838	6.1	84	0.00
109		Hexachlorobt	0.2976	0.2979	-0.1	84	0.00
110		Naphthalen	1.8461	1.6992	8.0	78	0.00
111		1,2,3-Tclbenzene	0.7320	0.6762	7.6	82	0.00

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

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ATTACHMENT III

INSTRUMENT SPECIFIC OPERATING CONDITIONS

If this SOP is accessed electronically outside of the CAS Rochester Intranet website, it is an uncontrolled-copy and will not be updated.

GCMS#6 OPERATING CONDITIONS

GC	Agilent 6890
Column	DB-VRX 0.18mm ID x 20m, 1.0um film
Carrier gas	Helium
Carrier gas mode	Ramped Flow
Flow rate	0.6 mL/min. for 5.0 min. 1.0mL/min. ramp to final flow of 1.0mL/min.
Injection port	Split/Splitless, EPC
Split ratio	100:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	45 deg.C, hold 5.0 min. 18.0 deg.C/min to 240 deg.C, hold 2.0 min.
Mass spectrometer	Agilent 5973
MS interface temp.	250 deg.C
MS source temp	240 deg.C
MS quad. temp	150 deg.C
Detection mode	EI full scan; mass range 35-300m/z

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GCMS#5 & GCMS#7 OPERATING CONDITIONS

GC	Agilent 5890
Column	DB-624 0.25mm ID x 60m, 1.4um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	0.9 mL/min
Injection port	Split/Splitless, no EPC
Split ratio	45:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	45 deg.C, hold 3.10 min. 8.0 deg.C/min to 200 deg.C, hold 4.0 min. 30 deg.C/min to 230 deg.C, hold 3.0 min.
Mass spectrometer	Agilent 5971
MS interface temp.	260 deg.C
MS source temp	NA
MS quad. temp	NA
Detection mode	EI full scan; mass range 35-300m/z

GCMS#8 OPERATING CONDITIONS

GC	Agilent 5890
Column	DB-624 0.18mm ID x 20m, 1.0um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	1.0 mL/min
Injection port	Split/Splitless, no EPC
Split ratio	60:1
Injection port temp.	180 deg.C
Autosampler	Centurion
Oven program	50 deg.C, hold 1.0 min. 16.0 deg.C/min to 190 deg.C, hold 0.0 min. 25 deg.C/min to 225 deg.C, hold 1.0 min.
Mass spectrometer	Agilent 5972
MS interface temp.	255 deg.C
MS source temp	NA
MS quad. temp	NA
Detection mode	EI full scan; mass range 35-300m/z

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GCMS#10 OPERATING CONDITIONS

GC	Agilent 6890
Column	DB-624 0.20mm ID x 25m, 1.12um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	1.2 mL/min
Injection port	Split/Splitless, EPC
Split ratio	75:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	50 deg.C, hold 5.0 min. 20 deg.C/min to 170 deg.C, hold 0.0 min. 40 deg.C/min to 240 deg.C, hold 4.0 min.
Mass spectrometer	Agilent 5975
MS interface temp.	250 deg.C
MS source temp	230 deg.C
MS quad. temp	150 deg.C
Detection mode	EI full scan; mass range 35-300m/z

GCMS#12 OPERATING CONDITIONS

GC	Agilent 6890
Column	DB-624 0.20mm ID x 25m, 1.12um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	1.2 mL/min
Injection port	Split/Splitless, EPC
Split ratio	75:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	50 deg.C, hold 5.00 min. 20 deg.C/min to 170 deg.C, hold 0.0 min. 40 deg.C/min to 240 deg.C, hold 4.0 min.
Mass spectrometer	Agilent 5973
MS interface temp.	250 deg.C
MS source temp	230 deg.C
MS quad. temp	150 deg.C
Detection mode	EI full scan; mass range 35-300m/z

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ATTACHMENT IV

DOD SUMMARY AND QC CRITERIA

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DOD SUMMARY

For work for the Department of Defense – the DOD Quality Systems Manual must be followed. The DOD Manual is based on the NELAC Standards with some additional requirements. The following are the requirements which are different or additional to routine analysis and must be followed for DOD work:

- Calibration Curve, Linear Regression: The correlation coefficient must be greater then or equal to 0.995.
- The Second Source Calibration Verification (ICV) must have a recovery of 80-120% of the true value.
- CCV - All targets and surrogates must <20%D. Client must be notified in advance to reporting any data to be reported with out of control CCV. When CCV fails, all samples must be reanalyzed since last successful CCV.
- The Method Blank must not have any hits above ½ the reporting limit. Common laboratory contaminants must not be above the reporting limit. Hits must be greater than 10x contamination to be reported.
- Apply J flag to all hits between LOD and LOQ.
- The ICAL and CCV associated with DOD samples must be compliant for all targets (do not allow 10% of targets to be out).
- The limits for surrogates, LCS, and MS are different from The Data Quality Objectives Table. Follow the DOD limits given in the following tables. All DOD targets must be in control. All DOD targets are spiked and evaluated.

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presented in Table G-2. The lower control limit generated for alternative or modified methods must be greater than 10% to be considered acceptable.

G.6 Surrogates

The surrogate compounds for each method are added to all samples, standards, and blanks to assess the ability of the method to recover specific non-target analytes from a given matrix and to monitor sample-specific recovery. Control limits for these compounds were calculated in the same study as the other analytes on the target analyte lists. Below are the limits for some of the surrogates of Methods 8260, 8270, 8081, and 8082, based on 3 standard deviations around the mean (Table G-3). Sufficient data were not received for those analytes during the LCS study to perform statistically significant analyses. No ME limits are presented as marginal exceedances are not acceptable for surrogate spikes.

Note: DoD prefers the use of those surrogates not identified as poor performing analytes in Table G-2 above.

Table G-3. Surrogates

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
8260 Water:				
1,2-Dichloroethane-d_4	95	8	70	120
4-Bromofluorobenzene	98	7	75	120
Dibromofluoromethane	100	5	85	115
Toluene-d_8	102	6	85	120
8260 Solid:				
4-Bromofluorobenzene	101	6	85	120
Toluene-d_8	100	5	85	115
8270 Water:				
2-Fluorobiphenyl	79	10	50	110
Terphenyl-d_{14}	92	14	50	135
2,4,6-Tribromophenol	82	13	40	125
2-Fluorophenol	63	14	20	110
Nitrobenzene-d_5	76	11	40	110
8270 Solid:				
2-Fluorobiphenyl	72	10	45	105
Terphenyl-d_{14}	78	15	30	125
2,4,6-Tribromophenol	80	15	35	125
2-Fluorophenol	70	11	35	105
Phenol-d_5/d_6	71	10	40	100
Nitrobenzene-d_5	69	10	35	100
8081 Water:				
Decachlorobiphenyl	83	17	30	135
TCMX	81	19	25	140
8081 Solid:				
Decachlorobiphenyl	94	13	55	130
TCMX	97	9	70	125
8082 Water:				
Decachlorobiphenyl	88	15	40	135
8082 Solid:				
Decachlorobiphenyl	91	11	60	125

G.7 In-House LCS Control Limits

The acceptability of LCS results within any preparatory batch shall be based on project-specified limits or the following DoD-specified LCS control limits, if project-specific limits are not available. If DoD limits are not available, the laboratory must use its in-house limits for batch acceptance.

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DoD strongly believes that it is important for laboratories to maintain their own in-house LCS limits. These in-house limits must be consistent with (i.e., within) the DoD limits (project-specific, if available; otherwise the following LCS-CLs). The laboratory in-house limits shall be calculated from the laboratory's historical LCS data in accordance with a documented procedure (e.g., SOP) that is consistent with good laboratory practice. That document must describe the process for establishing and maintaining LCS limits and the use of control charts.

The laboratory in-house limits are to be used for several purposes:

- Laboratories are expected to utilize their in-house limits as part of their quality control system, and to evaluate trends and monitor and improve performance.
- When a laboratory's in-house limits are outside the DoD control limits (upper and/or lower), they must report their in-house limits in the laboratory report (see Appendix E) even if the LCS associated with the batch fell within the DoD limits. Using this information, DoD will be able to determine how laboratory performance affects the quality of the environmental data.
- DoD may review the laboratory in-house limits and associated trends, as reflected in control charts, to determine whether the laboratory's overall performance is acceptable. If deemed unacceptable, this can allow DoD to decide not to use the laboratory again until substantial improvement has occurred.

Table G-4. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Water Matrix[2]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,1,1,2-Tetrachloroethane	105	8	80	130	75	135
1,1,1-Trichloroethane	100	11	65	130	55	145
1,1,2,2-Tetrachloroethane	96	11	65	130	55	140
1,1,2-Trichloroethane	100	8	75	125	65	135
1,1-Dichloroethane	101	11	70	135	60	145
1,1-Dichloroethene	99	10	70	130	55	140
1,1-Dichloropropene	102	10	75	130	65	140
1,2,3-Trichlorobenzene	99	14	55	140	45	155
1,2,3-Trichloropropane	98	9	75	125	65	130
1,2,4-Trichlorobenzene	100	11	65	135	55	145
1,2,4-Trimethylbenzene	103	10	75	130	65	140
1,2-Dibromo-3-chloropropane	91	14	50	130	35	145
1,2-Dibromoethane	100	7	80	120	75	125
1,2-Dichlorobenzene	96	9	70	120	60	130
1,2-Dichloroethane	100	10	70	130	60	140
1,2-Dichloropropane	100	8	75	125	65	135
1,3,5-Trimethylbenzene	102	10	75	130	65	140
1,3-Dichlorobenzene	100	8	75	125	65	130
1,3-Dichloropropane	100	9	75	125	65	135
1,4-Dichlorobenzene	99	8	75	125	65	130
2,2-Dichloropropane	103	11	70	135	60	150
2-Butanone	91	20	30	150	10	170

[2] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Total Xylene. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the DoD QSM, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section G.5 and for surrogate compounds in section G.6.

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Table G-4. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Water Matrix[2] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
2-Chlorotoluene	100	9	75	125	65	135
2-Hexanone	92	12	55	130	45	140
4-Chlorotoluene	101	9	75	130	65	135
4-Methyl-2-pentanone	96	13	60	135	45	145
Acetone	91	17	40	140	20	160
Benzene	102	7	80	120	75	130
Bromobenzene	100	8	75	125	70	130
Bromochloromethane	97	11	65	130	55	140
Bromodichloromethane	98	8	75	120	70	130
Bromoform	99	10	70	130	60	140
Bromomethane	88	19	30	145	10	165
Carbon disulfide	100	21	35	160	15	185
Carbon tetrachloride	102	12	65	140	55	150
Chlorobenzene	102	7	80	120	75	130
Chlorodibromomethane	96	13	60	135	45	145
Chloroethane	99	12	60	135	50	145
Chloroform	100	12	65	135	50	150
Chloromethane	83	15	40	125	25	140
cis-1,2-Dichloroethene	99	9	70	125	60	135
cis-1,3-Dichloropropene	100	10	70	130	60	140
Dibromomethane	101	8	75	125	65	135
Dichlorodifluoromethane	93	21	30	155	10	175
Ethylbenzene	100	9	75	125	65	135
Hexachlorobutadiene	97	15	50	140	35	160
Isopropylbenzene	101	9	75	125	65	135
m,p-Xylene	102	9	75	130	65	135
Methyl tert-butyl ether	94	10	65	125	55	135
Methylene chloride	96	14	55	140	40	155
Naphthalene	96	14	55	140	40	150
n-Butylbenzene	103	11	70	135	55	150
n-Propylbenzene	101	9	70	130	65	140
o-Xylene	100	7	80	120	75	130
p-Isopropyltoluene	102	10	75	130	65	140
sec-Butylbenzene	100	9	70	125	65	135
Styrene	100	11	65	135	55	145
tert-Butylbenzene	99	10	70	130	60	140
Tetrachloroethene	96	18	45	150	25	165
Toluene	100	7	75	120	70	130
trans-1,2-Dichloroethene	99	13	60	140	45	150
trans-1,3-Dichloropropene	98	15	55	140	40	155
Trichloroethene	99	9	70	125	60	135
Trichlorofluoromethane	103	15	60	145	45	160
Vinyl chloride	99	16	50	145	35	165

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Table G-5. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Solid Matrix[3]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,1,1,2-Tetrachloroethane	100	9	75	125	65	135
1,1,1-Trichloroethane	101	11	70	135	55	145
1,1,2,2-Tetrachloroethane	93	13	55	130	40	145
1,1,2-Trichloroethane	95	11	60	125	50	140
1,1-Dichloroethane	99	9	75	125	65	135
1,1-Dichloroethene	100	12	65	135	55	150
1,1-Dichloropropene	102	11	70	135	60	145
1,2,3-Trichlorobenzene	97	12	60	135	50	145
1,2,3-Trichloropropane	97	11	65	130	50	140
1,2,4-Trichlorobenzene	98	11	65	130	55	140
1,2,4-Trimethylbenzene	100	12	65	135	55	145
1,2-Dibromo-3-chloropropane	87	16	40	135	25	150
1,2-Dibromoethane	97	9	70	125	60	135
1,2-Dichlorobenzene	97	7	75	120	65	125
1,2-Dichloroethane	104	11	70	135	60	145
1,2-Dichloropropane	95	8	70	120	65	125
1,3,5-Trimethylbenzene	99	11	65	135	55	145
1,3-Dichlorobenzene	98	9	70	125	65	135
1,3-Dichloropropane	100	8	75	125	70	130
1,4-Dichlorobenzene	98	9	70	125	65	135
2,2-Dichloropropane	101	11	65	135	55	145
2-Butanone	94	22	30	160	10	180
2-Chlorotoluene	98	10	70	130	60	140
2-Hexanone	97	16	45	145	30	160
4-Chlorotoluene	100	9	75	125	65	135
4-Methyl-2-pentanone	97	17	45	145	30	165
Acetone	88	23	20	160	10	180
Benzene	99	9	75	125	65	135
Bromobenzene[4]	93	9	65	120	55	130
Bromochloromethane	99	9	70	125	60	135
Bromodichloromethane	100	9	70	130	60	135
Bromoform	96	13	55	135	45	150
Bromomethane	95	21	30	160	10	180
Carbon disulfide	103	19	45	160	30	180
Carbon tetrachloride	100	11	65	135	55	145
Chlorobenzene	99	8	75	125	65	130
Chlorodibromomethane	98	11	65	130	55	140
Chloroethane	98	20	40	155	20	175

[3] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Methyl tert-butyl ether and Total Xylene. Sufficient data to perform statistically significant analyses were not received for MTBE during the LCS study. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the DoD QSM, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section G.5 and for surrogate compounds in section G.6.

[4] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from fewer than four laboratories. Limits may be adjusted in the future as additional data become available.

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Table G-5. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Solid Matrix[3] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Chloroform	98	9	70	125	65	135
Chloromethane	90	13	50	130	40	140
cis-1,2-Dichloroethene	96	10	65	125	55	135
cis-1,3-Dichloropropene	99	9	70	125	65	135
Dibromomethane	100	9	75	130	65	135
Dichlorodifluoromethane[4]	85	17	35	135	15	155
Ethylbenzene	101	9	75	125	65	135
Hexachlorobutadiene	98	15	55	140	40	155
Isopropylbenzene	103	9	75	130	70	140
m,p-Xylene	102	8	80	125	70	135
Methylene chloride	97	14	55	140	40	155
Naphthalene	84	14	40	125	25	140
n-Butylbenzene	101	12	65	140	50	150
n-Propylbenzene	99	12	65	135	50	145
o-Xylene	101	8	75	125	70	135
p-Isopropyltoluene	104	10	75	135	65	140
sec-Butylbenzene	97	11	65	130	50	145
Styrene	101	9	75	125	65	135
tert-Butylbenzene	99	11	65	130	55	145
Tetrachloroethene	103	12	65	140	55	150
Toluene	99	9	70	125	60	135
trans-1,2-Dichloroethene	100	11	65	135	55	145
trans-1,3-Dichloropropene	96	10	65	125	55	140
Trichloroethene	101	8	75	125	70	130
Trichlorofluoromethane	106	27	25	185	10	215
Vinyl chloride	92	11	60	125	45	140

Table G-6. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Water Matrix[5]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Polynuclear Aromatics						
2-Methylnaphthalene	75.0	9.5	45	105	35	115
Acenaphthene	77.6	10.1	45	110	35	120
Acenaphthylene	78.5	9.4	50	105	40	115
Anthracene	83.0	9.7	55	110	45	120
Benz[a]anthracene	82.7	8.9	55	110	45	120
Benzo[a]pyrene	81.3	9.5	55	110	45	120

[5] A number of sporadic marginal exceedances of the control limits are allowed depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Benzidine, 2,6-Dichlorophenol, and N-nitrosopyrrolidine. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section G.5.

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ATTACHMENT V

MODIFIED 8260 AIR ANALYSIS

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Modified 8260 AIR ANALYSIS – Sampled in Tedlar Bags

DAILY STANDARD PREP:

5mL DI water containing 50ppb IS/SURR mix is added to Tekmar 2016 sparge tube. 25mL laboratory air is drawn into gas-tight syringe fitted with "open/close luer-lock" valve. Syringe valve is opened. 5uL of the 50ppm methylene chloride/Acetone standard is injected into the 25mL syringe containing air. Syringe valve is closed. Syringe is then warmed on top of GC oven near the heated injector for 2-5 minutes until the 5uL of injected standard volatilizes into the 25mL of air contained within the syringe. The DI water and IS/SURR in sparge tube is started purging. 25mL syringe containing volatilized standard is connected to the valve/down-tube assembly associated with purging position. Valves are opened at the syringe and at the down-tube to allow contents of the 25mL syringe to be transferred into the sparge tube while it purges. Valves are closed. 25mL syringe is disconnected from luer fitting at top of down-tube. CCV is running. Used DI water is removed from sparge tube following analysis.

SAMPLE PREP.

A luer-lock needle is fitted to "open/close valve" on 25mL gas-tight syringe. 25mL of air is removed from Tedlar bag via septum port found at one end of the bag. Needle is removed from syringe. Sample is injected into sparge tube the same way as decribed above.

Note: DI water and IS/SURR is replaced in sparge tube prior to each analysis. The syringe is not heated for sample analysis because sample is already in its fully volatilized form in the Tedlar bag.