Transmittal

Stantec Consulting Services Inc.
61 Commercial Street, Suite 100
Rochester NY 14614-1009
Tel: (585) 475-1440
Fax: (585) 272-1814

To:	**Sarah Saucier, P.E.**	From:	**Bob Mahoney**
Company:	**NYSDEC**	☐	For Your Information
		☑	For Your Approval
Address:	Division of Environmental Remediation Bureau C 625 Broadway, 11th Floor Albany, NY 112233	☐	For Your Review
		☑	As Requested
Date:	November 3, 2015		
Delivery:	FTP site Upload		

Reference: **Revised Work Plan for Excavation Initial Design Investigation**
Former Lockheed Martin Facility, Utica

Attachment:

Copies	Doc Date	Pages	Description
1	**November 3, 2015**	**866 (pdf)**	**Document entitled "Revised Work Plan for Excavation Initial Design Investigation, Former Lockheed Martin French Road Facility, Utica, New York"**

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STANTEC CONSULTING SERVICES INC.

Robert Mahoney, P.G.
Senior Environmental Geologist
Phone: 585-413-5301

ec: Steven Karpinski, NYSDOH
Charles Trione, Lockheed Martin
Jann Richardson, Lockheed Martin
Mary Morningstar, Lockheed Martin
Rick Zigenfus, ConMed Corporation
Jim Zigmont, CDM Smith
Kay Armstrong, Armstrong and Associates

Revised Work Plan for Excavation
Initial Design Investigation
Former Lockheed Martin
French Road Facility
Utica, New York

Prepared for:
Lockheed Martin Corporation
Energy, Environment, Safety and Health
6801 Rockledge Drive
Bethesda, Maryland 20817

Prepared by:
Stantec Consulting Services Inc.
61 Commercial Street
Rochester, NY 14614

November 3, 2015

CERTIFICATIONS

I Peter Nielsen of Stantec Consulting Services Inc., certify that I am currently a NYS registered professional engineer and that this Revised Work Plan for Excavation Initial Design Investigation 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).

Signature

11/3/15

Date

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Acronyms and Abbreviations

1,1-DCA	1,1-dichloroethane
ASP	Analytical Services Protocol
cis-1,2-DCE	cis-1,2-dichloroethene
CMS	Corrective Measures Study
ConMed	ConMed Corporation
CU	Commercial Use
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DER	Division of Environmental Remediation
DUSR	data usability summary report
EDD	electronic data deliverable
EIMS	Environmental Information Management System
ELAP	Environmental Laboratory Accreditation Program
FNPD	Former Northern Perimeter Ditch
GCTS	Groundwater Collection and Treatment System
HASP	Health and Safety Plan
IDW	investigation derived waste
Lockheed Martin	Lockheed Martin Corporation
mg/kg	milligrams per kilogram
MIP	Membrane Interface Probe
MS/MSD	matrix spike/matrix spike duplicate
NAPL	non-aqueous phase liquid
NYSDEC	New York State Department of Environmental Conservation

NYSDOH	New York State Department of Health
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
POGW	Protection of Groundwater
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
SCO	Soil Cleanup Objective
SPDES	State Pollutant Discharge Elimination System
Spectra	Spectra Subsurface Imaging Services Group, LLC
Stantec	Stantec Consulting Services Inc.
TCE	trichloroethene
TestAmerica	TestAmerica Laboratories, Inc.
µg/kg	micrograms per kilogram
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound

1.0 PROJECT BACKGROUND AND OBJECTIVES

1.1 PROJECT BACKGROUND

The Former Lockheed Martin French Road Facility is located at 525 French Road in Utica, Oneida County, NY ("site", Figure 1). The site is divided into two environmental remediation sites: 1) the Solvent Dock Area (Site No. 633036A); and 2) the West Lot (Site No. 633036). Lockheed Martin Corporation (Lockheed Martin) entered into an Order on Consent for the Solvent Dock Area on October 3, 2008; the Solvent Dock Area is regulated under the Resource Conservation and Recovery Act (RCRA). Lockheed Martin entered into an Order on Consent for the West Lot on April 1, 1999; the West Lot is listed as a Class 4 site on the New York State Registry of Inactive Hazardous Waste Disposal Sites (New York State Superfund site). Previous documents including reports of the various site investigations and remedial measures implemented to date should be referred to for a detailed site history. These documents are on file with the NYSDEC and most historical technical documents are available at the project's public repository site (Utica library). Based on the findings of the investigations to date, the NYSDEC issued its Final Statement of Basis in March 2015. As directed by the Final Statement of Basis, both areas will be managed under a combined Site Management Plan, which will be prepared as part of the site remedial program.

1.1.1 Area 2 Remediation

The Final Statement of Basis issued for the site by NYSDEC (2015) directs that soil in "Area 2" that is impacted with chlorinated volatile organic compounds (CVOCs) at concentrations in excess of NYSDEC's Part 375 Soil Cleanup Objectives (SCOs) for the Protection of Groundwater (POGW) requires excavation and disposal. This remedial action (combined with other actions) was included as Alternative A2-4 in the 2013 *Corrective Measures Study, Former Northern Perimeter Ditch, Solvent Dock Area, Former Lockheed Martin French Road Facility, Utica, New York*, prepared by ARCADIS (CMS). Complete excavation within Area 2, as currently defined by the Statement of Basis, would result in removal and disposal of approximately 1,170 cubic yards of soil over an area of approximately 2,100 square feet to a depth of approximately 15 ft.

As summarized in the CMS, eight test borings have previously been drilled in Area 2 within the excavation area delineated in the Statement of Basis (see Figure 2):

A2-PZ-1	A2-PZ-7	MW-17
A2-PZ-2	A2-PZ-8	MW-18
A2-PZ-6	MW-16	

Other borings were performed just outside the limits of the proposed A2 limits, as shown on Figure 2.

The primary CVOCs of concern are trichloroethene (TCE) and tetrachloroethene (PCE). Cis-1,2-dichlorethene (cis-1,2-DCE), 1,1-dichlorethane (1,1-DCA) and vinyl chloride (VC) were also detected although at lower concentrations. Soil samples from five of these eight borings inside the Area 2 limits exhibited one or more CVOC at concentrations in excess of POGW SCOs (see red boring symbols on Figure 2). Samples obtained from borings MW-16, MW-17 and A2-PZ-8 did not exhibit CVOCs at exceedance levels. As indicated on Figure 2, the distribution of CVOCs at exceedance levels appears generally to be in the eastern and western portions of Area 2; borings in the central portion did not exhibit POGW exceedances.

The depths of samples exhibiting exceedances ranged from approximately 6 to 12 ft. The highest individual CVOC concentration observed in these explorations was PCE at 210 mg/kg in boring/well A2-PZ-2 at a depth of 11-12 ft. The POGW SCOs for TCE and PCE are 0.47 mg/kg and 1.3 mg/kg, respectively.

The Statement of Basis also directed that the soil beneath the adjacent one-story storage building ("pole barn") be more thoroughly characterized. The pole barn is an unoccupied, one-story, slab-on-grade building immediately adjacent to and south of Area 2. As reported in the 1995 Phase I Environmental Site Assessment Report, the pole barn is the former location of a hazardous waste drum storage area. The pole barn contains a cylindrical sump structure approximately 2.5 ft. in diameter and of unknown depth, located along the north interior wall of the building. The sump was installed when the structure was constructed sometime prior to 1980 to receive potential spills from containers of waste stored in the building. The pole barn floor is sloped towards the sump. Details of the sump construction are unknown. In April 2015, the sump was observed to contain standing water at or near the floor slab level. This may indicate a direct hydraulic connection with the subsurface, which may respond to water table fluctuations. There is no apparent source of surface runoff to this drain. Evidence of a former penetration through the concrete berm that surrounds the floor of the pole barn, which now appears to be plugged, was observed directly above the sump. It is not known if the penetration originally was a conduit connecting to anything outside of the building.

To date, one subsurface exploration (test boring/monitoring well PZ-42) has been advanced beneath this structure. A soil sample from this boring did not exhibit CVOC presence at concentrations in excess of POGW SCOs. Groundwater sampled from monitoring well PZ-42 (June 2010) exhibited concentrations of TCE (18 µg/L), cis-1,2-DCE (31 µg/L), and 1,1-DCA (21 µg/L). Each of these detections exceeded the individual groundwater standards for these compounds of 5 µg/L.

1.1.2 PCB Exceedance Locations

In addition to the source area excavation and the pole barn investigation, the Statement of Basis directed that surface soil be removed from each of three sample locations where polychlorinated biphenyls (PCBs) have previously been detected in surface soil samples at exceedance levels. PCBs in samples identified as LMCU-SS-07, LMCU-SS-20 and LMCU-SS-21 (collected in 2013 from 0-0.5 ft. depth) were reported at concentrations in excess of NYSDEC's Part 375 Soil Cleanup Objectives (SCOs) for Commercial Use (CU, 1 mg/kg or 1,000 ug/kg). These locations are within both the Solvent Dock Area and West Lot sites, as shown on Figure 3. In accordance with the Statement of Basis, soil removal is to be performed at these three locations to a depth of 1 ft.

1.2 PROJECT OBJECTIVES

The objectives of the activities describe in this Work Plan are to:

- Investigate and potentially further refine the lateral and vertical limits of impacted soil in Area 2 where excavation is planned;
- Further investigate the pole barn sump and underlying soil;
- Delineate the limits of PCB-impacted surface soil at the three previous sample locations for excavation planning; and
- Provide the basis for Remedial Design.

2.0 PLANNED INVESTIGATION ACTIVITIES

All investigation activities will be performed in general conformance with NYSDEC's DER-10 guidance document. Additional complementary plans, including a Quality Assurance Project Plan (QAPP) and a Health and Safety Plan (HASP) have been included to supplement this Work Plan. All investigation activities will be performed in accordance with this Work Plan and with both of the following plans:

QAPP: Outlines the procedures to be used to assure that analytical results obtained from the investigation meet data quality objectives (Appendix A).

HASP: Describes personal safety protection standards and procedures to be followed by Stantec personnel and Stantec's subcontractors during the planned investigation activities (Appendix B).

2.1 SURVEY

An overall site survey was performed in 1995, and a Topographic and Utility survey was completed in 2007. Prior to the initiation of investigation activities, several surveying tasks will be completed to supplement the previously completed survey and mapping. Specifically, this will include:

- Confirming the dimension and elevations of the pole barn;
- Locating the preliminary Area 2 excavation limits, as depicted in the Statement of Basis;
- Locating proposed test borings after first locating the previously-identified Area 2 VOC exceedances and surface soil PCB exceedances based on existing survey coordinates;
- Supplementing existing ground surface elevation data; and
- Confirming known utility locations.

2.2 UNDERGROUND UTILITY PRE-CLEARANCE

Stantec will arrange for a pre-clearance survey for potential underground utility interference and will screen proposed field exploration locations in accordance with Lockheed Martin's *Minimum Requirements for Intrusive Fieldwork Work Plans* (2009). Stantec will employ the services of Spectra Subsurface Imaging Services Group, LLC (Spectra) to perform geophysical screening at areas targeted for subsurface investigation. Although the anticipated depth of soil disturbance for the three PCB exceedance locations is only 1 ft., pre-clearance will be performed at

each of the surface soil investigation locations since no previous subsurface data are known to exist for these locations.

Stantec will consult with ConMed to determine if existing site underground utility drawings are available. In addition, in accordance with New York law, a public utility stakeout will also be obtained through the DigSafelyNY program prior to performing any ground intrusive activities. If utility presence requires modification to the investigation locations proposed in this Work Plan, NYSDEC will be informed prior to initiating the explorations.

2.3 POLE BARN SUMP INSPECTION AND SAMPLING

To evaluate conditions of the sump structure in the pole barn, the fluids will be pumped from the sump into a 55-gallon drum(s). Sediment from the bottom of the sump, if present, will also be containerized. Any liquid and solid materials removed and containerized will be managed as investigation-derived waste (IDW) (see Section 2.6). A visual inspection of the structure will then be performed to determine if there are piping connections, a solid or soil bottom, inflow of groundwater, etc. The inspection will include recording sump dimensions and photographing the sump. If piping connections are observed in the sump, the location and termination of the piping will be investigated to the extent practicable given the existing structural constraints.

Prior to pumping out the sump fluids, a sample will be collected from the standing water in the sump. If groundwater is observed discharging into the sump following the pump-out, another sample of the groundwater will be collected for laboratory analysis for VOCs. The original sump water sample will only be analyzed if groundwater does not readily recharge the sump.

If the bottom of the sump is not solid, we propose to obtain a soil sample from beneath the sump using a Geoprobe® rig, as part of the Area 2 investigation discussed in the next section. If the sump bottom is concrete, we will use the Geoprobe to obtain a sample adjacent to the sump at a depth representative of the interval directly below the sump; this sampling depth will be determined in the field based on the measured sump depth. The soil sample will be submitted for laboratory analysis for VOCs using USEPA Method 8260C.

2.4 SOIL INVESTIGATION AND SAMPLING

The primary objective of the soil investigation and sampling plan is to delineate the extent of soil excavation in Area 2 and at the three surface soil locations. A Geoprobe® rig (direct push with continuous sampling) will likely be used in both the surface and subsurface investigations. Membrane Interface Probe (MIP) technology will only be used for the Area 2 investigation.

All non-dedicated equipment will be decontaminated prior to and following each use. Decontamination of equipment will consist of a wash with Alconox (or equivalent) solution and a tap water rinse. Following decontamination, direct contact between sampling equipment and the ground surface will not be permitted.

Table 1 provides a summary of the proposed number of samples and associated analysis for each investigation area.

2.4.1 Subsurface Soil Borings and Membrane Interface Probe (MIP) Investigation

In order to provide a more detailed and efficient characterization of the proposed Area 2 excavation limits, the investigation will include the use of MIP technology (manufactured by Geoprobe Systems®) combined with traditional direct-push Geoprobe soil borings. The MIP is a semi-quantitative, direct-push tool used to log, in real time, the relative concentration of total VOCs with depth in soil. MIP technology is capable of sampling VOCs from subsurface soil from both the vadose and saturated zones, and can rapidly locate and identify zones of relatively higher or lower contaminant concentrations. Soil vapor above and below the water table is continuously captured downhole and circulated with a carrier gas (typically hydrogen) via tubing to the surface for analysis by a variety of instruments.

The MIP consists of a heated probe with a semi-permeable membrane. As the heated probe is advanced, VOCs in the soil diffuse across the membrane and are transported up a "trunk line" to a gas chromatograph that can be equipped with an electron capture detector (ECD) sensor for generally lower-level detections and/or a halogen-specific detector (XSD) for generally higher-level detections. Based on the expected range of total CVOC concentrations within the investigation area, it is anticipated that the both the ECD and XSD sensors will initially be employed, however both instruments may not be used for the entire program depending on response.

The MIP assembly is typically also equipped with a photoionization detector and flame ionization detector (PID/FID) that measures the total VOCs in the soil gas. The instrument is continuously logging sensor data from the probe, which is designed to be pushed down at a rate of approximately one foot per minute (although the optimum rate can vary depending on soil and contaminant conditions).

The instrument also measures electrical conductivity (EC), which allows for qualitative lithologic logging of the soil. In general, finer grained portions of the formation (silts, clays) exhibit higher EC values than more permeable soils such as sands and gravels. The gas chromatograph responses are plotted on a graph that overlays the probe response data over the EC data, thus, creating a relatively high resolution picture of the contaminant distribution relative to lithology.

The Geoprobe Systems® *Geoprobe Membrane Interface Probe (MIP) Standard Operating Procedure* (SOP) is included in Appendix C. Use of the MIP for this investigation will be in general accordance with the SOP. MIP response testing will be performed prior to use at each borehole by inserting the probe into a sand or water standard prepared in advance with known concentrations of the VOCs of concern. It is anticipated that a stock solution containing TCE (concentration of 1 ppm) will likely be used.

The results produced by a MIP at any location are relative and generally require verification and actual VOC quantification with conventional soil sampling and laboratory analysis. Accordingly, the subsurface soil investigation will include obtaining soil samples for laboratory analysis to supplement and corroborate the MIP field data.

Based on the size of the area in question and the previous results, it is anticipated that three days of MIP work will be performed. It is proposed to advance up to approximately 22 probe holes in the current Area 2 excavation footprint and the adjacent pole barn. These initial locations have been chosen to delineate the extent of impacts around those locations where POGW SCO exceedances were noted previously. To that end, the following groups of initial borings are proposed as shown on Figure 2 (note that all locations are approximate only and subject to adjustment in the field):

- Group A: Four borings surrounding existing well MW-18 and one boring in the west corner of Area 2;

- Group B: Four borings in vicinity of A2-PZ-6/A2-PZ-1;
- Group C: Four boring surrounding wells A2-PZ-2/A2-PZ-7;
- Group D: Five borings in the Pole Barn and one boring in Area 2 directly north of the Pole Barn wall in the vicinity of the sump;
- Group E: Three borings in the area between Group A and Group B, where no POGW SCO exceedances are currently known to exist.

The probes will be advanced to a depth of 15 ft unless MIP data indicate impacts extending beyond that depth. Soil borings located within the pole barn will be pre-cored through the concrete floor slab.

The MIP data from each of these initial borings will be reviewed as obtained. The results from initial borings will be used to locate additional borings located generally further from the known areas of impact as appropriate to delineate the limits of VOC-impacted soils. Actual locations of up to ten subsequent borings will be dependent on the profile data obtained from the initial probes, and as such are not shown on Figure 2. As the MIP logs become available, they will be distributed daily to the project team for review and to facilitate collaborative decision making regarding subsequent boring locations to be completed the following day.

Upon completion of the MIP investigation, soil samples for laboratory confirmation analyses will be obtained in Geoprobe boreholes drilled immediately adjacent to selected MIP investigation locations. Locations will be selected in consultation with the project team based on the MIP results. Samples will be obtained from depths commensurate with the zones identified with the MIP equipment as containing elevated apparent VOC concentrations and from locations with low-level or no response, to identify potential lateral and vertical contaminant boundaries. If an elevated VOC response is not identified with the MIP equipment, the sample will be collected from the interval that best corresponds with the previously sampled interval which exhibited a POGW SCO exceedance in the soil boring being delineated (or in the previous soil boring that is closest). This may include bottom samples from one or more borings. For planning purposes Stantec has allowed for the collection of up to 44 soil samples for laboratory analysis for VOCs using USEPA Method 8260C. The actual number of samples from any single boring may vary depending on MIP data.

2.4.2 Surface Soil Investigation

The surface soil investigation will include additional surface soil sampling at and around each of the three previously identified surface soil PCB exceedance locations (Figure 3). Samples will be collected in a concentric "ring" pattern around each of the three exceedance locations, at distances of five and ten feet from the original sample location (Figure 3). Samples will be obtained using a Geoprobe® direct-push rig or a hand auger if warranted. The samples will be collected from 0 to 6 inches below the surface cover (concrete, asphalt, grass, etc.). Each ring will include four samples, resulting in the collection of eight surface soil samples for each of the three exceedance locations to be analyzed for PCBs by USEPA Method 8082. The soil data will be used to delineate the extent of surface soil impacted at levels greater than the SCO and which will require excavation. Analyses will be performed on a 48-hour turnaround time to facilitate rapid evaluation of conditions.

2.5 QUALITY ASSURANCE/QUALITY CONTROL SAMPLING

Table 2 summarizes the field Quality Assurance/Quality Control (QA/QC) samples to be collected during the field investigation. Field QA/QC samples to be collected include trip blanks, rinsate blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD) analyses. One trip blank will accompany each cooler containing aqueous samples analyzed for VOCs (excluding rinsate blanks). Field duplicates and MS/MSDs will be collected at a rate of one per 20 field samples per sample media. Rinsate blanks will be collected once per mobilization for each sampling methodology using non-dedicated sampling equipment. At this time it is anticipated that one rinsate blank will be collected for the surface soil sampling program (analyzed for PCBs) and two rinsate blanks will be collected for the Area 2/Pole Barn investigation (analyzed for VOCs). Rinsate blanks will be collected by pouring deionized water over decontaminated non-dedicated equipment into a sample container. The non-dedicated equipment planned for this project may include MacroCore samplers and/or hand surface soil sampling equipment. The QAPP is provided in Appendix A.

2.6 INVESTIGATION-DERIVED WASTE

IDW materials will be handled, containerized and disposed of in accordance with DER-10 guidance. Soil cuttings from test borings will be returned to the boreholes where feasible; remaining cuttings will be containerized and stored onsite in 55-gallon drums. Soil cuttings will be containerized for off-site disposal if they are observed to contain non-aqueous phase liquid (NAPL) or appear to be grossly

impacted. Wastes from PCB-impacted surface soils will be kept separate from VOC-impacted soils. Following the completion of the investigation, the soil will be profiled for disposal at a Lockheed Martin-approved facility that is permitted to accept the waste. The specific analyses performed will be dictated by disposal facility requirements. Decontamination water and water extracted from the pole barn sump will be containerized and stored onsite in 55-gallon drums. The containerized wastewater will be discharged through the GCTS, provided contaminant concentrations are demonstrated by appropriate lab analyses to be within required limits and pending NYSDEC Region 6 Division of Water approval, in accordance with the SPDES permit for the GCTS discharge. Should the GCTS disposal option not be practical, the wastewater will be disposed of at a Lockheed Martin-approved facility that is permitted to accept the waste.

3.0 LABORATORY ANALYTICAL PROGRAM

Sampling and analytical activities will be conducted in accordance with standard environmental sampling and analytical guidelines and protocols contained in the Quality Assurance Project Plan (QAPP) included in Appendix B.

Laboratory analyses will be performed by a laboratory accredited pursuant to the New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP). It is anticipated that the laboratory services will be provided by TestAmerica Laboratories, Inc. (TestAmerica) of Amherst, New York. Table 1 summarizes the proposed sampling and analysis for each medium. Soil will be analyzed for VOCs or PCBs as appropriate by EPA Methods 8260C and 8082, respectively. Analytical reports will be prepared in accordance with the NYSDEC Analytical Services Protocol (ASP) Category B requirements.

Soil analytical data will undergo a data usability evaluation and the results will be summarized in a Data Usability Summary Report (DUSR). The data usability evaluation will be performed in accordance with the NYSDEC's "Guidance for the Development of Data Usability Summary Reports," revised 1997 and DER-10.

4.0 INVESTIGATION DOCUMENTATION AND REPORTING

Detailed documentation of Site activities, observations, and data will be maintained during the field work. Reporting will include submission of a final written summary report to the NYSDEC. The report will be provided to the NYSDEC in both hard copy and electronic format.

4.1 FIELD DOCUMENTATION

Documentation of the field activities and environmental sampling will include the following (see Appendix A for detailed descriptions of the Quality Assurance Project Plan):

Field Notebook - Field personnel will maintain a bound field notebook which will document dates, times and duration of pertinent field occurrences. Notebook entries will be made on consecutive pages.

Project Photographs - Photographs will be taken of field activities.

Calibration Records - Calibration records for field instrumentation will be maintained in the field notebook.

Field Forms/Logs - Observations pertaining to Site geology and hydrogeology made during drilling and sampling will be recorded in test boring logs.

Safety Forms - Safety forms will be completed during all field activities and sampling events and the records will be maintained.

Chain-of-Custody Forms - Sample handling will be recorded on chain-of-custody forms with associated labels and custody seals.

4.2 REPORTING

Upon receipt and review of the full set of analytical data generated by the activities described in this Work Plan, an Initial Design Investigation Report will be prepared, documenting and summarizing the methods, field findings, lab results, and interpretations. The report will also provide conclusions and recommendations. The report contents will include narrative, figures, tables, and any additional appendix documentation necessary to summarize the findings of the field program. Analytical results will be summarized in both tabular and graphic form. The subsurface soil VOC results will be compared to NYSDEC's Part 375 POGW SCOs and the surface soil PCB results will be compared to the CU SCOs. The report will provide a discussion and graphic representation of the area(s) and depth of soil impacted at levels

above the applicable SCOs to facilitate the estimation of the volume of soil requiring excavation. Following completion of the report, a 30% Remedial Design package will be completed based on the investigation conclusions and recommendations.

An Electronic Data Deliverable (EDD) will be prepared in accordance with requirements of the NYSDEC Electronic Data Deliverable Manual (v.3, April 2013) and will be submitted to NYSDEC's Environmental Information Management System (EIMS). Where appropriate, the NYSDEC EDD will reflect DUSR-related modifications made to the reported data.

5.0 PROJECT SCHEDULE

Initiation of the activities proposed in this Work Plan will commence within approximately two weeks of receipt of NYSDEC's approval of this Work Plan, pending driller availability. A proposed task summary and the anticipated project schedule is presented in Table 3.

Tables

Table 1
Summary of Proposed Sampling Activities
Revised Work Plan for Excavation Initial Design Investigation
Former Lockheed Martin French Road Facility
Utica, New York

Location and Media	Number of Initial Investigation Locations[1]	Total Number of Samples	Analysis	
			TCL VOCs[2]	TCL PCBs[3]
Subsurface Soil				
Area 2	17	34	X	
Pole Barn	5	10	X	
Surface Soil				
SS-07	8	8		X
SS-20	8	8		X
SS-21	8	8		X

Notes:

[1] Proposed number of investigation locations (subsurface soil borings and surface soil sampling locations) is subject to change during the investigation program based on field observations. Variances to the Work Plan will be summarized in the Initial Design Investigation Report.

[2] TCL VOCs by USEPA Method 8260C

[3] TCL PCBs by USEPA Method 8082

Abbreviations:

PCBs - polychlorinated biphenyls

SS - surface soil

TCL - target compound list

VOCs - volatile organic compounds

Table 2
Summary of Proposed Quality Control Samples
Revised Work Plan for Excavation Initial Design Investigation
Former Lockheed Martin French Road Facility
Utica, New York

Analysis Parameters	USEPA Analysis Method	Estimated Number of Site Samples	QA/QC Samples				Total Number of Samples
			Field Duplicates[1]	MS/MSD[2]	Rinsate Blanks[3]	Trip Blanks[4]	
Subsurface Soil							
TCL VOCs	8260	44	3	6	2	0	55
Surface Soil							
TCL PCBs	8082	24	2	4	1	0	31
Sump Water/Groundwater							
TCL VOCs	8260	1	0	0	0	1	2

Notes:

[1] Field duplicates will be collected at a frequency of 1 per 20 samples for each sample medium.

[2] MS/MSDs will be collected at a frequency of 1 per 20 samples for each sample medium.

[3] One rinsate blank will be collected per mobilization for each sampling methodology using non-dedicated sampling equipment.

[4] One trip blank will be collected in each cooler containing aqueous samples to be analyzed for VOCs.

Abbreviations:

MS/MSD - matrix spike/matrix spike duplicate

PCBs - polychlorinated biphenyls

TCL - target compound list

VOCs - volatile organic compounds

Table 3
Estimated Project Schedule
Revised Work Plan for Excavation Initial Design Investigation
Former Lockheed Martin French Road Facility
Utica, New York

Task	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Prepare and Submit Draft Work Plan							
NYSDEC/NYSDOH Review of Draft Work Plan							
Prepare and Submit Revised Final Work Plan							
NYSDEC/NYSDOH Review/Approval of Revised Final Work Plan							
Survey							
Underground Utility Pre-Clearance							
Pole Barn Sump Inspection and Sampling							
Area 2 and Pole Barn Subsurface Sampling							
Surface Soil Sampling							
Laboratory Analysis							
Laboratory Data Validation and DUSR Preparation							
Prepare and Submit Draft Investigation Report							
NYSDEC/NYSDOH Review/Approval of Investigation Report							

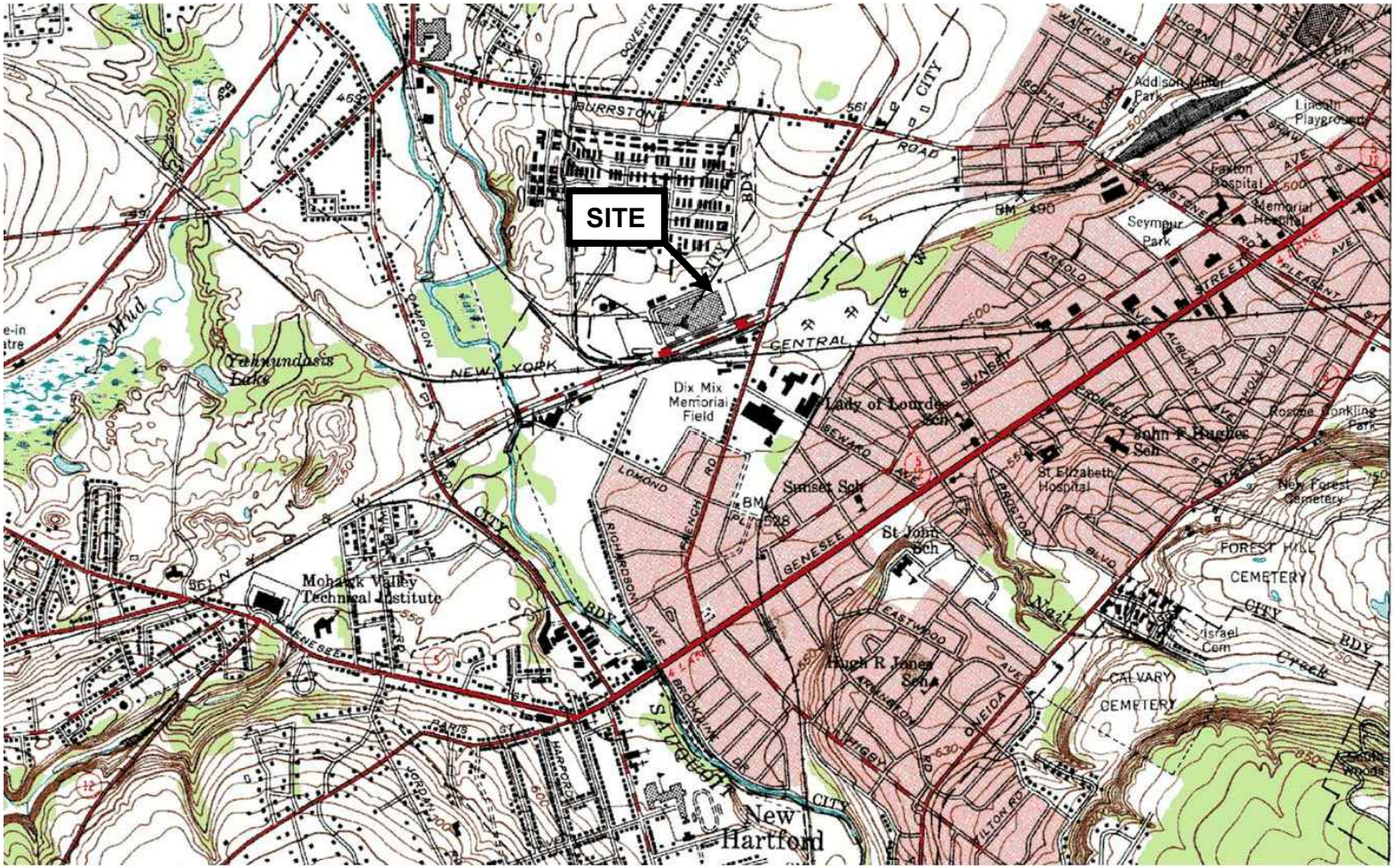
Dates estimated only, and subject to change

Lockheed Martin project task

NYSDEC/NYSDOH task

Figures

U:\190500800\07_photos_maps_images\DRAWINGS\Report Figures\8- Pre-Excavation Work Plan\Figure 1 Site Location Map.dwg LAYOUT: 1 SAVED: 11/2/2015 4:16 PM ACADVER: 2014 PAGESETUP: ---- PLOTSTYLETABLE: STANTEC - MONO.CTB PLOTTED: 11/2/2015 4:17 PM BY: LESS, ANDY



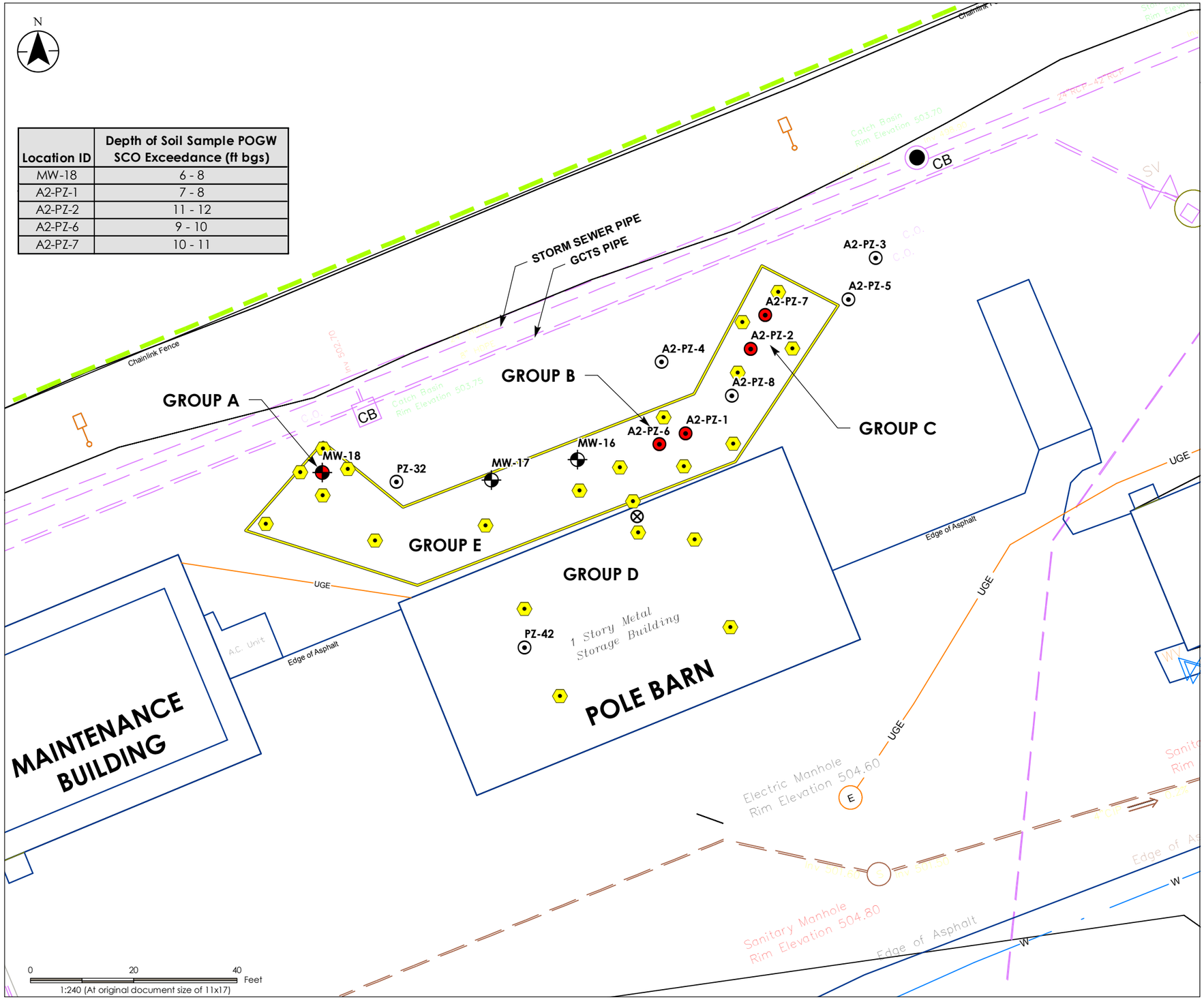
0 1000 2000
SCALE IN FEET

REVISED WORK PLAN FOR EXCAVATION
INITIAL DESIGN INVESTIGATION
FORMER LOCKHEED MARTIN, FRENCH ROAD FACILITY
UTICA, NEW YORK

SITE LOCATION MAP
NOVEMBER 2015

Stantec

Location ID	Depth of Soil Sample POGW SCO Exceedance (ft bgs)
MW-18	6 - 8
A2-PZ-1	7 - 8
A2-PZ-2	11 - 12
A2-PZ-6	9 - 10
A2-PZ-7	10 - 11



Stantec

Legend

- Proposed Initial Geoprobe Boring with M.I.P

Piezometers

- Locations with Soil POGW SCO Exceedances
- Locations without Soil POGW SCO Exceedances

Monitoring Wells

- Locations with Soil POGW SCO Exceedances
- Locations without Soil POGW SCO Exceedances
- Catch Basin (CB-3)
- Floor Sump Location
- Current Estimated Excavation Area Limits
- Property Boundary

Notes

1. Parcel boundaries taken from Sheet 2 of 8, Tax Map Overlay Former Lockheed Martin Facility Drawing, by Thew Associates, Dated 11/30/2007.
2. Utility and structural feature shapefiles from Topographic and Utility Survey (UK156-11-09 Utility Clearance.dwg), by Thew Associates, dated 11/30/2007.
3. Current estimated excavation area limits taken from NYSDEC's Final Statement of Basis (March 2015).
4. Feature locations and dimensions are approximate.
5. Coordinate System:
   NAD 1983 StatePlane New York Central FIPS 3102 Feet
6. POGW SCO = NYSDEC Part 375 Soil Cleanup Objectives for Protection of Groundwater.
7. M.I.P. = Membrane Interface Probe.

Project Location:
525 French Road
Utica, Oneida County, NY

Prepared by AL on 2015-08-11
1st Technical Review by BM on 2015-08-11
2nd Technical Review by PN on 2015-08-11

190500800

Client/Project
Revised Work Plan for Excavation Initial Design Investigation
Former Lockheed Martin French Road Facility
Utica, New York

Figure No.
2

Final Figure Date: 11/2/2015

Title
Proposed Area 2 and Pole Barn Investigation Locations

U:\190500800\07_photos_maps_images\DRAWINGS\Report Figures\8- Pre-Excavation Work Plan\Figure 2 - Proposed Area 2 and Pole Barn Investigation Locations_rev.mxd Revised: 2015-11-02 By: lbest

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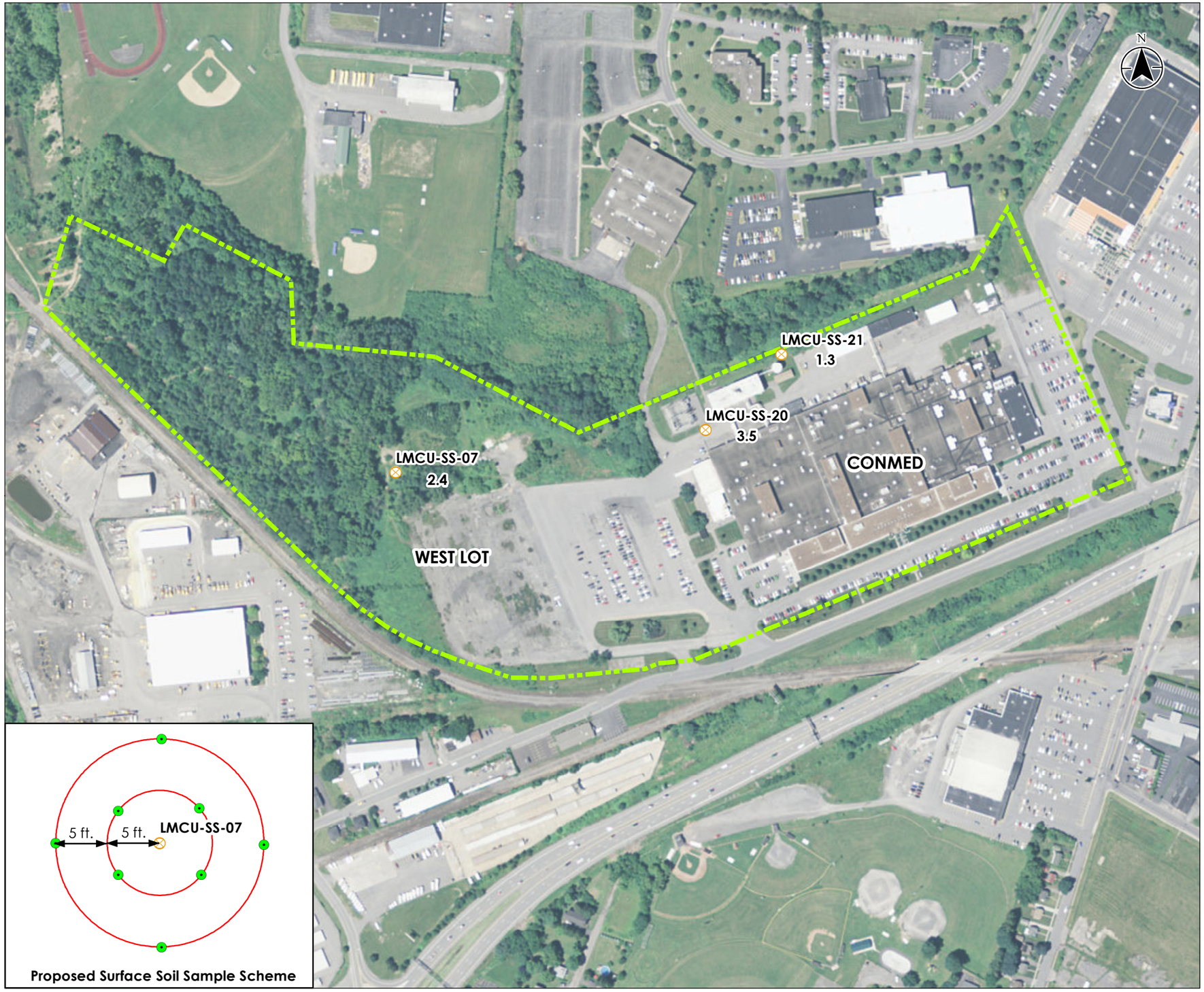

Stantec

Legend

- Surface Soil Sampling Location and PCB Concentration (October 2013)
- Property Boundary

0 300 600 Feet

1:3,600 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet
2. NYSDEC's Part 375 Commercial Use Soil Cleanup Objective for PCBs is 1 mg/kg.
3. Concentrations are provided in mg/kg.

Project Location:
525 French Road
Utica, Oneida County, NY

Prepared by AL on 2015-07-21
1st Technical Review by BM on 2015-07-21
2nd Technical Review by PN on 2015-07-21

190500800

Revised Work Plan for Excavation Initial Design Investigation
Former Lockheed Martin French Road Facility
Utica, New York

Figure No.
3

Title

Surface Soil PCB Exceedance Locations and Proposed Sampling Scheme

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U:\190500800\07_photos_maps_images\DRAWINGS\Report Figures\8- Pre-Excavation Work Plan\Figure 3 - Surface Soil PCB Exceedance Locations and Proposed Sampling Scheme.mxd Revised: 2015-11-02 By: lbest

Appendix A
Quality Assurance Project Plan

Stantec

Quality Assurance Project Plan
Solvent Dock Area
Former Lockheed Martin
French Road Facility
Utica, New York

Prepared for:
Lockheed Martin Corporation
Energy, Environment, Safety and Health
6801 Rockledge Drive
Bethesda, Maryland 20817

Prepared by:
Stantec Consulting Services Inc.
61 Commercial Street
Rochester, NY 14614

October 2015

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Appendix A – Laboratory Quality Management Plans and SOPs

1.0 PROJECT ORGANIZATION

1.1 PROJECT ORGANIZATION

Sampling detailed in documents for the Solvent Dock Area site ("the site") at the former Lockheed Martin Corporation French Road Facility in Utica, New York will require integrating personnel from the organizations identified below, collectively referred to as the "project team". These documents include, but are not limited to, the *Groundwater Collection and Treatment System Operation, Maintenance and Monitoring Manual* (ARCADIS, 2011a; updated by Stantec, 2014a), the *Sub-Slab Depressurization System Operation, Maintenance and Monitoring Plan* (ARCADIS, 2011b; updated by Stantec, 2014b), *Interim Groundwater Monitoring Program (ARCADIS, 2012)*, and the *Work Plan for Excavation Initial Design Investigation* (Stantec, 2015b). The responsibilities of each project-team member are described in detail below.

1.1.1 Overall Project Management

Stantec Consulting Services Inc. (Stantec) has overall responsibility for operation and maintenance (O&M) activities at the site on behalf of Lockheed Martin Corporation (Lockheed Martin), including routine and periodic sampling of environmental media. Stantec personnel will perform related sampling activities, evaluate data, and prepare the deliverables, as specified in the *Work Plan*. Lockheed Martin Corporation will direct the project, with oversight by the New York State Department of Environmental Conservation (NYSDEC). A list of key project management personnel is provided below.

Company/ Organization	Title	Name	Phone Number
NYSDEC	Project Manager	Sarah Saucier, P.E.	518-402-9662
Lockheed Martin	Project Manager	Charles Trione	301-548-2223
Stantec	Project Manager	Peter Nielsen, P.E.	585-413-5280
	Project Coordinator	Robert Mahoney, P.G.	585-413-5301
	Field Manager	Ben Haravitch	585-413-5326
	Quality Assurance Coordinator	Stephanie Reynolds-Smith	585-413-5272
TestAmerica Laboratories, Inc.	Project Manager	Ryan VanDette	716-504-9830

1.1.2 Task Managers

Representatives of the project team will direct staff performing the investigations and site activities. Personnel responsible for each site activity are listed below.

Company/ Organization	Title	Name	Phone Number
Stantec	Field Task Managers	Bob Mahoney- Ben Haravitch- Laura Best-	585-413-5301; 585-413-5301; 585-413-5327
	Survey Task Manager	Mike Grasso	585-413-5229
	Health and Safety Officer	Bob Mahoney	585-413-5301
	Database Administrator	Laura Best	585-413-5327
	Data Validator	Beth Crowley	303-618-1908

1.2 TEAM MEMBER RESPONSIBILITIES

Various team members' responsibilities are summarized below, by organization. Figure 1 provides a Project Organization Chart.

Lockheed Martin Corporation

Project Manager

- overall direction of site actions
- directing Stantec personnel
- reviewing Stantec work products, including data, memoranda, letters, reports, and all other documents transmitted to the NYSDEC

Stantec

Project Officer

- overseeing Stantec work products
- providing Stantec approval for major project deliverables

Project Manager

- managing and coordinating the project, as defined in the appropriate work plans, OMM, or required regulatory procedures, with an emphasis on adhering to the objectives of the site activities
- reviewing documents prepared by Stantec
- confirming that corrective actions are taken for deficiencies cited during any audits of site activities

Task Managers - Various task managers will supervise the deliverable as detailed in the appropriate work plans, OMM, and required regulatory procedures, as set forth in Section 1.1.2. Task Managers' duties include, as appropriate:

- managing relevant day-to-day activities
- developing, establishing, and maintaining files on relevant site activities
- reviewing data reductions from the relevant site activities
- performing final data review of field data reductions and reports on relevant site activities
- confirming that corrective actions are taken for deficiencies cited during audits of relevant site activities
- performing overall quality assurance/quality control (QA/QC) of the relevant portions of the site activities
- reviewing relevant field records and logs
- instructing personnel working on relevant site activities
- coordinating field and laboratory schedules pertaining to relevant site activities
- requesting sample bottles from the laboratory
- reviewing field instrumentation, maintenance, and calibration to meet quality objectives
- preparing reports pertaining to relevant site activities
- maintaining field and laboratory files of notebooks/logs, data reductions and calculations, and transmit originals to the project manager

Field Personnel

- performing field procedures associated with the final deliverable as set forth in the appropriate work plan
- performing field analyses and collecting QA samples
- calibrating, operating, and maintaining field equipment
- reducing field data
- maintaining sample custody
- preparing field records and logs

Quality Assurance Coordinator

- reviewing laboratory data packages
- overseeing and interfacing with the analytical laboratory

- coordinating field QA/QC procedures with task managers (including audits of field activities), concentrating on field analytical measurements and practices to meet data quality objectives (DQOs)
- reviewing field reports
- performing and reviewing audit reports
- preparing a QA/QC report in accordance with NYSDEC guidelines, including an evaluation of field and laboratory data and data-usability reports

Analytical Laboratories

Analytical laboratories' general responsibilities and duties include:

- sample analyses and associated laboratory QA/QC procedures
- supplying sampling containers and shipping cartons
- maintaining laboratory custody of sample
- strictly adhering to all protocols in this QAPP

Project Manager

- serving as the primary communication link between Stantec and laboratory technical staff
- monitoring workloads and confirming resource availability
- overseeing preparation of analytical reports
- supervising in-house chain-of-custody forms (COCs)

Quality Assurance Manager

- supervising personnel reviewing and inspecting all project-related laboratory activities
- conducting audits of all laboratory activities

New York State Department of Environmental Conservation

Project Manager

- providing NYSDEC with review and approval of the appropriate work plans, OMM, or required regulatory procedures supporting documents, and future deliverables
- monitoring progress of site activities

Quality Assurance Manager

- review and approval of this QAPP
- review of the QA/QC portion of any submitted report
- monitoring progress of the deliverable

- confirming that all activities are performed in compliance with applicable federal, state, and regional requirements
- performing field and laboratory audits, as necessary

2.0 PROJECT BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The site is located at 525 French Road in Utica, New York, and is currently occupied by the ConMed Corporation (ConMed). The site consists of a main manufacturing building, several outbuildings (maintenance building, boiler house, etc.), and parking lots, roadways, and landscaped areas.

2.2 SITE HISTORY AND SUMMARY OF ACTIVITIES

In the early 1950s, General Electric Company (GE) acquired approximately 55 acres of undeveloped land on French Road and constructed a 500,000-square-foot manufacturing facility. Figure 2 provides a Site Location Map. GE operations included manufacturing, assembly, and testing of electrical components for the defense and aerospace industries. GE operations continued until April 1993, when the facility was acquired by Martin Marietta Corporation (MMC). In March 1995, MMC merged with Lockheed Corporation to form Lockheed Martin Corporation. In March 1996, Lockheed Martin sold the property to Pinnacle Park, Inc., which subsequently transferred the property to and leased it back from the Oneida County Industrial Development Agency (OCIDA). ConMed, a medical supplies manufacturer and distributor, now occupies the facility under a lease with OCIDA. Lockheed Martin retains responsibility for environmental cleanup activities related to past releases at the Solvent Dock Area even though they no longer own the property.

Groundwater in the northeast portion of the main manufacturing building in an area known as the Solvent Dock and an area along the northern-perimeter ditch has been adversely affected by volatile organic compounds (VOCs). The Solvent Dock and immediate vicinity (referred to as the Solvent Dock Area) included a 275-gallon fiberglass overflow-retention tank. This tank was used to store spent waste solvents, which were periodically sampled, pumped from the tank, and disposed of by waste haulers. The tank was removed in June 1990, and was observed to be dented and leaking fluid. The northern-perimeter ditch (along the northern property boundary) was an open drainage swale, which received stormwater from the area north of the manufacturing building and conveyed the water, along with stormwater from the western portion of the property, to a manhole before eventually discharging to the municipal storm sewer.

Since 1991, GE, MMC, and Lockheed Martin have completed groundwater investigations in these areas. In November 1994, Blasland, Bouck, & Lee, Inc. (BBL) completed an investigation of the facility storm sewer in the Solvent Dock Area. The investigation determined that VOCs detected in the storm sewer were attributable to the discharge of VOC-contaminated groundwater into the northern-perimeter ditch and infiltration of VOC-contaminated groundwater from the Solvent Dock Area into the storm sewer beneath the building.

In May 1995, BBL completed a *Storm Sewer Investigation Report*, which recommended that the contaminated portion of the storm sewer flow be collected, treated, and discharged to meet proposed State Pollutant Discharge Elimination System (SPDES) VOC-effluent limitations. To address the source of VOCs entering the storm sewer, BBL evaluated remedial design alternatives that would remediate the contaminated groundwater (in accordance with NYSDEC recommendations). Results of this evaluation were presented in the *Storm Sewer Basis of Design Report* (BBL 1995).

Based on this report, BBL completed the final design of the *French Road Facility Ground-Water Collection and Treatment System* in October 1995. Construction of the system was completed in June 1996. The system collects groundwater from the Solvent Dock Area and the northern-perimeter ditch area, conveys the collected groundwater to a treatment building where VOCs are removed by a low-profile air stripper, and discharges the treated effluent to the municipal stormwater system. A hydraulic and chemical groundwater-monitoring program was developed to evaluate the effectiveness of the GCTS for the Solvent Dock Area. This program, as presented in the *Ground-Water Sampling and Analysis Work Plan* (BBL 1998), has been modified through monthly and quarterly correspondence with the NYSDEC to accommodate the changing conditions over the life of the project.

The FNPD was an open drainage swale that discharged stormwater to a municipal storm sewer. Stormwater in this area is now controlled by a below ground storm sewer. In response to observed groundwater contamination at the site (as described above), Lockheed Martin voluntarily installed and operated the GCTS and initiated an investigation of soil vapor and indoor-air quality. Beginning in 2007, Lockheed Martin and NYSDEC began developing an Order for the site, which became effective on October 3, 2008 (CO 6-20080321-5). The Order identified five areas of concern (AOC) and required further investigation and identification of corrective actions for each area. These investigations were completed in 2008, and the results are presented in a Corrective Measures Study, submitted to NYSDEC and NYSDOH on March 16, 2009 and conditionally approved by NYSDEC in their letter dated April 24, 2009. Recommended corrective measures included upgrades to the existing GCTS and SSDS. Upgrade designs for the GCTS and SSDS were completed and approved by NYSDEC/NYSDOH in 2010. Installation of the designed upgrades was completed in the spring of 2011 and the upgraded GCTS and SSDS are fully operational.

In response to NYSDEC/NYSDOH's review of the 2009 Corrective Measures Study, a number of supplemental investigations were completed at the Solvent Dock Area, principally at the Former Northern Perimeter Ditch (FNPD). The FNPD was an open drainage swale that discharged stormwater to a municipal storm sewer. Stormwater in this area is now controlled by a below ground storm sewer. Supplemental investigations included a 2012 pilot test to evaluate the application of *in situ* bioremediation as a means to remediate groundwater impacts at the FNPD. However, due to limited success in delivery of amendment in the site's silty soil as demonstrated during the pilot test, full scale installation was determined infeasible. As directed by NYSDEC, a Corrective Measure Study specific to the FNPD was prepared in 2013. On March 31, 2015, NYSDEC/NYSDOH

issued a final Statement of Basis requiring that impacted soil be removed from the FNPD and from three surface soil locations present at other areas of the facility, one of which is located in the West Lot. Stantec on behalf of Lockheed Martin Corporation has prepared a Work Plan in conjunction with this QAPP update to further delineate soil impacts requiring excavation before proceeding with the design and excavation of contaminated soil.

3.0 PROJECT DESCRIPTION

This section presents a general description of the activities to be conducted in accordance with this QAPP. Sampling activities will include:

- GCTS monitoring activities (SPDES permit sampling, stormwater sampling)
- Periodic groundwater sampling
- Periodic soil vapor and indoor air sampling
- SSDS-performance sampling (influent and effluent soil vapor sampling)
- Site investigation sampling (non-routine soil, groundwater and soil vapor sampling)

Sampling protocols are detailed in this QAPP, as well as protocols set forth in the *Interim Groundwater Monitoring Program*, *Groundwater Collection and Treatment System Operation, Maintenance and Monitoring Manual* (GCTS OM&M), *Sub-Slab Depressurization System Operation, Maintenance, and Monitoring Plan* (SSDS OM&M Plan), and other site-related investigative work plans. Samples collected during the above activities will be analyzed in accordance with the methods and protocols described in these plans and defined within this QAPP. Table 1 lists the constituents that will be analyzed for in the samples collected. A brief description of each task's objectives is presented below. More detailed descriptions appear in the associated plans, manuals and work plans.

3.1 GCTS MONITORING ACTIVITIES

The objective of GCTS monitoring is to collect and analyze treated groundwater and stormwater samples from the site to confirm the effectiveness of this corrective action and to comply with the existing SPDES permit.

3.2 PERIODIC GROUNDWATER SAMPLING

The objective of periodic groundwater sampling (associated with the *Interim Groundwater Monitoring Program*) is to collect and analyze groundwater samples to evaluate VOC concentrations at the site.

3.3 PERIODIC SOIL VAPOR AND INDOOR AIR SAMPLING

The objective of periodic soil-gas and indoor-air sampling is to collect and analyze sub-slab soil-vapor and indoor-air samples to quantify VOC concentrations at the site.

3.4 SSDS PERFORMANCE SAMPLING

The objective of SSDS-performance sampling is to collect and analyze influent soil-vapor and treated effluent vapor for the presence of VOC contaminants, as part of system-performance evaluations.

3.5 SITE INVESTIGATION SAMPLING

The objective of non-routine soil, groundwater and soil vapor sampling will generally be to collect and analyze media for VOCs, as part of further definition and evaluation of site impacts.

3.6 PROJECT APPROACH

Turnaround time for analytical results will vary based on the need for analytical data and the status of sampling activities. All samples collected will be analyzed in accordance with the methods presented in this QAPP.

3.7 PROJECT SCHEDULE

The project is ongoing, and routine sampling activities are scheduled monthly, quarterly, semi-annually, or annually. Specific sampling schedules can be found in the associated plans and manuals.

4.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The DQO process, as described in the USEPA *QA/G-5 QAPP* instructions document (USEPA, 2002b), provides a "logical framework" for planning field investigations. The following section addresses, in turn, each of the seven sequential steps in the USEPA QA/G-5 QAPP DQO process.

Step 1: State the Problem: Sampling activities will be conducted at the site to evaluate, investigate and confirm the presence or absence of VOCs in groundwater, stormwater and soil vapor.

Step 2: Identify the Goal of the Study: The initial use of the data is descriptive (distribution and concentration); no decision point is associated with this descriptive application. Subsequent to review of the descriptive information, an exposure evaluation will be performed based on the findings of the site investigation. The decision in this case is to determine the potential presence and significance of complete exposure pathways based on the distribution and concentrations of constituents of concern present at the site.

Step 3: Identify Information Inputs: Decision inputs incorporate both concentration and distribution of constituents of concern in site media. A fundamental basis for decision-making is that a sufficient number of data points of acceptable quality must be available from the investigation to support the decision. Thus, the necessary inputs for the decision are: 1) the proportion of non-rejected (usable) data points and 2) the quantity of data needed to evaluate whether regulatory unacceptable risks to human health and the environment exist at the site. The data will be evaluated for completeness, consistency among data sets, and general conformance with requirements of this QAPP and with historical data, as appropriate.

Step 4: Define the Study Boundaries: The site includes the area within the former Lockheed Martin facility in Utica, New York exhibiting groundwater that has been adversely affected by VOCs. This is primarily in the northeast portion of the main manufacturing building, in an area known as the Solvent Dock, and an area along the former northern perimeter ditch.

Step 5: Develop the Analytical Approach: Samples will typically be analyzed for the constituents of concern (COC) identified from the assessment of site history and previous sampling analytical results. VOCs are the primary site COC. Validation of the analytical results will determine whether data can be used for the project. Following validation, the data will be flagged, as appropriate, and any use restrictions noted.

Step 6: Specify Performance or Acceptance Criteria: Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability and 2) understanding the representative nature of the sampling design. This QAPP is designed to meet both specifications for this step. The sampling and analysis program has been developed based on a review of previous site data and knowledge of present site conditions. The laboratory detection-levels and planned data-quality reviews presented within the QAPP have been

determined appropriate and adequate for the project. Corrective actions are described elsewhere in this QAPP and in the appended documents. The representative nature of the sampling design has been determined by discussions among professionals familiar with the site and with the appropriate government agencies.

Step 7: Develop the Plan for Obtaining Data: The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody forms, laboratory analysis, and reporting that will provide results to support the evaluation of site data consistent with USEPA *National Contingency Plan* requirements. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, data reporting, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. Work plans and required regulatory procedures involve a phased approach to both sampling and analysis. This provides the opportunity to evaluate and focus each data collection step to optimize overall data collection. A DQO summary for the sampling investigation is presented in the subsequent section. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

4.1 DATA CATEGORIES

Three data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality:

- *Screening Data*— Screening data affords a quick assessment of site characteristics or conditions. This DQO applies to data collection involving rapid, non-rigorous analytical methods and QA. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.
- *Screening Data with Definitive Confirmation*— Screening data allows rapid identification and quantitation, although the quantitation can be relatively imprecise. This DQO is available for data collection requiring qualitative and/or quantitative verification of a select portion of sample findings (10 percent or more). This objective can also be used to verify less rigorous laboratory-based methods.
- *Definitive Data*— Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

For this project, three levels of data reporting have been defined:

- *Level 1: Minimal Reporting*— Minimal or "results only" reporting is used for analyses that, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

- *Level 2: Modified Reporting*— Modified reporting is used for analyses performed according to standard USEPA-approved methods and QA/QC protocols and that, based on the intended data use, require some supporting documentation but not full "Contract Laboratory Program" (CLP) reporting.
- *Level 3: Full Reporting*— Full CLP reporting is used for analyses that, based on intended data use, require full documentation. This reporting level would include Analytical Services Protocol (ASP) Superfund and Category B reporting.

The analytical methods to be implemented, as described in the appropriate work plans, OMM, or required regulatory procedures, will be USEPA SW-846 Methods and USEPA *Compendium of Methods for the Determination of Volatile Organic Compounds in Ambient Air*. Volatile organic compounds in water will be analyzed in accordance with NYSDEC ASP Revision 2005, QA/QC requirement, and Category B reporting deliverables.

4.2 FIELD INVESTIGATIONS

Field sampling will be conducted to support the DQOs. Details of field sampling investigations are described in the appropriate work plans, OM&M manuals, or required regulatory procedures.

5.0 HEALTH AND SAFETY

Health and safety protocols to be followed by field personnel during investigation activities are discussed in the *Site-Specific Health and Safety Plan* (Stantec, 2015a).

In compliance with the Occupational Safety and Health Administration's (OSHA) final rule *Hazardous Waste Operations and Emergency Response*, 29 *Code of Federal Regulations* 1910.120(e), all personnel working at the site will have completed the requirements for OSHA 40-Hour Hazardous Waste Operations and Emergency Response training. Field supervisors will have also completed the additional OSHA 8-Hour Supervisory Training.

6.0 DOCUMENTATION AND RECORDS

6.1 INTRODUCTION

Samples of environmental media will be collected as described in the appropriate work plans, OMM, or required regulatory procedures. Detailed descriptions of the documentation and reporting requirements are presented below.

6.2 SAMPLE DESIGNATION SYSTEM

6.2.1 Sample Codes

During sampling, samples will be identified with a unique designation system that will facilitate sample tracking. The sample-designation system will be consistent, yet flexible enough to accommodate unforeseen events and conditions. Sample names will typically start with the following letter codes:

- Test Boring Soil – "GP" (Geoprobe) or "SB" (Soil Boring)
- Surface Soil – "SuS"
- Groundwater - "MW" (Monitoring Well)
- Soil Vapor - "SV"
- Sub-slab Vapor – "SS"
- Indoor Air - "IA"
- SSDS Sump - "SDS"
- Catch Basin - "CB"
- Trip Blank -"TB"
- Equipment Blank -"EB"

Additional codes may be used pending the location and type of sample collected, such as "MS/MSD" (Matrix Spike/Matrix Spike Duplicate) "FD" (Field Duplicate). Where appropriate, the code system can be supplemented to accommodate additional sample identification information. For example, the code for test boring soil sample would include a qualifier to identify the depth increment (e.g., 0–0.5 feet).

Additional sample volumes collected for matrix spike (MS) and matrix-spike duplicate (MSD) analysis will be noted on the COCs, and the associated additional sample containers will be labeled with the appropriate suffix (MS or MSD). Rinse blanks will use the same coding scheme described above, substituting the location code with the prefix "RB" (e.g., the first rinse blank associated with backfill collection would be named RB-BF-01). Field duplicates will be labeled as ordinary field samples with a unique identification number (e.g., the first field duplicate associated with confirmation sample collection would be named DUP-01). Duplicate samples will not be identified and the laboratory will analyze them as "blind" QC samples.

6.2.2 Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record that allows reconstruction of all field events to aid in data review and interpretation. All documents, records, and information relating to fieldwork will be retained in the project file. The various forms of documentation to be maintained throughout the action include:

- *Daily Production Documentation*— A field notebook consisting of a waterproof, bound notebook that will contain a record of all site activities.
- *Sampling* — Detailed notes on customized log forms regarding sampling location, physical observations, and weather conditions, methodology, equipment, etc.
- *Sample COCs*— Chain-of-custody forms record the party(ies) responsible for sample collection, transport, and submittal to the laboratory. COCs will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by Stantec field personnel designated responsible for sample custody. If the designated sampling person relinquishes the samples to other sampling or field personnel, the chain-of-custody form will be signed and dated by the appropriate personnel to document the sample transfer. The original chain-of-custody form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample chain-of-custody form is included in Appendix A. Individuals will be deemed as having custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.
- *Field Equipment, Calibration, and Maintenance Logs*— To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

6.3 LABORATORY DOCUMENTATION FILES

6.3.1 Laboratory Project Files

The laboratory will establish a file for all pertinent data. The file will include all correspondence, faxed information, phone logs, and COCs. The laboratory will retain all project files and data packages for a period of five years.

6.3.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated QC steps. As such, logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent laboratory record. Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in

entry will be crossed out in indelible ink with a single stroke, corrected without the use of White-out® or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Unused logbook pages will be completed by lining out unused portions. Information on the sample, analytical procedures performed, and results of testing will be recorded by the analyst on laboratory forms or personal notebook pages. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory group leaders will periodically review laboratory notebooks for accuracy, completeness, and compliance with this QAPP. The laboratory group leader will verify all entries and calculations. If all entries are correct, then the laboratory group leader will initial and date the pages. Corrective action for incorrect entries will be taken before the laboratory group leader signs.

6.3.3 Computer Tape and Hard-Copy Storage

All electronic files and deliverables will be retained by the laboratory for not less than five years; hard-copy data packages (or electronic copies) will also be retained for not less than five years.

6.4 DATA REPORTING REQUIREMENTS

Data will be reported both in the field and by the analytical laboratory, as described below.

6.4.1 Field Data Reporting

Visual observations, manual measurements, and/or instrumentation in the field will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate task manager for adherence to the appropriate work plans, OMM, or required regulatory procedures for consistency. Concerns identified through this review will be discussed with field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation. If applicable, field data forms and calculations will be processed and included in appendices to the appropriate reports. The original field logs, documents, and data reductions will be kept in the project file at the Stantec office in Rochester, New York.

6.4.2 Laboratory Data Reporting

The laboratory is responsible for preparing ASP Category B data packages for all data packages and case narratives for all other analyses. All data reports for all parameters will include, at a minimum:

Narrative - Summary of sample analysis activities, including:

- laboratory name and address
- date of sample receipt
- cross-reference of laboratory identification number to contractor sample-identification

- analytical methods used
- deviations from specified protocol
- corrective actions taken

Included with the narrative will be any sample-handling documents, including field and internal COCs, air bills, and shipping tags.

Analytical Result - Reported according to analysis type, including the following, as acceptable:

- sample ID
- laboratory ID
- date of collection
- date of receipt
- date of extraction
- date of analysis
- detection limits

Sample results on the report forms will be collected for dilutions. Unless otherwise specified, results will be reported uncorrected for blank contamination.

Data for VOCs and TO-15 analyses will be expanded to include all supporting documentation necessary to provide a Category B package, with the exception of SPDES-related analysis. This additional documentation will include, but is not limited to, all raw data required to recalculate any result, including printouts, chromatograms, and quantitation reports. The report will also include standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

6.5 PROJECT DOCUMENTS

Project documentation will be placed in electronic project files according to Stantec file-retention protocols and Lockheed Martin requirements.

Final reports (including QAPPs and QA reports) are filed in a designated folder within the project files. These files will also be uploaded to an online SharePoint site accessible to project team members. Analytical laboratory documentation (when received) and field data will also be filed in a designated folder within the project file.

6.6 SAMPLING PROCESS DESIGN

Information regarding the sampling design and rationale and associated sampling locations can be found in the appropriate work plan, OMM, or required regulatory procedures.

7.0 SAMPLING METHOD REQUIREMENTS

Soil and sediment samples will be collected as described in the appropriate work plan, OMM, or required regulatory procedures. All required plans will also contain procedures to be followed to decontaminate and clean sampling equipment and to handle, package, and ship collected samples.

7.1 SAMPLE CONTAINERS AND PRESERVATION

Appropriate sample containers, preservation methods, and laboratory holding times are provided in the appropriate work plan, OM&M manual, or required regulatory procedures. Sampling descriptions are included in Table 2. The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned according to the USEPA Office of Solid Waste and Emergency Response Directive 9240.05A requirements. Field personnel will be responsible for properly labeling containers and preserving samples (as appropriate). Sample labeling procedures are discussed in Section 9.2.2.

7.2 FIELD CUSTODY PROCEDURES

The objective of these field-sample custody-procedures is to confirm that samples are not tampered with from the time of sample collection through transport to the analytical laboratory. Individuals will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel. Field custody documentation consists of both field logbooks and field chain-of-custody forms.

7.2.1 Field Logbooks

Field logbooks will provide the means to record the data-collection activities performed. Entries will provide as much detail as possible so that future site visitors can reconstruct a particular situation without reliance on memory. Field logbooks will be bound field-survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- project name and file number
- book data start and end dates
- end date

Logbook entries will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the station location shall be recorded. The number of photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, as well as the date of calibration.

Samples will be collected following the procedures documented in the appropriate work plan, OMMs, or required regulatory procedures. The equipment used to collect samples will be noted, as well as the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample-identification numbers will be assigned before sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

7.2.2 Sample Labeling

Preprinted sample labels will be affixed to sample bottles before delivery to the sampling site. Each sample label must have the following information:

- project
- date collected
- time collected
- location
- sampler
- analysis to be performed
- preservative
- sample number

7.2.3 Field Chain-of-Custody Forms

Completed chain-of-custody forms will be required for all samples to be analyzed. COCs will be initiated by the sampling crew in the field and filled out as samples are collected. The COCs will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original COCs will accompany the samples to the laboratory. Copies of the COCs will be made before shipment (or multiple-copy forms used) for field documentation. The COCs will remain with the samples at all times. The samples and signed COCs will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., FedEx) or hand delivered to a mobile or permanent laboratory or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink. The labels will include sample information, such as sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be

performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate chain-of-custody form will be prepared for those samples and marked to indicate with whom the samples are being split. The individual relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this shall be noted in the "Received By" space. All split-sample data are intended to be managed by the third party and will not be under the requirements of this QAPP.

7.3 MANAGEMENT OF INVESTIGATION-DERIVED MATERIALS AND WASTES

Management of investigation-derived materials and wastes will be performed consistent with the USEPA guidance *Guide to Management of Investigation-Derived Wastes,* 9345.3-03FS, January 1992. Disposable equipment (including personal protective equipment) and debris will be containerized and appropriately labeled during sampling events and disposed of accordingly. Equipment will be decontaminated, as appropriate, as discussed in the appropriate work plan, OMMs, or required regulatory procedures.

7.4 PACKING, HANDLING, AND SHIPPING REQUIREMENTS

Sample packaging and shipment procedures are designed to confirm that the samples and their COCs will arrive at the laboratory intact. Samples will be packaged for shipment as outlined below:

- Confirm that sample containers have the sample labels securely affixed to the container with clear packing tape.
- Check the caps on the sample containers to confirm that they are properly sealed.
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- At time of collection, complete the COCs with the required sampling information and confirm that the recorded information matches the sample labels. ***Note*:** If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COCs before this transfer. The appropriate personnel will sign and date the COCs to document the sample-custody transfer.
- Using duct tape, secure the outside drain-plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1–2 inches of cushioning material in the bottom of the cooler.
- Place the sealed sample containers into the cooler. A final cross-check of sample containers and the COCs will be completed at this time.
- Place ice in plastic bags and seal. Place loosely in the cooler.

- Fill the remaining space in the cooler with cushioning material.
- Place COCs in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock, and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating "this side up." Cover the labels with clear plastic tape. Place a signed custody seal over the sample cooler lid.

For air samples, each sample will be packaged for shipment as outlined below:

- Confirm that the brass plug is installed and snug on the canister.
- Package the canister and flow controller in the shipping container supplied by the laboratory. The canister does not require preservation with ice or refrigeration.
- Complete the appropriate forms and sample labels as required by the laboratory (i.e., affix card with a string).
- Complete the COCs and place the requisite copies in the shipping container. Close the shipping container and affix a custody seal to the container closure.

Samples will be hand delivered or delivered by an express carrier within 48 hours of the time of collection. Shipments will be accompanied by the COCs identifying the contents. The original chain-of-custody form will accompany the shipment and the sampler will retain copies for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COCs as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

The analytical laboratory will provide sample-custody seals and packing materials for filled sample containers. The filled, labeled, and sealed containers will be placed on ice in a cooler and carefully packed to eliminate the possibility of container breakage. All samples will be properly chilled in accordance with the laboratory-specific SOP (Appendix A). Additional procedures for packing, handling, and shipping environmental samples are presented in the *Field Sampling Plan* (FSP).

7.5 LABORATORY CUSTODY PROCEDURES

7.5.1 General

Laboratory personnel will be responsible for sample custody upon sample receipt. The original field COCs will accompany all samples requiring laboratory analysis. The laboratory will use chain-of-custody guidelines described in USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All

laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

7.5.2 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample-custodian will verify the cooler seal, open the cooler, and compare the contents against the field COCs. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, Stantec will be notified immediately. The laboratory sample-custodian will be responsible for logging in the samples, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location, and date and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

7.5.3 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory COCs when removing samples from storage. The laboratory will organize samples into sample-delivery groups (SDGs). An SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of seven calendar days and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific MS/MSD pair, which shall be received by the laboratory at the start of the SDG assignment.

7.5.4 Sample Storage Following Analysis

The laboratory will maintain samples for at least one month after the final report is delivered to Stantec. The laboratory will be responsible for the eventual and appropriate disposal of the samples. The analytical laboratory will inform Stantec before any samples are disposed of. Unused portions of the samples, sample extracts, and associated wastes will be disposed of by the laboratory in accordance with applicable rules and regulations as specified in their SOP for waste disposal (included in Appendix A).

8.0 ANALYTICAL-METHOD REQUIREMENTS

8.1 FIELD PARAMETERS AND METHODS

Any specific field-measurement protocols are provided in the appropriate work plan, OMM, or required regulatory procedures.

8.2 LABORATORY PARAMETERS AND METHODS

The methods listed below include the range of analyses likely to be performed. The associated laboratory SOPs can be found in Appendix A. Laboratory analytical requirements presented in the subsections below include a general summary of requirements, specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. SW-846 methods with NYSDEC ASP 2005 Revision, QA/QC, and reporting deliverables requirements will be used for all analytes.

8.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 2	Sample Containers, Preservation Methods, and Holding Time Requirements
Table 3	Environmental and Quality-Control Analyses
Tables 4a-4c	Parameters, Methods, and Target Reporting-Limits (water, soil, air)

8.2.2 Supplemental Remedial Design Sample Matrices

This QAPP covers the soil, groundwater, treated groundwater, stormwater, soil and sub-slab vapor, indoor and outdoor (ambient) air, and treated system effluent vapor, to be completed for the final deliverable. Analyses will be performed following the methods listed in Table 3. Results will typically be reported in milligrams per kilogram (mg/kg) for soil, micrograms per liter (µg/L) for water, and micrograms per cubic meter (µg/m^3) for vapor, as presented in Tables 4a through 4c.

8.2.3 Analytical Requirements

The primary sources describing the analytical methods to be used during the investigation are provided in USEPA *Methods for Chemical Analysis of Water and Waste* and USEPA *Compendium of Methods for the Determination of Organic Compounds in Ambient Air* with NYSDEC ASP 2005 Revision, QA/QC, and reporting deliverables requirements.

9.0 QUALITY CONTROL REQUIREMENTS

9.1 QUALITY ASSURANCE INDICATORS

The overall QA objective for this QAPP is to develop and implement procedures for sampling, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action, such that valid data will be generated. These procedures are presented or referenced in the following sections of this QAPP. Specific QC checks are discussed in Section 11.2. QA indicators are generally defined in terms of five parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP, as referenced below.

9.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and depends on sampling and analytical variability and the variability of environmental media at the site. Field activities have been designed to assess the presence of the chemical constituents at the time of sampling. The appropriate work plans, OMM, and required regulatory procedures present the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. Using the prescribed field and laboratory analytical methods in concert with the associated holding times and preservation requirements is intended to ensure representative data.

9.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between this investigation, and to the extent possible, with existing data will be maintained through consistent sampling and analytical methodology as set forth in the appropriate work plans, OMM, and required regulatory procedures, as well as this QAPP, SW-846, and USEPA *Compendium Organic Compounds in Ambient Air* analytical methods with NYSDEC ASP Revision 2005, QA/QC requirements, Category B reporting deliverables, and through the use of QA/QC procedures and appropriately-trained personnel.

9.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 9.6.

9.1.4 Precision

Precision is the measure of reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the project objectives. Sampling and analytical procedures will be followed to maximize precision. All work for this investigation will adhere to established protocols presented in the appropriate work plans, OMM. Required regulatory procedures-checks for analytical precision will include analysis of MSDs, laboratory duplicates, and field duplicates. Checks for field-measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Section 9.4.

9.1.5 Accuracy

Accuracy is the deviation of a measurement from the true value of a known standard. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MSs, blank spikes, and surrogates (system-monitoring compounds) will be used to assess the accuracy of the laboratory analytical data. Further discussion of these QC samples is provided in Section 9.5.

9.2 FIELD QUALITY CONTROL CHECKS

9.2.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and periodically reported for field measurements. A duplicate measurement will involve obtaining measurements a second time at the same sampling location. Duplicate measurements will be collected at least once per day during a sampling event.

9.2.2 Sample Containers

Certified, clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2005 will be supplied by the laboratory.

9.2.3 Field Duplicates

Field duplicates will be collected from the different site materials to verify the reproducibility of the sampling methods. Field duplicates will be prepared by placing well homogenized aliquots (except samples for VOC analysis) from the same sampling location into individual sample containers, which are submitted blind to the laboratory. Field-duplicate water samples and soil samples for VOC analysis will constitute collocated samples rather than homogenized aliquots. In general, field duplicates will be analyzed at a 5 percent frequency (every 20 samples) for the chemical constituents. Table 3 provides

an estimated number of field duplicates to be prepared for each applicable parameter and matrix.

9.2.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis once per mobilization for each sampling method using non-dedicated equipment. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) that has been routed through a cleaned sampling device. When dedicated sampling devices or sample containers are used to collect the samples, rinse blanks will not be necessary. Table 3 estimates the number of rinse blanks for environmental media samples to be collected.

9.2.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during storage and transport. Trip blanks will be analyzed at a frequency of once per day per cooler containing aqueous samples to be analyzed for VOCs. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory) that will remain unopened by the field sampling team and accompany the field samples throughout the sampling event. Trip blanks will only be analyzed for VOCs. Table 3 estimates the number of trip blanks to be collected for each matrix and parameter.

9.3 ANALYTICAL LABORATORY QUALITY CONTROL CHECKS

9.3.1 General

Internal laboratory QC-checks will be used to monitor data integrity. These checks will include method blanks, MS/MSDs, spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Project QC limits for duplicates and MSs are identified in Table 1. Laboratory control charts will be used to determine long-term instrument trends.

9.3.2 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. A method blank is useful in identifying possible sources of contamination within the analytical process. The method blank must be initiated at the beginning of the analytical process and encompass all aspects of the analysis. The method blank helps account for any potential contamination attributable to glassware, reagents, instrumentation, or other sources that could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

9.3.3 Matrix Spike/Matrix Spike Duplicates

MS/MSDs will be site-specific and used to measure the accuracy of analyte recovery from the sample matrices. MS/MSD pairs will be analyzed at a 5 percent frequency (every 20 samples or once every week, whichever comes first). When MS recoveries are outside QC limits, associated control samples and surrogate-spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine its effect on the reported sample results. Table 3 estimates the number of MS and MSD analyses to be performed for each applicable parameter.

9.3.4 Surrogate Spikes

Surrogates are compounds unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) methods, and is added to the samples before purging or extraction. The surrogate spike is used to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to the sample matrix.

If surrogate-spike recoveries exceed specified QC limits, the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and re-analysis of the samples with additional control may be necessary. Surrogate-spike compounds will be selected using the guidance provided in the analytical methods.

9.3.5 Laboratory Duplicates

For inorganics, laboratory duplicates will be analyzed to assess laboratory precision. Laboratory duplicates are defined as a separate aliquot of an individual sample that is analyzed as a separate sample. Table 1 identifies the precision objectives for laboratory duplicate air analyses.

9.3.6 Calibration Standards

Calibration-check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration-check standard will be analyzed at the beginning and end of an analytical series or periodically throughout a series containing a large number of samples. In general, calibration-check standards will be analyzed after every 12 hours, or more frequently, as specified in the applicable analytical method. In analyses where internal standards are used, a calibration-check standard will only be analyzed in the beginning of an analytical series. If results of the calibration-check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be re-analyzed. Laboratory-instrument calibration-standards will be selected using the guidance provided in the analytical methods, as summarized in Section 11.2.

9.3.7 Internal Standards

Internal-standard areas and retention times will be monitored for organic analyses performed by GC/MS methods. Method-specified internal-standard-compounds will be spiked into all field samples, calibration standards, and QC samples after preparation and before analysis. If internal-standard areas in one or more samples exceed the specified tolerances, the cause will be investigated, the instrument will be recalibrated, if necessary, and all affected samples will be re-analyzed. Acceptability of internal-standard performance will be determined using the guidance provided in the analytical methods.

9.3.8 Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from the calibration standards. The intent of reference-standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes preparation of calibration standards, validity of calibration, sample preparation, instrument setup, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

9.4 DATA PRECISION ASSESSMENT PROCEDURES

Field precision is difficult to measure because of temporal variations in field parameters. Precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis. Laboratory data precision for organic analyses will be monitored through the use of MS/MSD and laboratory duplicates as identified in Table 1.

Data precision will be measured by calculating the relative percent-difference (RPD) by the following equation:

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

Where:

A = analytical result from one of two duplicate measurements

B = analytical result from the second measurement

9.5 DATA ACCURACY ASSESSMENT PROCEDURES

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs. Laboratory accuracy will be assessed via the use of MSs, surrogate spikes, internal standards, and reference standards. Where available and appropriate, QA performance standards will

be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\text{Percent Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = value measured in spiked sample or standard

X = value measured in original sample

B = true value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy over the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for MS recoveries and surrogate recovery objectives are identified in the NYSDEC ASP 2005 Revision and contained in Table 1.

9.6 DATA COMPLETENESS ASSESSMENT PROCEDURES

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

10.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

10.1 INTRODUCTION

Testing and maintenance schedules have been developed for both field and laboratory instruments. A summary of testing and maintenance to be performed is presented below.

10.2 FIELD INSTRUMENTS AND EQUIPMENT

Each piece of field equipment will be inspected before field sampling to confirm that it is operational. If the equipment is not operational, it will be serviced before its use. All equipment will be fully charged and/or have fresh batteries, as appropriate. If instrument service is required, the appropriate task manager or field worker is responsible for following the maintenance schedule and arranging for timely service. Field instruments will be maintained according to their respective manufacturer's instructions.

10.2.1 Equipment Maintenance

All measuring and test equipment to be used in support of Site activities that directly affects the quality of the analytical data shall be subject to preventive maintenance measures that minimize equipment downtime. Equipment will be examined to certify that it is in operating condition, including checking the manufacturer's operating manual to confirm that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to confirm that any earlier equipment problems have not been overlooked and that any necessary repairs to equipment have been carried out.

Field equipment returned from a site will be inspected to confirm that it is in working order. The inspection will be recorded in the logbook or field notebooks, as appropriate. The last user is obligated to record any equipment problems in the logbook. Non-operational field equipment will either be repaired or replaced. Appropriate spare parts will be made available for field meters. Maintenance of consultant- or subcontractor-owned or leased equipment shall be in accordance with the manufacturer's instructions, and all maintenance records shall be requested from the equipment owner/leasing company and reviewed before mobilizing any equipment to the site. No equipment shall be allowed on site if proper maintenance for that piece of equipment has not been performed and recorded.

10.3 LABORATORY INSTRUMENTS AND EQUIPMENT

10.3.1 General

Laboratory-instrument and equipment-documentation procedures include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (including information regarding the repair and the individual who performed the repair). Preventive maintenance of laboratory equipment generally will follow the guidelines

recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

10.3.2 Instrument Maintenance

Maintenance schedules for laboratory equipment adhere to the manufacturer's recommendations. Records reflect the complete history of each instrument and specify the timeframe for future maintenance. Major repairs or maintenance procedures are performed through service contracts with manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory-systems managers are responsible for routine maintenance of instruments used in a particular laboratory. Any routine preventive maintenance performed is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the laboratory-systems manager. All major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

10.3.3 Equipment Monitoring

The operation of balances, incubators, ovens, refrigerators, and water purification systems will be checked and documented daily. Any discrepancies will be immediately reported to the appropriate laboratory personnel for resolution.

11.0 INSTRUMENT CALIBRATION AND FREQUENCY

11.1 FIELD INSTRUMENTS AND EQUIPMENT

Calibration of field instruments is documented in the FSP for the applicable field analysis method, and such procedures take precedence over the following discussion. Field personnel are responsible for confirming that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. Where applicable, each log will include, at a minimum, the following information:

- name of device and/or instrument calibrated
- device/instrument serial/identification numbers
- calibration method
- tolerance
- calibration standard used
- frequency of calibration
- date(s) of calibration(s)
- name of person(s) performing calibration(s)

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated at the intervals specified by the manufacturer or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service. Equipment found out of tolerance during the period of use shall be removed from the field, and measuring and testing done with the equipment shall be addressed via the corrective-action system described in Section 15.4 of this QAPP.

11.2 LABORATORY INSTRUMENT AND EQUIPMENT

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used. Equipment calibration procedures for detecting VOCs will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit E, Part II Section 2. When analyses are conducted according to the USEPA SW-846 Methods and USEPA *Compendium Organic Compounds in Ambient Air*, the calibration procedures and frequencies specified in the applicable method will be followed, as noted in the attached SOPs (Appendix A). For analyses governed by SOPs, see the appropriate SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to QA audits. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors.

All equipment-calibration standards are traceable, directly or indirectly, to the National Institute of Standards and Technology. All standards received shall be logged into

standard-receipt logs maintained by the individual analytical groups. Each group shall maintain a standards-log that tracks the preparation of standards used for calibration and QC purposes.

12.0 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Supplies to be used in the field and laboratory will be free of target chemicals and interferences. All reagents will be tested before use with site samples. Standards will be verified against a second source standard. The laboratory will follow a "first in/first out" procedure for the storage and use of all consumables to minimize the risk of contamination and degradation. The various supplies and consumables required on site are noted in the various field SOPs included in the appropriate work plans and OMM.

13.0 DATA ACQUISITION REQUIREMENTS FOR NON-DIRECT MEASUREMENTS

At present, direct use of historical data generated by outside parties is not anticipated in completing the final deliverable. Historical data will guide the determination of sampling locations for the deliverable. Before use, historic data sets will be reviewed according to the procedures identified in subsequent sections of this QAPP to determine appropriate uses of such data. The extent to which these data can be validated will be determined by the analytical level and QC data available. Evaluation of historic data for deliverable purposes requires:

- identification of analytical levels
- evaluation of QC data, when available
- development of conclusions regarding the acceptability of the data for intended uses

Acceptability of historic data for its intended uses will be determined by applying these procedures and professional judgment. If the quality of historic data cannot be determined, its use will be limited to general trend evaluations.

14.0 DATA MANAGEMENT

The purpose of data management is to confirm that all necessary data are accurate and readily accessible to meet the project's analytical and reporting objectives. Field investigations will include a relatively large number of samples. Thus, a structured, comprehensive, and efficient program for data management will be necessary due to the large amount of data that will be produced.

The project's data-management program includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be used to efficiently process the information collected, such that data are readily accessible and accurate. These procedures are detailed in the following section. The data management plan has five elements: 1) sample-designation system, 2) field activities, 3) sample tracking and management, 4) data-management system, and 5) document control and inventory.

14.1 SAMPLE DESIGNATION SYSTEM

A concise and easily-understandable sample designation system is an important part of project sampling-activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample-designation system to be used during sampling will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sampled collected, as outlined in Section 6.2.1.

14.2 FIELD ACTIVITIES

Field activities designed to gather information necessary to make decisions during deliverable creation require consistent documentation and accurate recordkeeping. During site activities, standardized procedures will be used to document field activities, data security, and QA. Field activities will be conducted in accordance with applicable work plans, internal SOPs, general industry standards, and this QAPP. General procedures are described in further detail in the following subsections.

14.2.1 Field Documentation

Complete and accurate recordkeeping is a critical component of the field investigation. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To confirm that the field investigation is thoroughly documented, several different records, each with its own specific reporting requirements, will be maintained, including:

- field logs
- COCs
- instrument-calibration records

Each of these types of field documentation is described below.

Field Logs: Personnel performing field activities will keep field logs detailing all observations and measurements made. Data will be recorded directly into site-dedicated bound field books, or customized log forms, with each entry dated and signed. To determine at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media-sampling locations will be surveyed to accurately record their locations. The survey crew will use their own field logs and supply the sampling-location coordinates to the database administrator.

Chain-of-Custody Forms: COCs are used to document and track sample possession from time of collection to the time of disposal. A chain-of-custody form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the chain-of-custody procedure. Chain-of-custody procedures and a sample form are included in all appropriate work plans, the OMM, and required regulatory procedures.

Instrument Calibration Records: As part of data QA procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration confirms that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Section 11.1. To demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate:

- calibration date and time
- equipment type and identification number
- calibration frequency and acceptable tolerances
- identification of individual(s) performing calibration
- reference standards used
- calibration data
- information on calibration success or failure

The calibration record will serve as a written account of monitoring or detection equipment QA. All erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

14.2.2 Data Security

Measures will be taken during the field investigation to confirm that samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the

field office or locked in the field vehicle. Access to these files will be limited to the field personnel who use them.

14.3 SAMPLE MANAGEMENT AND TRACKING

A record of all field documentation will be maintained to confirm the validity of data used in the site analysis. To effectively execute such documentation, specific sample tracking and data management procedures will be used throughout the sampling program. Sample tracking will begin with the completion of COCs, as summarized in Section 7.2.3. The completed COCs associated with collected samples will be faxed to the quality assurance coordinator (QAC). Copies of all completed COCs will be maintained in the field office. The laboratory shall verify receipt of the samples electronically (via e-mail) on the following day. When analytical data are received from the laboratory, the QAC will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed up by the QAC.

14.4 DATA MANAGEMENT SYSTEM

In addition to the sample tracking system, a data management system is utilized. The central focus of the data management system will be to develop a personal-computer-based project database. The project database, to be maintained by the database administrator, will combine pertinent geographical, field, and analytical data. Information that will populate the database will be derived from three primary sources: surveying of sampling locations, field observations and logged sample information, and analytical results. Each of these sources is discussed in the following sections.

14.4.1 Survey Information

In general, each location sampled as part of the deliverable will be surveyed to confirm accurate documentation of sample locations for mapping and GIS purposes (if appropriate), to facilitate the re-sampling of select sampling locations during future monitoring programs, if needed, and for any potential remediation activities. Surveying activities in the field will consist of collecting information that will be used to compute northing and easting in state plane coordinates for each sampling location and the collection of information to compute elevations relative to the National Geodetic Vertical Datum of 1988 for select sampling locations, as appropriate. All field books and/or field forms associated with surveying will be stored as a project record.

14.4.2 Field Observations and Logged Sample Information

An important part of the information that will ultimately reside in the project's data management system will originate in field observations. Following certain sampling events, the field personnel who performed the sampling may prepare a status memorandum to summarize and document the event. Topics to be discussed might include sample locations and depths, sampling methodologies, QA/QC procedures, blind duplicate and

MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy observations.

Tables are typically attached to the memorandum to summarize measurements recorded in the field books and/or on the field forms. For example, for sediment samples, the table would present the sampling date and time, water depth, sediment depth, depth of sediment recovered in a given core, the depth increment submitted for analysis, and a description of the lithology.

Status memos can be used to keep project personnel informed of the details of field activities and are invaluable during development of the final report. Status memos will be used to transfer field observations into the data management system. Pertinent field data will be manually entered into the appropriate database tables from the COCs and field notebooks and/or field forms.

14.4.3 Analytical Results

The laboratory will provide analytical results both as pdf lab reports and electronic data deliverables (EDDs). Data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the chain-of-custody form were performed. If discrepancies are noted, the QAC will be notified and will promptly follow up with the laboratory to resolve any issues.

Each data package will be validated in accordance with the procedures presented in Section 18. Data not meeting the specified standards will be flagged pending resolution of the issue. The flag will not be removed until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following data validation, the digital files will be used to populate the appropriate database tables. When required, a NYSDEC EQuIS EDD will be prepared and submitted to NYDEC's Environmental Information Management System (EIMS). The NYSDEC EDD will be prepared in compliance with the formatting and content descriptions as provided on the NYSDEC website.

EDDs will be used to populate analytical data summary tables, such that manual re-entry of values will not be required.

14.5 DOCUMENT CONTROL AND INVENTORY

Stantec maintains project files for this site at its Rochester, New York office; final reports are uploaded to an online SharePoint site accessible to project team members. Each client project is assigned a file/job number. Whenever possible, originals are placed in these files. These are the central files and will serve as the site-specific files for the deliverable.

15.0 ASSESSMENT AND RESPONSE ACTIONS

15.1 INTRODUCTION

Performance and systems audits will be completed in the field and laboratory during creation of the deliverable, as described below.

15.2 FIELD AND SYSTEM AUDITS

The following field-performance and systems audits will be completed during this project. The appropriate task manager will monitor field performance. Field-performance-audit summaries will evaluate field activities to verify that they are performed according to established protocols. The Stantec QAC will review field reports and communicate concerns to the Stantec project manager and/or task managers, as appropriate. In addition, the Stantec QAC will review the rinse and trip-blank data to identify potential deficiencies in field sampling and cleaning procedures. Systems audits comparing scheduled QA/QC activities associated with this document with actual QA/QC activities completed will also be performed. The appropriate task manager and QAC will periodically confirm that work is being performed consistent with this QAPP, the appropriate work plan, OMM, or required regulatory procedures.

15.3 LABORATORY AUDITS

The laboratory will perform internal audits consistent with NYSDEC ASP 2005 Revision, Exhibit E. Internal laboratory-audits are conducted by the laboratory QAC. As part of the audit, the overall performance of laboratory staff is evaluated and compared to performance criteria outlined in the laboratory QA manual and SOPs. Results of these audits are summarized and issued to each department supervisor, the laboratory manager, and the laboratory director. Each laboratory QAC will also perform a systems audit to determine if the procedures implemented by their laboratory comply with the QA manual and SOPs.

In addition to each laboratory's internal audits, each laboratory (as a participant in state and federal certification programs) is audited by representatives of the certifying regulatory agency. Audits are usually conducted annually and focus on laboratory conformance to the specific program-protocols for which the laboratory seeks certification. The auditor reviews sample-handling and tracking documentation, analytical methodologies, analytical support documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary. Stantec reserves the right to conduct an on-site audit of any laboratory before the start of project analyses. Additional audits may be performed during the course of the project, as necessary.

15.4 CORRECTIVE ACTION

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP, the appropriate work plan, OMM, or required regulatory

procedures. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the actions are described below.

15.4.1 Field Procedures

If a condition is noted in the field that could adversely affect data quality, corrective action will be taken to prevent or mitigate this condition. Condition identification, cause, and corrective action implemented by the field manager or their designee will be documented and reported to the appropriate Stantec task manager, QAC, and project manager. Examples of such situations include:

- Protocols as defined by the QAPP, appropriate work plan, OMM, or required regulatory procedures have not been followed
- Equipment not in proper working order or is not properly calibrated
- QC requirements not met
- Unresolved issues resulting from performance or systems audits

Project personnel will continuously monitor ongoing work performance in the course of normal daily responsibilities.

15.4.2 Laboratory Procedures

In the laboratory, when a condition is noted to adversely affect data quality, corrective action will be taken to prevent or mitigate this condition. Condition identification, cause, and corrective action taken will be documented and reported to the appropriate project manager and QAC. Corrective action may be initiated, at a minimum, under the following conditions:

- Specific laboratory analytical protocols have not been followed
- Protocols as defined by this QAPP have not been followed
- Pre-determined data-acceptance standards are not obtained
- Equipment is not in proper working order or calibrated
- Sample and test results are not completely traceable
- QC requirements have not been met
- Unresolved issues resulting from performance or systems audits

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities. Corrective action begins when the problem is identified. At whatever level this occurs (analyst, supervisor, data review, or QC), the issue is brought to the attention of the laboratory QAC and, ultimately, the laboratory director. Final approval of any action deemed necessary is subject to the approval of the laboratory director. Any corrective action deemed necessary would be implemented, based on system or performance audits or the results of data review. The corrective action may

include sample re-extraction, re-preparation, re-analysis, cleanup, dilutions, matrix modifications, or other activities.

16.0 REPORTS TO MANAGEMENT

16.1 INTERNAL REPORTING

The analytical laboratory will submit analytical reports to Stantec for review. If required, Stantec will, in turn, submit the reports to the data validator for review. Supporting data (i.e., historic data, related field or laboratory data) will also be reviewed to evaluate data quality, as appropriate. The Stantec QA manager will incorporate results of data validation reports and assessments of data usability into a summary report (if required) that will be submitted to the Stantec project manager and appropriate task managers. If required, this report will be filed in the project file at Stantec's Rochester, New York office and will include the following:

- Assessment of data accuracy, precision, and completeness for both field and laboratory data
- Results of the performance and systems audits
- Significant QA/QC problems, solutions, corrections, and potential consequences
- Analytical data validation report

16.2 SUPPLEMENTAL REMEDIAL DESIGN REPORTING

As samples are transported to the laboratory, a copy of the chain-of-custody form will be forwarded to the Stantec project manager. Upon receipt of the "ASP— Category B Data Package" from the laboratory, the Stantec QA manager will determine if the data package has met the required DQOs. The analytical data package will be submitted to the Stantec project manager and the analytical data will be incorporated into the final deliverable report in a tabulated format.

17.0 DATA REDUCTION AND REVIEW

17.1 GENERAL DATA PROCESSING

After field and laboratory data are obtained, the data will be subjected to the following:

- reduction, or manipulation mathematically, or otherwise into meaningful and useful forms
- review
- organization, interpretation, and reporting
- data validation

17.2 FIELD DATA REDUCTION AND REVIEW

17.2.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets, and/or on forms. Such data will be reviewed by the appropriate task manager for adherence to the appropriate work plan, OMM, or required regulatory procedures and this QAPP for consistency. Concerns identified through this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into data evaluation.

17.2.2 Field Data Review

Field-data calculations, transfers, and interpretations will be conducted by field personnel and reviewed for accuracy by the appropriate task manager and the QAC. Logs and documents will be checked for:

- general completeness
- readability
- usage of appropriate procedures
- appropriate instrument calibration and maintenance
- reasonableness in comparison to present and past data collected
- correct sample locations
- correct calculations and interpretations

17.3 LABORATORY DATA-REDUCTION AND REVIEW

17.3.1 Laboratory Data Reduction

Data reduction calculations will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data-system. Raw data will be entered into permanently bound laboratory notebooks. The data entered must be sufficient to

document all factors used to arrive at the reported value. Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards.

Inorganic analyses will be based on regression analysis. Regression analysis is used to fit a curve through the calibration-standard data. Sample concentrations will be calculated using the resulting regression-equations. Non-aqueous values will be reported on a dry-weight basis. Unless otherwise specified, all values will be reported uncorrected for blank contamination.

17.3.2 Laboratory Data Review

Data will be subjected to multi-level review by the laboratory. The group leader will review all data reports before release for the final data report and signature by the laboratory project manager. The laboratory QAC will review a cross-section of the final data reports before shipment to Stantec.

Corrective action will be taken if discrepancies or deficiencies exist in the analytical results, as discussed in Section 15.4. Deficiencies discovered as a result of internal data-review, as well as the corrective actions to be used to rectify the situation, will be documented on a "Corrective Action Form." This form will be submitted to the Stantec project manager.

17.4 DATA VALIDATION AND VERIFICATION

All data generated for health and safety and engineering/design-control purposes will be subjected to the data validation and verification procedures outlined in Section 18. Data generated for disposal purposes, SPDES permit reporting and system OMM will not be reviewed.

18.0 DATA VALIDATION AND VERIFICATION

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results were correctly transcribed from the instrument read-outs, and which, if any, environmental samples were related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements. Stantec will validate appropriate data and produce a Data Usability Summary Report (DUSR) for each individual SDG using the most recent versions of the USEPA's *Function Guidelines* (USEPA, 1999b) and USEPA Region II SOPs for data validation available when the project began, where appropriate. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements apart from what is specified in this QAPP will be detailed on COCs. Upon receipt of laboratory data, the data validator will execute the following procedures:

- Evaluate completeness of the data package
- Verify that field COCs were completed and that samples were handles properly
- Verify that holding times were met for each parameter. Holding-time exceedences, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis
- Verify that parameters were analyzed according to the methods specified
- Review QA/QC data (i.e., make sure duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method; verify that duplicate and MS recoveries are acceptable)
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the project manager and/or laboratory manager, as appropriate
- If data appear suspect, investigate the specific data of concern. Calculations will be traced back to raw data; if calculations do not agree, the cause will be determined and corrected
- Deficiencies discovered through the data review, as well as corrective actions implemented in response, will be documented and submitted as a written report addressing the following topics (as applicable to each method):

- data-package assessment
- description of any protocol deviations
- failures to reconcile reported and/or raw data
- assessment of any compromised data
- overall appraisal of the analytical data
- table of site name, sample quantities, matrix, and fractions analyzed

Note that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information. Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. The Stantec QAC may make suggestions for re-analysis at this point. Data validation reports will be kept in the project file at the Stantec office in Rochester, New York.

19.0 RECONCILIATION WITH USER REQUIREMENTS

Data results will be examined to determine the performance achieved for each data-usability criterion. Performance will then be compared with project objectives and DQOs. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

- retrieval of missing information
- request for additional explanation or clarification
- re-analysis of sample from extract (when appropriate)
- re-calculation or re-interpretation of results by the laboratory

These actions may improve data quality, reduce uncertainty, and may eliminate the need to qualify or reject data. If these actions do not improve data quality to an acceptable level, the following additional actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/non-critical nature of the sample

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, additional samples must be collected and analyzed.

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Tables

Table 1
Analytical Quality Control Limits
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Parameter	Accuracy - % Recovery[1]			Precision - RPD[1]		
	Surrogate	MS/MSD	LCS	MS/MSD	Lab Duplicate	Field Duplicate
Water						
Volatile Organics	See Tables 1A, 1B, and 1C					0-25
Soil						
Volatile Organics	See Tables 1A, 1B, and 1C					0-50
Polychlorinated Biphenyls (PCBs)	30-150	29-135	50-150	0-15[2]/0-20[3]	--	0-50
Air						
VOCs TO-15	70-130	--	70-130	--	20	0-25

Notes:
[1] The listed QC limits are based on the *USEPA National Functional Guidelines for Superfund Organic Methods Data Review* (2014). Actual limits are determined based on laboratory performance.
[2] Aroclor 1016 (MS/MSD precision limit objectives may vary depending on specific Aroclor)
[3] Aroclor 1260 (MS/MSD precision limit objectives may vary depending on specific Aroclor)
QC - quality control
MS/MSD - matrix spike/matrix spike duplicate
RPD - relative percent difference
LCS - laboratory control sample

Table 1A
Analytical Quality Control Limits
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

VOC INITIAL AND CONTINUING CALIBRATION AND LABORATORY CONTROL LIMITS				
Analyte	**Minimum RRF**	**Maximum %RSD or RPD**	**Opening Maximum %D or %R**	**Closing Maximum %D or %R**
Dichlorodifluoromethane	0.01	25	±40.0	±50.0
Chloromethane	0.01	20	±30.0	±50.0
Vinyl chloride	0.01	20	±25.0	±50.0
Bromomethane	0.01	40	±30.0	±50.0
Chloroethane	0.01	40	±25.0	±50.0
Trichlorofluoromethane	0.01	40	±30.0	±50.0
1,1-Dichloroethene	0.06	20	±20.0	±25.0
1,1,2-Trichloro-1,2,2-trifluoroethane	0.05	25	±25.0	±50.0
Acetone	0.01	40	±40.0	±50.0
Carbon disulfide	0.1	20	±25.0	±25.0
Methyl acetate	0.01	40	±40.0	±50.0
Methylene chloride	0.01	40	±30.0	±50.0
trans-1,2-Dichloroethene	0.1	20	±20.0	±25.0
Methyl tert-butyl ether	0.1	40	±25.0	±50.0
1,1-Dichloroethane	0.3	20	±20.0	±25.0
cis-1,2-Dichloroethene	0.2	20	±20.0	±25.0
2-Butanone	0.01	40	±40.0	±50.0
Bromochloromethane	0.1	20	±20.0	±25.0
Chloroform	0.3	20	±20.0	±25.0
1,1,1-Trichloroethane	0.05	20	±25.0	±25.0
Cyclohexane	0.01	40	±25.0	±50.0
Carbon tetrachloride	0.1	20	±25.0	±25.0
Benzene	0.2	20	±20.0	±25.0
1,2-Dichloroethane	0.07	20	±20.0	±25.0
Trichloroethene	0.2	20	±20.0	±25.0
Methylcyclohexane	0.05	40	±25.0	±50.0
1,2-Dichloropropane	0.2	20	±20.0	±25.0
Bromodichloromethane	0.3	20	±20.0	±25.0
cis-1,3-Dichloropropene	0.3	20	±20.0	±25.0
4-Methyl-2-pentanone	0.03	25	±30.0	±50.0

Table 1A
Analytical Quality Control Limits
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

VOC INITIAL AND CONTINUING CALIBRATION AND LABORATORY CONTROL LIMITS				
Analyte	**Minimum RRF**	**Maximum %RSD or RPD**	**Opening Maximum %D or %R**	**Closing Maximum %D or %R**
Toluene	0.3	20	±20.0	±25.0
trans-1,3-Dichloropropene	0.2	20	±20.0	±25.0
1,1,2-Trichloroethane	0.2	20	±20.0	±25.0
Tetrachloroethene	0.1	20	±20.0	±25.0
2-Hexanone	0.01	40	±40.0	±50.0
Dibromochloromethane	0.2		±20.0	±25.0
1,2-Dibromoethane	0.2	20	±20.0	±25.0
Chlorobenzene	0.4	20	±20.0	±25.0
Ethylbenzene	0.4	20	±20.0	±25.0
m,p-Xylene	0.2	20	±20.0	±25.0
o-Xylene	0.2	20	±20.0	±25.0
Styrene	0.2	20	±20.0	±25.0
Bromoform	0.1	20	±25.0	±50.0
Isopropylbenzene	0.4	20	±25.0	±25.0
1,1,2,2-Tetrachloroethane	0.2	20	±25.0	±25.0
1,3-Dichlorobenzene	0.5	20	±20.0	±25.0
1,4-Dichlorobenzene	0.6	20	±20.0	±25.0
1,2-Dichlorobenzene	0.6	20	±20.0	±25.0
1,2-Dibromo-3-chloropropane	0.01	25	±30.0	±50.0
1,2,4-Trichlorobenzene	0.4	20	±30.0	±50.0
1,2,3-Trichlorobenzene	0.4	25	±30.0	±50.0

Table 1A
Analytical Quality Control Limits
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

VOC INITIAL AND CONTINUING CALIBRATION AND LABORATORY CONTROL LIMITS				
Analyte	**Minimum RRF**	**Maximum %RSD or RPD**	**Opening Maximum %D or %R**	**Closing Maximum %D or %R**
Deuterated Monitoring Compound / Surrogates				
Vinyl chloride-d3	0.01	20	±30.0	±50.0
Chloroethane-d5	0.01	40	±30.0	±50.0
1,1-Dichloroethene-d2	0.05	20	±25.0	±25.0
2-Butanone-d5	0.01	40	±40.0	±50.0
Chloroform-d	0.3	20	±20.0	±25.0
1,2-Dichloroethane-d4	0.06	20	±25.0	±25.0
Benzene-d6	0.3	20	±20.0	±25.0
1,2-Dichloropropane-d6	0.2	20	±20.0	±25.0
Toluene-d8	0.3	20	±20.0	±25.0
trans-1,3-Dichloropropene-d4	0.2	20	±20.0	±25.0
2-Hexanone-d5	0.01	40	±40.0	±50.0
1,1,2,2-Tetrachloroethane-d2	0.2	20	±25.0	±25.0
1,2-Dichlorobenzene-d4	0.4	20	±20.0	±25.0

Table 1B
Analytical Quality Control Limits
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

SURROGATE RECOVERY LIMITS		
DMC / SURROGATE	**%R for Water Sample**	**%R for Soil Sample**
Vinyl chloride-d3	60-135	30-150
Chloroethane-d5	70-130	30-150
1,1-Dichloroethene-d2	60-125	45-110
2-Butanone-d5	40-130	20-135
Chloroform-d	70-125	40-150
1,2-Dichloroethane-d4	70-125	70-130
Benzene-d6	70-125	20-135
1,2-Dichloropropane-d6	70-120	70-120
Toluene-d8	80-120	30-130
trans-1,3-Dichloropropene-d4	60-125	30-135
2-Hexanone-d5	45-130	20-135
1,1,2,2-Tetrachloroethane-d2	65-120	45-120
1,2-Dichlorobenzene-d4	80-120	75-120

Table 1C
Analytical Quality Control Limits
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

MATRIX SPIKE LIMITS				
Analyte	**%R for Water Sample**	**RPD for Water Sample**	**%R for Soil/Sediment Sample**	**RPD for Soil/Sediment Sample**
1,1-Dichloroethene	61 - 145	0 - 14	59 - 172	0 - 22
Trichloroethene	71 - 120	0 - 14	62 - 137	0 - 24
Benzene	76 - 127	0 - 11	66 - 142	0 - 21
Toluene	76 - 125	0 - 13	59 - 139	0 - 21
Chlorobenzene	75 - 130	0 - 13	60 - 133	0- 21

Table 2
Sample Containers, Preservation, and Holding Times
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Parameter and Media	Method	Bottle Type	Preservation	Holding Time[3]
Water				
Volatile Organic Compounds	8260[1]	Three 40 mL glass vials	Cool to 4° C; pH<2 (HCl)	48 hours to preservation; 10 days to analysis (if preserved)
Soil				
Volatile Organic Compounds	8260[1]	One 2 oz clear or amber wide mouth glass soil jar	Cool to 4°C	48 hours to preservation; 10 days to analysis (if preserved)
Polychlorinated Biphenyls (PCBs)	8082[1]	One 4 oz clear or amber wide mouth glass soil jar	Cool to 4°C	5 days to analysis (if preserved)
Air				
Volatile Organic Compounds	TO-15[2]	One Canister (1L or 6L)	None	10 days to analysis

Notes:

[1] USEPA Office of Solid Waste and Emergency Response, *Test Methods for Evaluating Solid Waste SW-846, 4th Edition, revised 2006.*

[2] EPA Compendium Method TO-15, "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canister and Analyzed by Gas Chromatography/Mass Spectrometry", USEPA, January 1999

[3] All holding times are calculated from verified time of sample receipt and will be consistent with Exhibit I of the NYSDEC Analytical Services Protocol

°C - degrees Celsius

mL - milliliters

oz - ounce

Table 3
Quality Control Sample Frequency and Analyses
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Parameter and Media	QA/QC Sampling Frequency			
	Trip Blank	Rinse Blank	Field Duplicate	Matrix Spike/ Matrix Spike Duplicate
Groundwater				
Volatile Organic Compounds	1/cooler	NA	1/20	1/20
Soil				
Volatile Organic Compounds	N/A	1/mob.	1/20	1/20
Polychlorinated Biphenyls	N/A	1/mob.	1/20	1/20
Air				
Volatile Organic Compounds	N/A	NA	1/20	NA

Notes:
1/mob. - One rinse blank will be collected per mobilization for each sampling method using non-dedicated equipment.
1/cooler - One trip blank will be included in each cooler containing aqueous samples that will be analyzed for VOCs.
N/A - not applicable
QA/QC - quality assurance/quality control

Table 4a
Parameters, Methods, and Target Reporting Limits (water)
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Analyte	Water (µg/L)		
	NYS TOGS[2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260[1]			
1,1,1-Trichloroethane	5	0.82	1.0
1,1,2,2-Tetrachloroethane	5	0.21	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	5	0.31	1.0
1,1,2-Trichloroethane	1	0.23	1.0
1,1-Dichloroethane	5	0.38	1.0
1,1-Dichloroethene	5	0.29	1.0
1,2,4-Trichlorobenzene	5	0.41	1.0
1,2-Dibromo-3-chloropropane	0.04	0.39	1.0
1,2-Dibromoethane	0.0006	0.73	1.0
1,2-Dichlorobenzene	3	0.79	1.0
1,2-Dichloroethane	0.6	0.21	1.0
1,2-Dichloropropane	1	0.72	1.0
1,3-Dichlorobenzene	3	0.78	1.0
1,4-Dichlorobenzene	3	0.84	1.0
2-Butanone	50	1.3	10
2-Hexanone	50	1.2	5.0
4-Methyl-2-pentanone	NA	2.1	5.0
Acetone	50	3.0	10
Benzene	1	0.41	1.0
Bromodichloromethane	50	0.39	1.0
Bromoform	50	0.26	1.0
Bromomethane	5	0.69	1.0
Carbon disulfide	60	0.19	1.0
Carbon tetrachloride	5	0.27	1.0
Chlorobenzene	5	0.75	1.0
Chloroethane	5	0.32	1.0
Chloroform	7	0.34	1.0
Chloromethane	5	0.35	1.0
cis-1,2-Dichloroethene	5	0.81	1.0
cis-1,3-Dichloropropene	0.4	0.36	1.0
Cyclohexane	n/v	0.18	1.0
Dibromochloromethane	50	0.32	1.0
Dichlorodifluoromethane	5	0.68	1.0
Ethylbenzene	5	0.74	1.0
Isopropylbenzene	5	0.79	
Methyl acetate	n/v	0.50	2.5
Methyl tert-butyl ether (MTBE)	10	0.16	1.0
Methylcyclohexane	n/v	0.16	1.0
Methylene chloride	5	0.44	1.0
Styrene	5	0.73	1.0

see notes on following page

Table 4a
Parameters, Methods, and Target Reporting Limits (water)
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Analyte	Water (µg/L)		
	NYS TOGS[2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260[1] (continued)			
Tetrachloroethene	5	0.36	1.0
Toluene	5	0.51	1.0
trans-1,2-Dichloroethene	5	0.90	1.0
trans-1,3-Dichloropropene	0.4	0.37	1.0
Trichloroethene	5	0.46	1.0
Trichlorofluoromethane	5	0.88	1.0
Vinyl chloride	2	0.90	1.0
Xylenes (total)	5	0.66	2.0

Notes:

[1] USEPA Office of Solid Waste and Emergency Response, *Test Methods for Evaluating Solid Waste SW-846, 4th edition, revised 2006.*

[2] NYSDEC TOGS 1.1.1 (Division of Water, Technical and Operation Guidance Series) Table 1 - Ambient Water Quality Standards and Guidance Values, reissued June 1998 with errata in January 1999 and addenda in April 2000 and June 2004

n/v - no standard/guideline value

µg/L - micrograms per liter

MDL - method detection limit

RL - reporting limit

Table 4b
Parameters, Methods, and Target Reporting Limits (soil)
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Analyte	Soil (mg/kg)		
	NYSDEC Part 375 SCOs[1,2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260[1]			
1,1,1-Trichloroethane	0.68[2], 500$_c$[3]	0.00036	0.005
1,1,2,2-Tetrachloroethane	1000$_d$[2], 500$_c$[3]	0.00081	0.005
1,1,2-Trichloro-1,2,2-trifluoroethane	1000$_d$[2], 500$_c$[3]	0.0011	0.005
1,1,2-Trichloroethane	1000$_d$[2], 500$_c$[3]	0.00065	0.005
1,1-Dichloroethane	0.27[2], 240[3]	0.00061	0.005
1,1-Dichloroethene	0.33[2], 500$_c$[3]	0.00061	0.005
1,2-Dibromoethane	n/v	0.00064	0.005
1,2-Dichloroethane	0.02$_g$[2], 30[3]	0.00025	0.005
1,2-Dichloropropane	1000$_d$[2], 500$_c$[3]	0.0025	0.005
2-Butanone	0.12[2], 500$_c$[3]	0.0018	0.025
2-Hexanone	1000$_d$[2], 500$_c$[3]	0.0025	0.025
4-Methyl-2-pentanone	1000$_d$[2], 500$_c$[3]	0.0016	0.025
Acetone	0.05[2], 500$_c$[3]	0.0042	0.025
Benzene	0.06[2], 44[3]	0.00025	0.005
Bromodichloromethane	1000$_d$[2], 500$_c$[3]	0.00067	0.005
Bromoform	1000$_d$[2], 500$_c$[3]	0.0025	0.005
Bromomethane	1000$_d$[2], 500$_c$[3]	0.00025	0.005
Carbon disulfide	1000$_d$[2], 500$_c$[3]	0.0025	0.005
Carbon tetrachloride	0.76[2], 22[3]	0.00048	0.005
Chlorobenzene	1.1[2], 500$_c$[3]	0.00066	0.005
Chloroethane	1000$_d$[2], 500$_c$[3]	0.0011	0.005
Chloroform	0.37[2], 350[3]	0.00031	0.005
Chloromethane	1000$_d$[2], 500$_c$[3]	0.0003	0.005
cis-1,2-Dichloroethene	0.25[2], 500$_c$[3]	0.00064	0.005
cis-1,3-Dichloropropene	1000$_d$[2], 500$_c$[3]	0.00072	0.005
Cyclohexane	n/v	0.0007	0.005
Dibromochloromethane	1000$_d$[2], 500$_c$[3]	0.00064	0.005
Dichlorodifluoromethane	n/v	0.00041	0.005
Isopropylbenzene	1000$_d$[2], 500$_c$[3]	0.00075	0.005
Methyl acetate	n/v	0.003	0.005
Methylcyclohexane	n/v	0.00076	0.005
Methylene chloride	0.05[2], 500$_c$[3]	0.0023	0.005
Tetrachloroethene	1.3[2], 150[3]	0.00067	0.005
Toluene	0.7[2], 500$_c$[3]	0.00038	0.005

see notes on following page

Table 4b
Parameters, Methods, and Target Reporting Limits (soil)
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Analyte	Soil (mg/kg)		
	NYSDEC Part 375 SCOs[1,2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260[1] (continued)			
trans-1,2-Dichloroethene	0.19[2], 500$_c$[3]	0.00052	0.005
trans-1,3-Dichloropropene	1000$_d$[2], 500$_c$[3]	0.0022	0.005
Trichloroethene	0.47[2], 200[3]	0.0011	0.005
Trichlorofluoromethane	n/v	0.00047	0.005
Vinyl chloride	0.02[2], 13[3]	0.00061	0.005
1,2,4-Trichlorobenzene	1000$_d$[2], 500$_c$[3]	0.0003	0.005
1,2-Dibromo-3-chloropropane	n/v	0.0025	0.005
1,2-Dichlorobenzene	1.1[2], 500$_c$[3]	0.00039	0.005
1,3-Dichlorobenzene	2.4[2], 280[3]	0.00026	0.005
1,4-Dichlorobenzene	1.8[2], 130[3]	0.0007	0.005
Ethylbenzene	1[2], 390[3]	0.00035	0.005
Methyl t-butyl ether (MTBE)	0.93[2], 500$_c$[3]	0.00049	0.005
Styrene	1000$_d$[2], 500$_c$[3]	0.00025	0.005
Xylenes (total)	1.6[2], 500$_c$[3]	0.00084	0.010
Polychlorinated Biphenyls (PCBs) 8082[1]			
Aroclor 1016	3.2$_o$[2], 1$_o$[3]	0.049	0.25
Aroclor 1221	3.2$_o$[2], 1$_o$[3]	0.049	0.25
Aroclor 1232	3.2$_o$[2], 1$_o$[3]	0.049	0.25
Aroclor 1242	3.2$_o$[2], 1$_o$[3]	0.049	0.25
Aroclor 1248	3.2$_o$[2], 1$_o$[3]	0.049	0.25
Aroclor 1254	3.2$_o$[2], 1$_o$[3]	0.12	0.25
Aroclor 1260	3.2$_o$[2], 1$_o$[3]	0.12	0.25

Notes:

[1] USEPA Office of Solid Waste and Emergency Response, *Test Methods for Evaluating Solid Waste SW-846, 4th Edition, revised 2006.*

[2] NYSDEC 6 NYCRR Part 375 Soil Clean-up Objectives (SCOs) - Restricted Use - Protection of Groundwater

[3] NYSDEC 6 NYCRR Part 375 Soil Clean-up Objectives (SCOs) - Restricted Use - Commercial

$_c$ The SCOs for commercial use were capped at a maximum value of 500 mg/kg. See TSD Section 9.3.

$_o$ The criterion is applicable to total PCBs, and the individual Aroclors should be added for comparison.

$_d$ The SCOs for industrial use and the protection of groundwater were capped at a maximum value of 1000 mg/kg (Organics) and 10000 mg/kg (Inorganics). See 6 NYCRR Part 375 TSD Section 9.3.

$_g$ For constituents where the calculated SCO was lower than the rural soil background concentration as determined by the DEC/DOH rural soil survey, the rural soil background concentration is used as the Track 2 SCO value for this use of the site.

mg/kg - milligrams per kilogram.

n/v - no standard/guideline value

MDL - method detection limit

RL - reporting limit

Table 4c
Parameters, Methods, and Target Reporting Limits (air)
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Analyte	Air (µg/m^3)		
	Guidance Criteria[2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds TO-15[1]			
1,1,1-Trichloroethane	-	0.164	1.1
1,1,2,2-Tetrachloroethane	-	0.233	1.4
1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113)	-	0.314	1.5
1,1,2-Trichloroethane	-	0.202	1.1
1,1-Dichloroethane	-	0.113	0.81
1,1-Dichloroethene	-	0.0396	0.79
1,2,4-Trichlorobenzene	-	0.252	3.7
1,2,4-Trimethylbenzene	-	0.0787	0.98
1,2-Dibromoethane	-	0.138	1.5
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	-	0.364	1.4
1,2-Dichlorobenzene	-	0.108	1.2
1,2-Dichloroethane	-	0.210	0.81
1,2-Dichloropropane	-	0.162	0.92
1,3,5-Trimethylbenzene	-	0.0934	0.98
1,3-Butadiene	-	0.0796	0.44
1,3-Dichlorobenzene	-	0.120	1.2
1,4-Dichlorobenzene	-	0.114	1.2
1,4-Dioxane	-	0.577	18
2,2,4-Trimethylpentane	-	0.107	0.93
2-Butanone	-	0.271	1.5
2-Hexanone	-	0.697	2.1
3-Chloropropene	-	0.501	1.6
4-Ethyltoluene	-	0.0983	0.98
4-Methyl-2-Pentanone	-	0.737	2.1
Acetone	-	1.64	12
Benzene	-	0.0926	0.64
Benzyl Chloride	-	0.0932	1.0
Bromodichloromethane	-	0.194	1.3
Bromoform	-	0.258	2.1
Bromomethane	-	0.171	0.78
Carbon Disulfide	-	0.0934	1.6
Carbon Tetrachloride	-	0.0692	0.25
Chlorobenzene	-	0.0829	0.92
Chloroethane	-	0.161	1.3
Chloroform	-	0.186	0.98
Chloromethane	-	0.124	
cis-1,2-Dichloroethene	-	0.119	0.79
cis-1,3-Dichloropropene	-	0.132	0.91
Cyclohexane	-	0.0344	0.69
Dibromochloromethane	-	0.170	1.7
Dichlorodifluoromethane (Freon 12)	-	0.277	2.5
Ethylbenzene	-	0.0868	0.87

see notes on following page

Table 4c
Parameters, Methods, and Target Reporting Limits (air)
Quality Assurance Project Plan
Former Lockheed Martin French Road Facility
Utica, New York

Analyte	Air (µg/m^3)		
	Guidance Criteria[2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds TO-15[1] (continued)			
Heptane	-	0.152	0.82
Hexachlorobutadiene	-	0.384	2.1
Hexane	-	0.0987	0.71
Isopropyl Alcohol	-	0.369	12
m+p-Xylene	-	0.109	2.2
Methyl tert-butyl ether	-	0.0793	0.72
Methylene Chloride	-	0.417	1.7
o-Xylene	-	0.0782	0.87
Styrene	-	0.0682	0.85
Tetrachloroethene	-	0.203	1.4
Tetrahydrofuran	-	0.531	15
Toluene	-	0.0942	0.75
trans-1,2-Dichloroethene	-	0.107	0.79
trans-1,3-Dichloropropene	-	0.118	0.91
Trichloroethene	-	0.161	0.22
Trichlorofluoromethane (Freon 11)	-	0.253	1.1
Vinyl Bromide	-	0.0875	0.88
Vinyl Chloride	-	0.0665	0.10

Notes:

[1] EPA Compendium Method TO-15, "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canister and Analyzed by Gas Chromatography/Mass Spectrometry", USEPA, January 1999

[2] The NYSDOH Guidance for Evaluting Soil Vapor Intrusion (2006) will be used for evaluation of soil gas, sub-slab soil vapor, and indoor air samples. System effluent samples will be evaluated for discharge compliance accordingly.

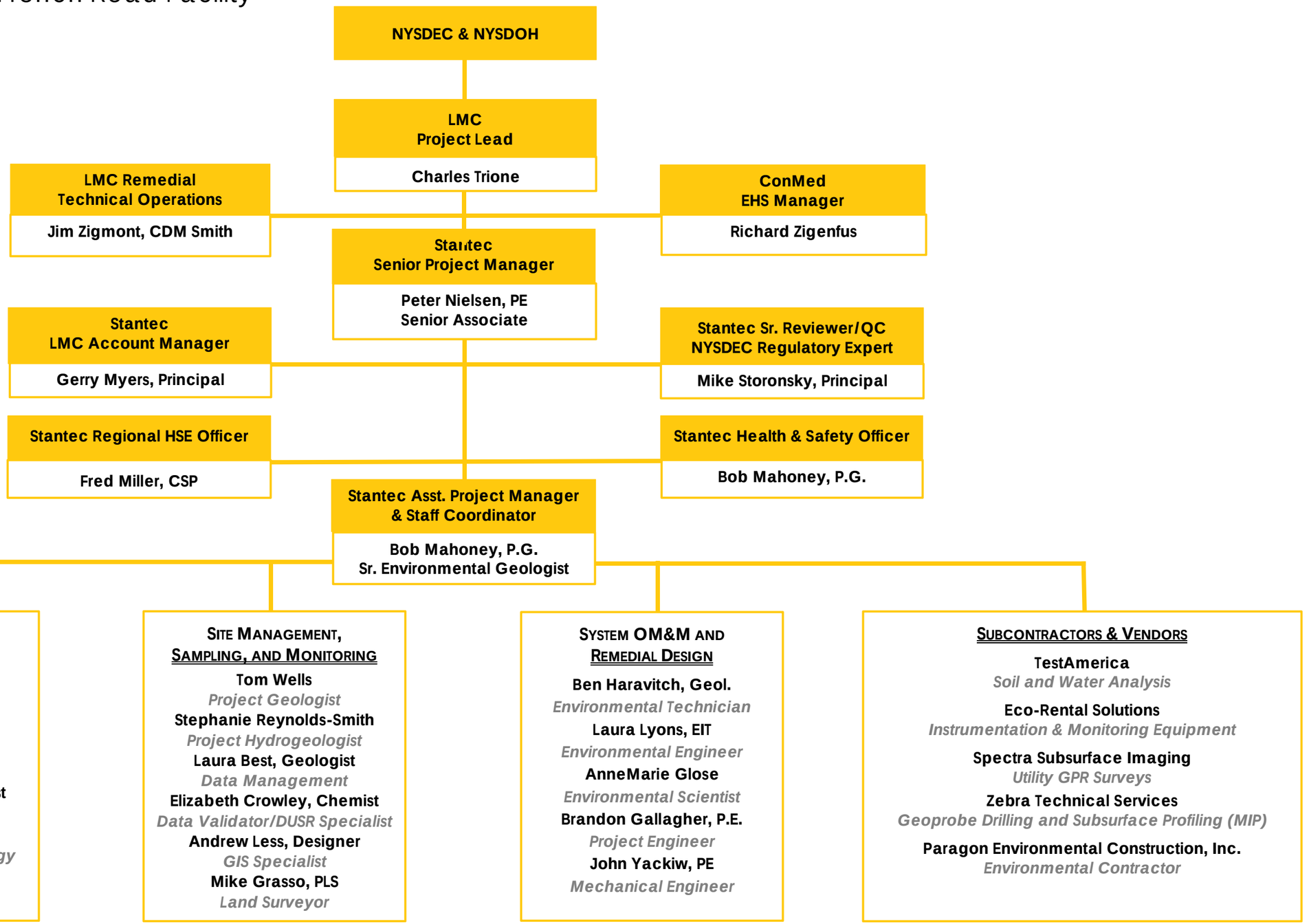
µg/L - micrograms per liter

MDL - method detection limit

RL - reporting limit

Figures

Figure 1
Project Organization Chart
Former Lockheed Martin French Road Facility
Utica, NY



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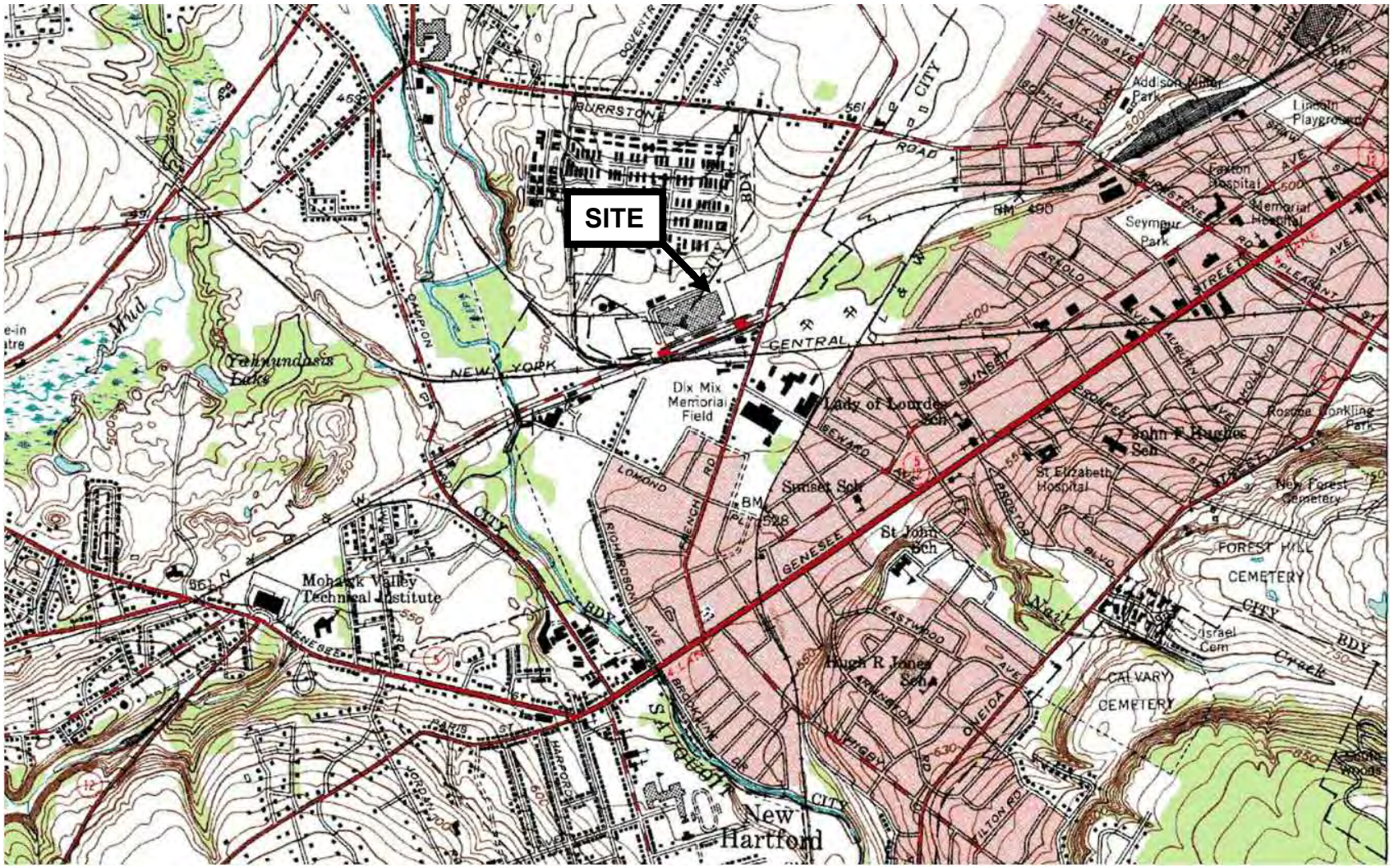

□□ALIT□ ASS□RANCE PRO□ECT PLAN □□APP□
SOLVENT DOCK AREA
FORMER LOCKHEED MARTIN, FRENCH ROAD FACILITY
UTICA, NEW YORK

SITE LOCATION MAP
□□L□ 2015

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Appendix A

Laboratory Quality Management Plans and SOPs

CORPORATE QUALITY MANAGEMENT PLAN

Analytical Laboratories

Revision: 2.1
August 2014

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Corporate Quality Management Plan

Approval Signatures

Dr. Charles W. Carter
Vice President - Quality, Technical & Operations Support

11 August 2014
Date

Raymond J. Frederici
Corporate Quality and EH&S Director

24 April 2014
Date

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3.0 Introduction

3.1 Overview

TestAmerica is the leading environmental testing firm in the United States. We provide innovative technical expertise and comprehensive analytical testing services from over 90 locations nationwide with a staff of over 2500 employees. Some of our specialty analyses include source and ambient air, aquatic toxicity, asbestos, explosives, specialty organics, dioxins, drinking water, industrial hygiene, sediments and tissues, emerging contaminants, radiochemistry and mixed waste testing.

Our environmental testing service capabilities are broad and include chemical, physical, and biological analyses of a variety of matrices, including aqueous, solid, drinking water, waste, tissue, air, mold and fungus (mycology) and saline/estuarine samples. These testing services include specialty capabilities for air toxics testing, radiological, mixed waste testing, geotechnical testing, tissue preparation and analysis, aquatic toxicology, dioxin/furan testing, indoor air quality and microscopy services, asbestos analysis, High Resolution Mass Spectrometry (HRMS), Inductively Coupled Plasma/MS (ICP/MS), Liquid Chromatography/MS (LC/MS), PCR microbiology and on-site technologies including mobile laboratories. TestAmerica is well positioned to support a variety of clients including commercial, governmental and chemical industries.

3.2 Purpose

The purpose of the Corporate Quality Management Plan (CQMP) is to describe TestAmerica's quality system and outline those systems which enable all employees of TestAmerica to meet the Quality Assurance (QA) Policy and Data Integrity Goals. This management plan also describes specific QA activities and requirements; and prescribed frequencies of the defined items. Roles and responsibilities of the Executive Committee (senior management) and their support of the quality system are also defined. Each of our laboratories maintains an independent operational Quality Assurance (QA) Manual based on this CQMP.

3.3 References

The following references were used in preparation of this management plan and are the basis of the TestAmerica Quality System:

- The NELAC Institute (TNI) Standard, dated 2009.
- ISO/IEC Guide 17025:2005(E).
- AIHA-LAP, LLC Policy Documents
- NVLAP Procedures and General Requirements, NIST Handbook 150
- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final

Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.

- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th, 19th, 20th, 21st, and on-line Editions.
- U.S. Department of Energy Order 414.1B, Quality Assurance, April 29, 2004.
- U.S. Department of Energy Order 414.1C, Quality Assurance, June 17, 2005.
- *U.S. Department of Energy, Quality Systems for Analytical Services*, Revision 3.6, November 2010.
- U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.2, October 2010.
- U.S. Department of Defense, *Air Force Center for Environmental Excellence Quality Assurance Project Plan (QAPP),* Version 4.0.02, May 2006.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.4 Scope

The requirements set forth in this CQMP are applicable to all TestAmerica laboratories. Where this management plan uses the terms "must" and "shall", this refers to required activities. Practices described herein represent how those activities are performed in general, and each laboratory may have a more detailed description of that activity.

EMLab P&K & Metco businesses have the responsibility and authority to operate within the regulatory requirements of the jurisdiction in which their work is performed. As such, they are bound by the standards on which their Quality Assurance Manuals are based.

Each laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where this CQMP may conflict with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. Each laboratory's QA Manual (Section 5.3.1) shall take precedence over the CQMP in those cases. Furthermore, each TestAmerica laboratory has the responsibility and authority to operate in compliance with documented client requirements where they do not conflict with regulatory requirements or TestAmerica's Ethics Policy (Document No. CW-L-P-004). TestAmerica shall not enter into any client agreement that conflicts with regulatory requirements in the jurisdiction in which the work is being performed. Where documented client agreements conflict with this document, but meet the regulatory requirements of the jurisdiction in which the work is performed, the client agreements shall supersede the requirements in this CQMP. Each laboratory must maintain a local perspective in its scope of services and client relations and maintain a national perspective in terms of quality.

TestAmerica Policies are documented and adhered to by each laboratory. The Quality Assurance (QA) Manager at each laboratory is responsible to ensure that their QA Manual remains in the Corporate-approved format and that all updates are in accordance with the CQMP and their respective operational processes.

TestAmerica operates under the regulations and guidelines of the following federal programs:

- Department of Defense Environmental Restoration (DoD ER)
- Air Force Center for Environmental Excellence (AFCEE)
- US Army Corp of Engineers, Hazardous, Toxic and Radioactive Waste (USACE HTRW)
- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Department of Energy (DOE)
- Marine Protection, Research, and Sanctuaries Act (MPRSA)
- Navy Facilities Engineering Service Center (NFESC)
- National Pollutant, Discharge, and Elimination System (NPDES)
- Nuclear Regulatory Commission (NRC)
- Occupational Safety and Health Administration (OSHA)
- Resource Conservation and Recovery Act (RCRA)
- Safe Drinking Water Act (SDWA)
- Toxic Substances Control Act (TSCA)
- The Asbestos Hazard Emergency Response Act (AHERA)

TestAmerica also provides services under various state and local municipal guidelines. A listing of each laboratory's service offerings and certifications is presented on TestAmerica's website or available from each of the laboratories.

This CQMP was written to comply with The NELAC Institute (TNI) 2009 Standard and the ISO/IEC Guide 17025:2005(E) Standards.

3.5 Terms and Definitions

TestAmerica views our Quality Assurance Program as a company-wide system designed to ensure that data produced by our laboratories conform to the standards established by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. Each laboratory's QA Manual contains a glossary of terms and acronyms that are widely used in our industry.

4.0 Management Requirements

4.1 Roles and Responsibilities

TestAmerica's Management Organizational structure is presented in Figure 4-1. Corporate employees are located at various TestAmerica laboratories or off-site locations. A QA Manager shall be designated at each TestAmerica laboratory.

In the event of a vacancy for an Executive Committee position, a person will be designated by the CEO to fulfill that responsibility.

Chief Executive Officer (CEO)

The CEO is a member of the Board of Directors, leads the Executive Committee and is ultimately responsible for the quality and performance of all TestAmerica laboratories. The CEO establishes the overall quality standard and data integrity program for the Analytical Business, providing the necessary leadership and resources to assure that the standard and integrity programs are met. The CEO authorizes the CQMP and as such, sets the standards for the quality system.

Vice President of Quality, Technical & Operations Support

The responsibilities of the Vice President (VP) of Quality, Technical & Operations Support include quality assurance; technical support for both laboratories and clients; monitoring and improvement of customer service; Information Technology and automation; technical oversight of laboratory practices; legal and contract issues; technical sales support; and pricing controls. The VP provides support and direction to both the Directors and Managers of these areas. The VP authorizes the CQMP and supports the CEO in decisions regarding long-term planning, resource allocation and capital expenditures.

Vice President of Client Service

The VP of Client Services leads the Client Service Organization (CSO) and is responsible for client satisfaction, driving operational excellence and improving client responsiveness. The VP provides direction to the Client Service Directors, Programs Managers and Project Managers.

Corporate Quality Director

The Corporate Quality Director reports directly to the VP of Quality, Technical & Operations Support. With the aid of the Executive Committee, Laboratory Directors, Quality Directors and QA Managers, the Corporate Quality Director has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance Program within TestAmerica. Additional responsibilities include:

- Review of QA/QC aspects of Corporate SOPs & Policies, national projects and expansions or changes in services.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.

Technical Services Director

The Technical Services Director is responsible for establishing, implementing and communicating TestAmerica's Analytical Business's Technical Policies, SOPs, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

Executive Vice President Operations

The Executive VP of Operations reports directly to the Chairman and CEO of TestAmerica. The Exec. VP oversees the operations of all TestAmerica laboratories and the EMLab P&K business unit. The VP's of Operations report directly to Exec. VP of Operations.

Vice Presidents of Operations

Each VP of Operations reports directly to the Executive VP of Operations and is a part of the Executive Committee. Each VP of Operations is responsible for the overall administrative and operational management of their respective laboratories. The VP's responsibilities include allocation of personnel and resources, long-term planning, goal setting, and achieving the financial, business, and quality objectives of TestAmerica. The VP's ensure timely compliance with Corporate Management directives, policies, and management systems reviews. The VP's are also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

Quality Compliance Director

The Quality Compliance Director reports to the Corporate Quality Director. The Quality Compliance Director has QA oversight of laboratories; monitors and communicates DoD / DoE requirements; develops corporate tools for ensuring and improving compliance; develops corporate assessment tools; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Systems Director and the Corporate Quality Director, the Quality Compliance Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

Quality Systems Director

The Quality Systems Director reports to the Corporate Quality Director. The Quality Systems Director has QA oversight of laboratories; develops quality policies, procedures and management tools; monitors and communicates regulatory and certification requirements; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Compliance Director and the Corporate Quality Director, the Quality Systems Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

Ethics and Compliance Officers (ECOs)

TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – VP of Quality, Technical and Operations Support and the Corporate Quality Director. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. One ECO is a member of the Executive Committee and the other has a direct line of communication to the entire Executive Committee Members. The ECOs ensure that the organization distributes the data integrity and ethical practice policies to all employees and ensures annual training and orientation of new hires to the Ethics Program and its policies. The ECOs are responsible for establishing & maintaining a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and provide recommendations for policy enhancements to the CEO, VP's of Operations, Laboratory Directors or other appropriate individuals within the laboratory. The ECOs assist the QA Manager in the coordination of internal auditing of ethics-related activities and processes within the laboratory, in conjunction with regular internal auditing functions.

The ECOs also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating TestAmerica's Information Technology (IT) Policies, SOPs and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as TestAmerica's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with TNI standards, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various locations.

Environmental Health and Safety Officer (EHS)

The EHS Officer is responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking of all safety and health-related information and reports, as well as managing compliance activities for TestAmerica locations.
- Coordination/preparation of the Corporate Environmental Health and Safety Manual that is used by each laboratory to prepare its own laboratory-specific Environmental Health & Safety Manual.
- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations.
- Serve as the Department of Transportation (D.O.T.) focal point and provide technical assistance to location management.
- Serve as the Hazardous Waste Management main contact and provide technical assistance to location management.

Laboratory Director

The Laboratory Director oversees the daily operations of the defined laboratory. The Laboratory Director's responsibilities include supervision of staff, setting goals and objectives for both the business and the employees, and achieving the financial, business, technical and quality objectives of the laboratory. The Laboratory Director ensures timely compliance with audits and corrective actions, and is responsible for maintaining a working environment which encourages open, constructive problem solving and continuous improvement.

QA Manager

The QA Manager is responsible for ensuring that the defined laboratory's quality system and QA Manual meet the requirements set forth in the CQMP. They ensure compliance with the programs listed in Section 3.4 that are applicable to the laboratory. They also provide quality systems training to all new personnel, maintain the QA Manual in a current and active status, perform or oversee systems, data, special, and external audits. The QA Manager performs, or supervises, the maintenance of QA records, the maintenance of certifications and accreditations, the submission of monthly QA Reports, and assists in reviewing new work as needed. The QA Manager shall have the final authority to accept or reject data, and to stop work in progress in the event that procedures or practices compromise the validity and integrity

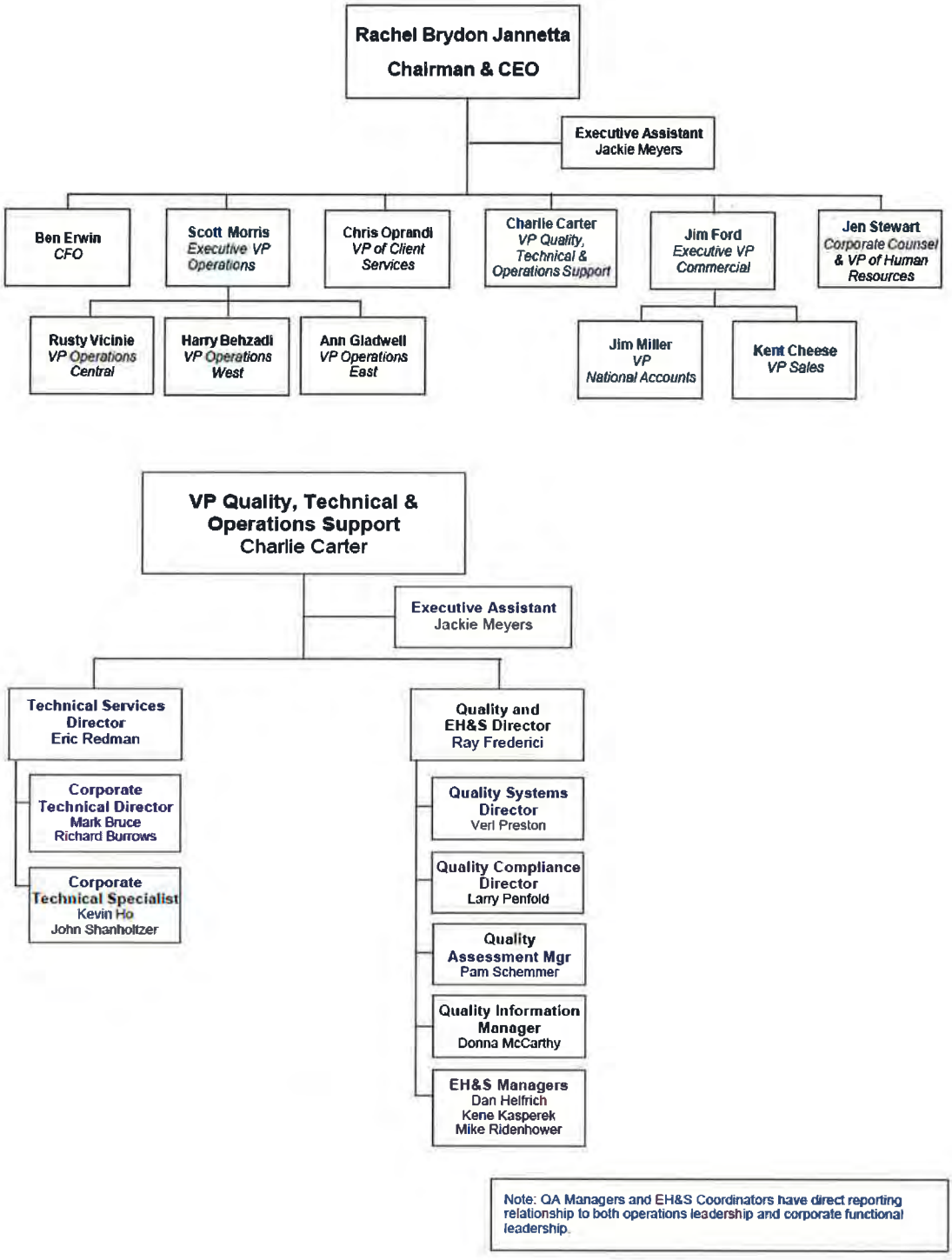
of analytical data. The QA Manager is available to any employee at the laboratory to resolve data quality or ethical issues. The QA Manager shall be independent of laboratory operations. The laboratory QA Manager has a direct reporting relationship to the Quality Director and has a detailed description of their roles and responsibilities within their QA Manual.

Technical Manager

The Technical Manager(s) has the overall responsibility for a defined portion of the technical operations of the laboratory, and are otherwise referred to as the Department Supervisor(s). They ensure compliance with the programs listed in Section 3.4 that are applicable to the laboratory. The Technical Manager solves day to day technical issues, provides technical training and guidance to staff, project managers, and clients, investigates technical issues identified by QA, and directs evaluation of new methods.

Figure 4-1.

TestAmerica's Management Organizational Charts



5.0 Quality System

5.1 Quality Assurance Policy

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

5.2 Management's Commitment to Quality Assurance and Data Integrity

TestAmerica's management team is committed to providing data of known and documented quality and of the highest level of service in the environmental testing industry. To ensure that the data produced and reported by TestAmerica meets the requirements of our clients and complies with the letter and spirit of municipal, state and federal regulations, TestAmerica maintains quality and data integrity systems that are clear, effective, well communicated, and supported at all levels in the company. Therefore, the responsibility for quality resides with every employee.

5.3 Objectives of the Quality System

The goal of the TestAmerica quality system is to ensure that business and technical operations are conducted with the highest standards of professionalism and ethics in the industry.

To achieve this goal, it is necessary to provide our clients with not only scientifically sound, well-documented, and regulatory-compliant data, but also to ensure that TestAmerica provides the highest quality service available in the industry with uncompromising data integrity. A well-structured and well-communicated quality system is essential in meeting this goal. TestAmerica's quality system is designed to minimize systematic error, encourage constructive, documented problem solving (e.g., root cause analysis), and provide a framework for continuous improvement within the organization.

This CQMP is the basis for TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica laboratories shall conduct their operations.

5.3.1 Laboratory Quality Assurance Manual

Each TestAmerica laboratory shall have a QA Manual that further describes the specific QA program at their laboratory. At previously stated, the policies and procedures outlined in the individual QA Manuals shall be compliant with this CQMP and the various accreditation and certification programs that each laboratory has listed in their QA Manuals.

The QA Manual shall address the following items:

Section No.	Title	2009 TNI Standard Reference
-	Cover Page	V1M2 Sec. 4.2.8.3
1.0	Title Page	
2.0	Table of Contents	V1M2 Secs. 4.2.8.3-4.2.8.4
3.0	Introduction, Scope & Applicability	V1M2 Sec. 4.2.8.4
4.0	Management Requirements	V1M2 Sec. 4
5.0	Quality System	V1M2
6.0	Document Control	V1M2 Secs. 4.2.7; 4.3.1; 4.3.2.2; 4.3.3.3; 4.3.3.4
7.0	Service to the Client	V1M2 Secs. 4.4.1 - 4.4.4
8.0	Subcontracting of Tests	V1M2 Secs. 4.4.3; 4.5.4
9.0	Purchasing Services & Supplies	V1M2 Sec. 4.6.1
10.0	Complaints	V1M2 Sec. 4.8
11.0	Control of Non-Conforming Work	V1M2 Secs. 4.9.1; 5.10.5
12.0	Corrective Action	V1M2 Sec. 4.11
13.0	Preventive Action / Improvement	V1M2 Secs. 4.10; 4.12.1; 4.12.2
14.0	Control of Records	V1M2 Secs. 4.2.7; 4.13.1.1; 4.13.3
15.0	Audits	V1M2 Sec. 4.14
16.0	Management Reviews	V1M2 Sec. 4.1.6; 4.15; 4.15.1; 4.15.2
17.0	Personnel	V1M2 Secs. 5.2; 5.2.1
18.0	Accommodations & Environmental Conditions	V1M2 Sec. 5.3
19.0	Test Methods & Method Validation	V1M2 Sec. 5.4.1
20.0	Equipment and Calibration	V1M2 Secs. 5.5.4; 5.5.5; 5.5.6
21.0	Measurement Traceability	V1M2 Sec. 5.5
22.0	Sampling	V1M2 Sec. 5.7
23.0	Handling of Samples	V1M2 Sec. 5.8.1
24.0	Assuring the Quality of Test Results	V1M2 Sec. 5.9
25.0	Reporting Results	V1M2 Sec. 5.10

5.3.2 Data Quality Objectives

Data Quality Objectives (DQOs) is the process that results in a series of qualitative and quantitative statements. The DQO process is a methodology used by project planners to define the environmental question to be answered and the processes needed to ensure the generation of the type, quantity, and quality of environmental data that will be needed for the intended application. DQOs are identified before project initiation, and are the basis of laboratory quality control limits in project documents, such as Quality Assurance Program Plans (QAPPs) and

Sampling & Analysis Plans (SAPs). QC samples routinely used by TestAmerica are described in Section 24.

Data quality indicators, a subset of the DQOs, include Precision, Accuracy, Representativeness, Completeness, and Comparability:

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, agree with each other. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. In laboratory reports, batch precision is commonly expressed in terms of relative percent difference (RPD) for replicate pairs of measurements (e.g., matrix spike/matrix spike duplicates) or relative standard deviation (RSD) for more than two replicates.

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations. Accuracy is commonly expressed by the laboratory as the percent recovery of analytical spikes. However, project teams typically consider bias and precision separately when assessing data quality.

Representativeness is a qualitative term that describes the ability of the sample team to collect samples and laboratory personnel to analyze those samples in such manners that the data produced accurately and precisely reflects the conditions at the site. Data representativeness is primarily a function of sampling strategy (e.g., the sampling scheme must be designed to maximize representativeness). The portion of the sample used for analysis must also be representative of the entire sample delivered to the laboratory.

Completeness is defined as the percentage of measurements that are judged valid or useable. Examples of factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, loss of sample during laboratory analysis, improper documentation such that traceability is compromised, or the sample result is rejected due to failure to conform to QC specifications. A completeness objective of greater than 90% of the data specified by the statement of work is the goal established for most projects.

Comparability is a measure of the confidence with which one data set can be compared to another. To ensure comparability, project plans typically require the use of methods approved by EPA or other standards setting bodies. Within the laboratory, analysts are required to use uniform procedures (e.g., SOPs) and a uniform set of units and calculations for analyzing and reporting environmental data.

What is most important for the laboratory is that the components of analytical variability (uncertainty) can be estimated when QC samples of the right types and at the appropriate frequency are incorporated into measurement process at the laboratory. With these QC results, the laboratory's client can assess whether or not the DQOs were met. With data of known and documented quality, the laboratory data and ultimately the environmental decision made using the data can withstand scientific and legal scrutiny.

6.0 Document Control

6.1 Document Type

The following documents, at a minimum, must be controlled at each TestAmerica laboratory:

- Laboratory QA Manual
- Standard Operating Procedures (SOPs)
- Corporate Quality Management Plan (CQMP)
- Corporate Policies and Procedures
- Corporate Policies and Procedures distributed outside the Intranet

6.2 Document Control Procedure

The security and control of documents is essential to ensure that confidential information is not distributed and that all current copies of a given document are from the latest approved revision. Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Number, Revision Number, Effective Date and Number of Pages. Controlled documents are authorized by Management and/or the QA Department. Controlled documents are marked as such and records of their distribution are maintained by the QA Department. Document control maybe achieved by either electronic or hardcopy distribution.

Controlled documents shall be available at all laboratories where the operational activity described in the document is performed.

6.3 Document Revision

Quality system policies and procedures will be reviewed at a minimum of every two years* and revised as appropriate. Changes to documents occur when a procedural change warrants a revision of the document to reflect the operational or analytical process. When an approved revision of a document is ready for distribution, obsolete copies of the document shall be replaced with the current version of the document. The previous revision of the document must be archived by the QA Department.

* Laboratory's participating in the DoD programs will update their documents every calendar year. Corporate quality documents that support the DoD programs will be reviewed annually by Corporate staff members.

6.4 Official Documents

TestAmerica's Corporate Quality staff posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the intranet site known as Oasis. These are collectively termed "Official Documents".

All TestAmerica laboratories are required to implement the requirements stated in the Corporate Manuals, SOPs and Policies and to incorporate those requirements into their laboratory specific documents. Work Instructions, White Papers and Training Materials provide information and model approaches for implementing the corporate requirements. These materials allow for the capture of corporate knowledge and its preservation within the company.

Each laboratory has the responsibility and authority to operate within the regulatory requirements of the jurisdiction in which their work is performed. Where TestAmerica official documents conflict with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy.

A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving of Corporate Documents is located in the Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archive.

7.0 Service to the Client

7.1 Contract Review

For many environmental sampling and analysis programs, the testing design is site- or program-specific and does not necessarily "fit" into a standard laboratory service or product. It is TestAmerica's intent to provide both standard and customized environmental testing services to our clients. To ensure project success, technical staff shall perform a thorough review of technical and QC requirements contained in contracts. The technical requirements of each contract are reviewed to ensure TestAmerica's capability to meet those requirements.

Contract review shall include a review of the client's requirements in terms of target analyte lists, requested test methods; and sensitivity, accuracy, and precision requirements. The TestAmerica representative ensures that the laboratory's test methods are suitable to achieve these requirements and must ensure that the laboratory holds the appropriate certifications and approvals to perform the work. The review also includes the laboratory's capabilities in terms of turnaround time, capacity, and resources to provide the services requested, as well the laboratory's ability to provide the documentation, whether hardcopy or electronic. If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica laboratory or to an outside firm, TestAmerica will advise the client of that arrangement in writing and, when appropriate and as required by specific programs or projects, gain the approval of the client (refer to Section 8, Subcontracting).

All contracts entered into by TestAmerica shall be reviewed and approved by the appropriate personnel at the laboratory or laboratories performing the work. Any contract requirement or amendment to a contract communicated to TestAmerica verbally must be documented and confirmed with the client in writing. Any discrepancy between the client's requirements and TestAmerica's capability to meet those requirements is resolved in writing before acceptance of the contract. Contract amendments, initiated by the client and/or TestAmerica, are documented in writing for the benefit of both the client and TestAmerica.

All contracts, Quality Assurance Program Plans (QAPPs), Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the permanent project record as defined in Section 14.

7.2 Project Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site-specific testing programs. To achieve this goal, TestAmerica assigns a Project Manager (PM) to each client. The PM is the primary point of contact for the client. It is

the PM's responsibility to ensure that project-specific technical and QC requirements are effectively communicated to the laboratory personnel before and during the project.

Each TestAmerica laboratory shall have established project planning procedures in order to ensure that communication is inclusive and effective. These include project memos, designation and meetings of project teams, and meetings between the laboratory staff and the client. TestAmerica has found it very effective to invite the client into this process. TestAmerica strongly encourages our clients to visit the laboratories and conduct formal or informal sessions with employees in order to effectively communicate ongoing client needs as well as project-specific details for customized testing programs.

7.3 Client Confidentiality

Data and sample materials provided by the client or at the client's request, and the results obtained by TestAmerica, shall be held in confidence (unless such information is generally available to the public or is in the public domain) subject to any disclosure required by law or legal process. TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

7.4 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develop laboratory- and client-specific surveys to assess client satisfaction.

8.0 Subcontracting

TestAmerica may subcontract work to another competent and qualified laboratory, and will advise the client of that arrangement in writing and, when appropriate and as required by specific programs or projects, gain the approval of the client. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending samples to the subcontract laboratory. The originating laboratory shall obtain proof of certification from the subcontract laboratory, and retain this information in their project records. Where applicable, specific QC guidelines, QAPPs, and/or SAPs are transmitted to the subcontract laboratory. Samples are subcontracted under formal Chain of Custody (COC).

Non-TestAmerica subcontract laboratories may receive an on-site audit by a representative of TestAmerica's QA staff if it is deemed appropriate by the QA Manager. The audit involves a measure of compliance with the required test method, QC requirements, as well as any special client requirements. The originating laboratory may also perform a paper audit of the subcontractor, which could entail reviewing the QA Manual, the last two PT studies, and a copy of any recent regulatory audits with the laboratory's responses. Complete details on TestAmerica's Subcontracting Procedure are available in Corporate SOP No. CA-L-S-002.

Project reports from both TestAmerica and external subcontractors are discussed in Section 25.

9.0 Purchasing Services and Supplies

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short-term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Chemical reagents, solvents, glassware, and general supplies are monitored to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents meet with the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with the Corporate SOP No. CA-Q-S-001, Solvent & Acid Lot Testing & Approval.

10.0 Complaints

TestAmerica believes that an effective client complaint handling process has important business and strategic value. Listening to and documenting client's concerns captures "client knowledge" that helps to continually improve the process and outpace the competition. Implementing a client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

Client complaints shall be documented, communicated to management, and addressed promptly and thoroughly. Client complaints are documented by the employee receiving the complaint. The documentation can take the form of a corrective action report (as described in Section 12) or in a format specifically designed for that purpose.

The nature of the complaint is identified, documented, and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA department is notified and may conduct a special audit to assist in resolving the issue. A written confirmation or letter to the client outlining the issue and response taken is strongly recommended as part of the overall action taken.

The number of client complaints shall be reported to the Quality Directors in the QA monthly report submitted by each laboratory. The overall number of complaints received per laboratory is tracked and the appropriateness of the response to client complaints is assessed. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Management Systems Review. Most client feedback is acquired either verbally or in writing. However, TestAmerica also uses a number of additional mechanisms to obtain client feedback including a customer satisfaction survey and a response card system. Each of these is monitored for trends and opportunities for improvement.

11.0 Control of Non-Conforming Work

Each laboratory shall have a procedure to control and document non-conformances. Non-conformances broadly include any QC result outside of established control limits or actions outside of established processes. Non-conformances may relate to client-specific requirements, procedural requirements, or equipment issues. All non-conformances in the laboratory are documented at the time of their occurrence.

All non-conformances that affect a sample and/or sample data become part of the affected project's permanent record. When appropriate, reanalysis is performed where QC data falls outside of specifications, or where data appears anomalous. If the reanalysis is within established tolerances, the results are approved. If the reanalysis is still outside tolerances, further reanalysis or consultation with the Technical Manager, PM, Laboratory Director, or QA Manager for direction may be required. All records of reanalysis are maintained with the data files.

Where non-conformances specifically affect a client's sample and/or data, the client shall be informed and action must be taken. Action can take the form of reporting and flagging the data, and including a description of the non-conformance in the project narrative or cover letter.

12.0 Corrective Action

12.1 General

Each TestAmerica laboratory shall maintain an established and documented corrective action process. The outcome of each investigation, actions taken and follow-up to prevent recurrence is documented. The more significant the issue to be corrected, the more formal the investigation into root cause and the more detailed the documentation that is required.

12.2 Initiation

Any employee in TestAmerica shall be authorized to initiate a corrective action. The initial source of corrective action can also be external to TestAmerica (e.g., client complaint, regulatory audit, or proficiency testing results). When a situation that requires corrective action is identified, the following items are documented by the initiator on the corrective action report (or however named): the nature of the problem; the name of the initiator; and the date identified. If the problem relates to a specific client or project, the name of the client and project number is recorded, and the PM is informed immediately.

12.3 Cause Analysis

The corrective action process must be embarked upon as a joint problem solving and constructive effort. Identification of systematic errors, or errors that are likely to occur repetitively due to a defect or weakness in a system, is particularly valuable in maintaining an environment of continuous improvement in laboratory operations.

When a corrective action report (or however named) is initiated, the initiator works with the affected employee(s) and/or department(s) to identify the root cause of the problem. An essential part of the corrective action process is to identify whether the problem occurred due to a systematic or isolated error.

If the initiator of the corrective action report (or however named) is uncertain as to what would constitute appropriate corrective action or is unable to resolve the situation, the problem is identified to the Technical Manager, Laboratory Director or the QA Manager who provides assistance in the corrective action process. The root cause of the problem and associated cause analysis is documented.

12.4 Corrective Action

Once the root cause of a problem is identified, the initiator and affected employee(s) and/or department(s) examine potential actions that will rectify the present problem to the extent possible, and prevent recurrence of future, similar occurrences. An appropriate corrective action is then recommended. The corrective action must be appropriate for the size and nature of the issue.

If the corrective action concerns a specific project related issue, the PM or the Manager of PMs approves the corrective action before its implementation. Implementation of the corrective action and the date of implementation are documented on the corrective action report (or however named).

If a corrective action is related to a specific project report, it is included in the project file. An essential part of the corrective action process is communication and awareness of the problem, the cause, and the action taken to prevent future occurrences and/or rectify the immediate problem.

12.5 Monitoring Corrective Action

The QA department reviews corrective action reports and selects one or more of the more significant corrective actions for inclusion in the annual systems audit. The QA Department may also implement a special audit. The purpose of inclusion of the corrective action process in both routine and special audits is to monitor the implementation of the corrective action and to determine whether the action taken has been effective in overcoming the issue identified.

13.0 Preventative Action

Each laboratory shall maintain an established and documented preventative action process. Preventative action is identifying process weaknesses which have the potential to lead to failure(s). Preventative action includes analysis of the quality system to detect, analyze, and eliminate potential causes of non-conformances. It may include trend analysis using control charts to detect chemical analysis problems before QC results exceed control limits at a high frequency. When potential problems are identified, preventative action is initiated to effectively address the problem to eliminate or reduce the risk identified.

13.1 Management of Change

A Management of Change System is a documentation system designed to manage significant events and changes that occur within the laboratory. The types of changes include, but are not limited to: major accreditation and approval changes, addition or deletion to laboratory capabilities, key personnel changes and the addition of a new type of instrumentation. Through a documentation system (however named by the laboratories), the potential risks inherent with a

new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures.

A Management of Change System can apply to all areas except in the application of: maintenance, repairs and activities which are "repair or replacement in-kind", and other changes at the discretion of the Laboratory Director. A laboratory may expand on this process for internal changes as long as the basic framework of documentation & communication is followed.

14.0 Control of Records

14.1 Record Types & Record Retention

Table 14-1 outlines TestAmerica's standard record retention time. For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.2.

Table 14-1. Example of TestAmerica Record Types[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs - Lab Reports	5 years from analytical report issue*
Official Documents	- QA Manual - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 years from archival * **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely

	Record Types [1]:	Retention Time:
	Hazardous Waste Permits	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions are listed in each laboratory QA Manual.

14.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the TestAmerica standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement must be implemented and noted in the archive or addressed in a laboratory-specific records retention procedure. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the record retention management system provides information as to who to contact for authorization prior to destroying the data.

Table 14-2. Example - Special Record Retention Requirements

Program	Retention Requirement [1]
Drinking Water – All States	5 years (project records) 10 years - Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (final reports only)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio VAP	10 years and State contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1] Extended retention requirements must be noted with the archive documents or addressed in laboratory-specific records retention procedures.

14.3 Archives and Record Transfer

Archives must be indexed such that records are accessible on either a project or temporal basis. Archives are protected against fire, theft, loss, deterioration, and vermin. Electronic records are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to archives is controlled and documented. On-site and/or off-site laboratories may be used.

TestAmerica ensures that all records are maintained as required by the regulatory guidelines and per the CQMP upon laboratory location change or ownership transfer. Upon a laboratory location change, all archives are retained by TestAmerica in accordance with the CQMP. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established.

15.0 Audits

15.1 Internal Audits - Audit Types and Frequency

Various types of audits shall be performed at the laboratories throughout the calendar year. Audit types and frequencies are categorized in Table 15-1.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality System Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or designee (Refer to SOP No. CW-Q-S-003)	Technical Audits Frequency: 50% of methods annually
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or designee (Refer to SOP No. CW-Q-S-003)	SOP Compliance Review Frequency: • Evert 2 years • 100% of SOPs annually (DoD Labs)
Special	QA Department or designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, accreditation body requirements (such as NVLAP, A2LA and AIHA-LAP, LLC), client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions shall also be assessed. The audit is divided into modules for each operating or support area of the lab, and each module is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may be modified as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. The SOPs are also evaluated as the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be an integral part of the training. All newly trained analysts shall read the SOP for the procedure on which they have been trained, and provide feedback to the technical manager on the SOP and procedure.

15.1.4 Special Audits

Special audits are conducted on an as-needed basis. These are generally as a follow-up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Proficiency Testing (PT)

Each laboratory participates semi-annually (TNI) or annually (Non-TNI) in proficiency testing audits conducted through the analysis of PT samples provided by a third party. The laboratory participates in the types of PT studies pertinent to the work, such as Drinking Water, Non-Potable Water, Soil, Air, and Radiochemistry. The EMLab P&K facility participation in external PT programs and internal round robin PT programs is described in the EMLab Quality Manual and SOPs.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems in the regular production process, they may need to be treated differently as would any special or unique request submitted by a client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to special circumstance; and all such decisions are documented within the project file.

Written responses to unacceptable PT results are required. In some cases, it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control situation for the applicable method/process.

15.2 External Audits

TestAmerica laboratories are routinely audited by clients and external regulatory authorities. TestAmerica is available for these audits and makes every effort to provide the auditors with the personnel, documentation, and assistance required by the auditors. TestAmerica recommends that the audits be scheduled with the QA Department so that all necessary personnel are available on the day of the audit.

15.3 Audit Findings

Audit findings are documented using the corrective action process. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a pre-defined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the laboratory management personnel. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the laboratory's corrective action plan will be forwarded to the Corporate Quality staff.

If any audit finding casts doubt on the effectiveness of the operations or on the validity of the laboratory's test results, the laboratory shall take timely corrective action and investigate the situation. The laboratory shall notify clients in writing if the investigation identified that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit shall be scheduled to ensure that the event has been corrected.

Clients must be notified promptly in writing of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation. Further details are provided in the Corporate SOP No. CW-L-S-002, Internal Investigation & Data Recall.

16.0 Management Reviews

16.1 QA Reports to Management

A monthly QA report shall be prepared by the QA Manager or their designee and forwarded to their Laboratory Director, VP of Operations and Quality Directors. The report includes statistical results that are used to assess the effectiveness of the quality system.

A Corporate QA Monthly Report containing a compilation of the Laboratory QA reports statistics, information on progress of the Corporate QA program, and a narrative outlining significant occurrences and/or concerns shall be compiled by the Quality Directors and forwarded to the Corporate Quality Director who, after preparing comments, forwards the report to the CEO, VP of Quality, Technical & Operations Services and the VP's of Operations.

16.1.1 Monthly QA Report and Metrics

The QA Manager's monthly QA report is due by the third day of the month, or the next business day if the third falls on a non-business day. The report will contain a narrative summary and metrics spreadsheet. At a minimum, the report content will contain the laboratory's status for defined quality metrics and a discussion of both improvements and weaknesses in the quality system. During the course of the year, the Laboratory Director, VP of Operations, Corporate Quality Director or the Quality Directors may request that additional information be added to the report.

16.2 Management Systems Review

Each laboratory shall perform a management quality system review annually in accordance with the Corporate SOP No. CW-Q-S-004, Management Systems Review. This will synchronize quality planning with the fiscal year planning. The management systems review will assess the adequacy of the laboratory's quality system and plan any changes in laboratory organization, policies, practices, and certifications / accreditations in order to achieve operational efficiencies, meet regulatory requirements and client expectations.

17.0 Personnel

17.1 General

TestAmerica management believes that its highly qualified, ethical and professional staff is the single most important asset in assuring the highest level of data quality and service in the industry.

17.1.1 Training

TestAmerica is committed to furthering the professional and technical development of analysts at all levels. Minimum training requirements for TestAmerica employees are outlined in Table 17-1.

Table 17-1. TestAmerica Analyst Minimum Training Requirements

Required Training	Time Frame*	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Refresher	Annually	All

Required Training	Time Frame*	Employee Type
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

**From date of initial employment unless otherwise indicated.*

Technical training is accomplished within each laboratory by the technical management to ensure method comprehension. The laboratory shall have a defined training program. As part of the technical training, all new personnel shall be required to demonstrate competency in performing a particular method by successfully completing an Initial Demonstration of Capability (DOC) before conducting analysis independently on client samples.

DOCs are performed by analysis of four replicate QC samples. Results of successive Laboratory Control Sample (LCS) analyses can be used to fulfill the DOC requirement. The accuracy and precision, measured as average recovery and standard deviation (using n-1 as the population), of the 4 replicate results are calculated and compared to those in the test method (where available). If the test method does not include accuracy and precision requirements, the results are compared to target criteria set by the laboratory. The laboratory sets the target criteria such that they reflect the DQOs of the specific test method or project. A DOC Certification Statement is recorded and maintained in the employee's training or personnel file.

The following documentation must be on file at the laboratory for each technical employee. Additional items may be maintained based on the laboratory-specific QA Manual.

- DOC.
- The employee has read and understood the latest version of the laboratory's quality documentation.
- The employee has read and understood the latest, approved version of all test methods and/or SOPs for which the employee is responsible.
- Annual evidence of continued DOC that may include successful analysis of a blind QC sample on the specific test method, or a similar test method, or an annual DOC, or four successive & successful LCSs.
- An Ethics Agreement signed by each staff member (renewed annually).

17.1.2 Ethics Policy

Establishing and maintaining a high ethical standard is an important element of TestAmerica's Quality System. In order to ensure that all personnel understand the importance the company places on maintaining such standards at all times, TestAmerica has established an *Ethics Policy*, Policy No. CW-L-P-004, and an Ethics Agreement. Each employee shall sign the Ethics Agreement, signifying agreed compliance with its stated purpose. The Ethics Agreement is required to be signed on an annual basis.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize the Company's ability to do work on Government contracts. Inappropriate ethical behavior in any area of the company will not be tolerated.

Ethics is also a major component of TestAmerica's Quality and Data Integrity Systems. Employees must be trained as to the legal and environmental repercussions that result from data misrepresentation. These training guidelines are outlined in Table 17-1. A data integrity hotline is maintained by TestAmerica and administered by the Corporate Quality Department.

18.0 Accommodations & Environmental Conditions

Each laboratory must be secure and access must be controlled and documented. Access is controlled by various measures including locked doors, passwords, electronic access cards, security codes, and staffed reception areas. All visitors sign in and are escorted by TestAmerica personnel while at a laboratory.

TestAmerica's laboratories are designed for efficient, automated high-quality operations. All laboratories are equipped with Heating, Ventilation, and Air Conditioning (HVAC) systems appropriate to the needs of each laboratory. Environmental conditions in the laboratories, such as hood flow, are routinely monitored and documented.

All laboratories are equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. TestAmerica also provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, respirators, etc.

19.0 Test Methods and Method Validation

19.1 Test Methods

Most of the test methods performed at our laboratories originate from test methods published by a regulatory agency such as the U.S. EPA and other state and federal regulatory agencies. These include, but are not limited to, the following published compendiums of test methods:

- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980.*
- *Eastern Environmental Radiation Facility Radiochemistry Procedures Manual, EPA, PB84-215581, June 1984.*
- *HASL-300 28th Edition, Environmental Measurements Laboratory (EML), 1997.*
- *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition, EPA/600/4-90/027F, August 1993.*
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- *Analytical Method for Determination of Asbestos Fibers in Water, EPA-600/4-83, September 1983.*
- *Determination of Asbestos Structures Over 10-mm in Length in Drinking Water, EPA-600/R-94-134, June 1994.*
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of March 12, 2007, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 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. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

19.2 Standard Operating Procedures

Each laboratory shall maintain a Standard Operating Procedure (SOP) Index for both Method and Process SOPs. Method SOPs are maintained to describe a specific test method. Process SOPs are maintained to describe functions and processes not related to a specific test method.

Technical SOPs will contain the following information (in any order):

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Number and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 19-1).

Identification of Test Method
Applicable Matrix
Reporting Limit
Scope and Application, including test analytes
Summary of the Test Method
Definitions
Interferences
Safety
Equipment and Supplies
Reagents and Standards
Sample Collection, Preservation, Shipment and Storage
Quality Control

Calibration and Standardization
Procedure
Calculations
Method Performance
Pollution Prevention
Data Assessment and Acceptance Criteria for Quality Control Measures
Corrective Actions for Out-of-Control Data
Contingencies for Handling Out-of-Control or Unacceptable Data
Waste Management
References
Tables, Diagrams, Flowcharts and Validation Data
Method Modifications
SOP Revision History

Non-Technical SOPs may contain the following information (in any particular order):

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Number and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 19-1).

Scope
Summary
Definitions
Responsibilities

Safety
Procedure
References
Tables, Diagrams and Flowcharts
SOP Revision History

The QA Department is responsible for the maintenance of SOPs, archival of SOP historical revisions, maintenance of an SOP index, and records of controlled distribution. SOPs, at a minimum, must undergo periodic review as described the each laboratory's QA Manual or SOP. Where an SOP is based on a published method, the laboratory must maintain a copy of the reference method.

Figure 19-1. Proprietary Information Statement

Copyright Information:
This documentation has been prepared by TestAmerica Laboratories, Inc. and its affiliates ("TestAmerica"), solely for their own use and the use of their customers in evaluating their qualifications and capabilities in connection with a particular project. The user of this document agrees by its acceptance to return it to TestAmerica upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use it for any purpose other than that for which it was specifically provided. The user also agrees not to give access to this document to any third parties including but not limited to consultants, unless such third parties specifically agree to these conditions.

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SOP Appendix
In some cases, a standard laboratory procedure is modified slightly for a specific client or project at the client or regulatory agency's request. In these cases, an Appendix to the SOP may be attached that indicates the modifications to the SOP which are specific to that project. SOP appendices shall not be used to alter test methods required by regulation such that the modifications would result in non-compliance with the regulation. All client- or project-specific modifications must be approved by laboratory management.

19.3 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of this process. Method validation records are designated QC records and are archived accordingly.

Determination of Method Selectivity
If the new method is based on a published consensus method or an EPA method, then analysis of blanks and spikes as described in the source method is sufficient. If the laboratory is developing a method without a published source method, then more extensive validation is required. The laboratory must perform analysis of spikes in each sample matrix of interest. In some cases to achieve the required selectivity for an analyte, a confirmation analysis may be required.

Determination of Method Sensitivity
The sensitivity of new methods is normally demonstrated using the procedure described in the Corporate SOP No. CA-Q-S-006, Detection Limits. Sensitivity can also be estimated for short-term projects using other techniques (e.g., signal-to-noise ratio of low concentration standards), but only with client agreement.

Limit of Quantitation (LOQ) and Reporting Limit (RL)
The LOQ is the minimum level at which the concentration of an analyte can be determined within limits of confidence required by the data user. The lowest calibration standard must be at or below the LOQ. The LOQ cannot be at or below the detection limit concentration. Confirmed

results between the method detection limit and the LOQ, if reported at all, must be qualified as estimated concentrations. The laboratory's routine reporting limit (RL) is equal to the LOQ, and higher reporting limits may be used to satisfy special project requirements.

Special project RLs can be lower than the lab's standard LOQ if there is a written agreement with the client that poorer bias and precision are acceptable. The client must be informed in writing (e.g., confirmation of communication, letter of agreement, QAPP or report narrative) of the likelihood of less accurate quantitation, increased probability of false positive and false negative results, potential method compliance problems, and/or potential misidentification at the lower concentration. The RL can never be below the method detection limit.

Determination of Freedom From Contamination
A determination performed on a blank matrix that determines the method to be free from contaminants.

Determination of Range
Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally, the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

Determination of Accuracy and Precision
Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria. If the laboratory is developing a method without a published source method, then more extensive validation is required. The laboratory must establish the bias and precision in each sample matrix of interest throughout the working range.

Documentation of Method
The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

Continued Demonstration of Method Performance
Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, Method Blanks (MB) or PT samples.

19.4 Permitting Departures from Documented Procedure

Each laboratory must have a procedure that defines the process, documentation, and level of authorization required to permit departures from documented procedures.

Where a departure from a documented SOP, test method, or policy is determined to be necessary, or unavoidable, the departure shall be documented and be authorized by the appropriate level of management, which is defined in the policy. In some instances, it is appropriate to inform the client before permitting a departure. Any such occurrence is documented in the cover letter and/or project narrative.

20.0 Equipment and Calibration

20.1 Equipment Operation

TestAmerica is committed to routinely updating and automating instrumentation. Our laboratories maintain state of the art instrumentation to perform the analyses within the QC specifications of the test methods. Each laboratory shall maintain an equipment list that must include the following information:

- Date installed or year placed in service;
- Manufacturer's name, model number, serial number; and
- Condition when received.

All equipment is subject to rigorous checks upon its receipt, upgrade, or modification to establish that the equipment meets with the selectivity, accuracy, and precision required by the test method for which it is to be used. All manufacturer's operations and maintenance manuals are to be maintained current to date and accessible for the use of the equipment operator. Documentation of equipment usage is maintained using analytical run and maintenance logbooks or the electronic versions of said documents.

20.2 Equipment Maintenance

Each laboratory must employ a system of preventative maintenance in order to ensure system up time, minimize corrective maintenance costs and ensure data validity. All routine maintenance is performed as recommended by the manufacturer and may be performed by an analyst, instrument specialist or outside technician. Maintenance logbooks or electronic records are kept on all major pieces of equipment in which both routine and non-routine maintenance is recorded. The details of the maintenance activity and date performed are recorded each time service procedures are performed. The return to analytical control following instrument repair must also be documented. Maintenance logbooks or electronic records are retained as QA records.

Maintenance contracts are held on specific pieces of equipment where outside service is efficient, cost-effective, and necessary for effective operation of the laboratory.

20.3 Equipment Verification and Calibration

All equipment shall be tested upon receipt to establish its ability to meet the QC guidelines contained in the test method for which the instrumentation is to be used. This testing shall be documented. Once an instrument is placed in routine service, ongoing instrument calibration is demonstrated at the appropriate frequency as defined in the test method. Refer to the Corporate Policy CA-T-P-002, Selection of Calibration Points, for further guidance. Any instrument that is deemed to be malfunctioning is clearly marked and taken out-of-service. When the instrument is brought back into control, acceptable performance is documented.

20.4 Calibration

Each laboratory must define calibration protocols in their laboratory-specific SOPs. Refer to the Corporate SOP CA-Q-S-005, Calibration Curves, for guidance on the calibration curve models used at TestAmerica and the basic formulae and calculations associated with them.

20.5 Glassware Cleaning

Each laboratory must define glassware cleaning procedures in their laboratory SOPs.

20.6 Data Integrity and Security

This section details those procedures that are relevant to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data. Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

Security and Traceability

Access to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data must be both controlled and recorded. There are various systems at TestAmerica to which this applies, which include the Laboratory Information Management System (LIMS), as well as specific systems such as chromatography data systems.

Control of the system is accomplished through limitation of access to the system by users with the education, training and experience to perform the task knowledgeably and accurately. System users are granted privileges that are commensurate with their experience and responsibilities.

Computer access is tracked by using unique login names and passwords for all employees. "General" or "multi-user" account access to computer systems that collect, analyze and process raw instrumental data, and those that manage and report data shall not be permitted unless documented and approved by laboratory management. Entries and changes are documented with the identity of the individual making the entry, and the time and date. Where a computer system is processing raw instrumental data, the instrument identification number is recorded. Many of these systems have the capability of maintaining audit trails to track entries and changes to the data. This function is activated on any computer system that has that capability.

TestAmerica requires that all sensitive computer systems, defined as LIMS servers and other servers of critical importance, be locked in a secured room. Access must be limited only to employees who need physical access to those systems. This room must also provide climate control within the parameters provided by the vendor of the secured equipment.

Verification

All commercially obtained software shall be verified prior to use and after version upgrade. Verification involves assessing whether the computer system accurately performs its intended function. Verification generally is accomplished by comparing the output of the program with the output of the raw data manually processed, or processed by the software being replaced. The records of the verification are required to contain the following information: software vendor, name of product, version, comparison of program output and manual output, raw data used to verify the program, date, and name of the individual performing the verification. Records of verification are retained with IT personnel.

Validation

Software validation involves documentation of specifications and coding as well as verification of results. Software validation is performed on all in-house programs. Records of validation include original specifications, identity of code, printout of code, software name, software

version, name of individual writing the code, comparison of program output with specifications, and verification records as specified above. Records of validation are retained with IT personnel.

Auditing
The QA Departments quality system audits may include review of the control, security, and tracking of IT systems and software.

Version Control
The laboratory shall maintain copies of outdated versions of software and associated manuals for all software in use at the laboratory for a period of five years from its retirement date. The associated hardware, required to operate the software, must also be retained for the same time period.

21.0 Measurement Traceability

21.1 General

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, De-ionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All temperature measuring devices, including thermometers and thermisters, are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

Laboratory DI and RO water systems must have documented preventative maintenance schedules and the conductivity of the water will be recorded on each day of use.

21.2 Reference Standards Traceability

The receipt of all reference standards must be documented. References standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All standards should be purchased with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate

of Analysis, the purity of the standard is documented by analysis. The documentation of standard purity is archived, and references the Standard Identification Number.

All efforts are made to purchase standards that are ≥97.0% purity or as prescribed by the methods. If this is not possible, the purity is used in performing standards calculations.

All initial calibrations shall be verified with a standard obtained from a second manufacturer or from a different lot. For the DoD ELAP program, a second lot is acceptable when only one manufacturer of the standard exists or when the vendor guarantees that the second lot is from a different manufacturer. The appropriate QC criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS is used as the second source confirmation.

21.3 Reagents

Reagents are, in general, required to be analytical reagent grade unless otherwise specified in method SOPs. Reagents must be, at a minimum, the purity required in the test method. The date of reagent receipt and/or preparation and the expiration date are documented.

22.0 Sampling

22.1 Sampling Plans

Sample representativeness and integrity are the foundations upon which meaningful analytical results rely. Where documented and approved SAPs and/or QAPPs are in place, they must be approved by laboratory management and be available to the laboratory before sample receipt.

23.0 Handling of Samples

23.1 General

Chain of Custody (COC) can be established either when sample containers are sent to the field, or at the time of sampling. TestAmerica can provide all of the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms and packing materials/instructions required to properly preserve, pack, and ship samples to the laboratory.

Samples are received at the laboratory by a designated sample custodian and a unique Laboratory Project Identification Number is assigned. The following information is recorded for each sample shipment: Client/Project Name, Date and Time of Laboratory Receipt, Laboratory Project Number, and Signature or initials of the personnel receiving the cooler and making the entries.

Upon inspection of the cooler and custody seals, the sample custodian opens and inspects the contents of the cooler, and records the cooler temperature. If the cooler arrival temperature exceeds the required or method specified temperature range; sample receipt is considered "compromised" and the procedure described in Section 23.2 is followed. All documents are immediately inspected to assure agreement between the test samples received and the COC.

Any non-conformance, irregularity, or compromised sample receipt as described in Section 23.2 must be documented and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the permanent project record.

Samples that are being tested at another TestAmerica laboratory or by an external subcontractor shall be appropriately packaged and sent out under COC.

Following sample labeling as described in Section 23.3, the samples are placed in storage (refrigerated, frozen or room temperate, as applicable). Sample storage is required to be access-controlled. All samples are stored according to the requirements outlined in the test method and in a manner such that they are not subject to cross contamination or contamination from their environment. Unless specified by method or state regulation, a tolerance range of 0-6°C is used for refrigerated storage. Sample storage temperatures are monitored daily.

23.2 Sample Acceptance Policy

Each laboratory shall maintain a sample acceptance policy that describes compromised sample receipt. Samples shall be considered "compromised" if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond the specified holding time.
- Samples are received without appropriate preservative.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When "compromised" samples are received, it must be documented by the laboratory and the client must be contacted for instructions. If the client decides to proceed with the analysis, the project report shall clearly indicate any of the above conditions and the resolution. If resolution is not reached with the client or the client cannot be contacted, then the "compromised" samples should be rejected.

23.3 Sample Identification and Traceability

Each sample container shall be assigned a unique Sample Identification Number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a sample identification label.

All unused portions of samples are returned to the secure sample control area. Where required by the project, empty sample containers are also retained.

23.4 Sub-sampling

Sub-sampling procedures must be referenced in each laboratory's QA Manual and documented in their SOPs.

23.5 Sample Preparation

Sample preparation procedures must be referenced in each laboratory's QA Manual and documented in their SOPs.

23.6 Sample Disposal

Each laboratory shall have an SOP describing sample retention and disposal procedures. Samples should be retained in the laboratory-designated storage location(s) for a minimum of 30 days after the project report is sent; however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for a longer time-frame based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Samples may be returned to the client per written request. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

Samples shall be disposed of in accordance with federal, state and local regulations. Each laboratory must have an SOP detailing the disposal of samples, digestates, and extracts. All laboratories shall remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated).

24.0 Assuring the Quality of Test Results

24.1 Control Samples

Control samples are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch. Control samples must be uniquely identified and correlated to unique batches. There are also a number of QC sample types that monitor field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Control sample types and typical frequency of their application are outlined in Table 24-1. Note that frequency and use of control samples vary with specific regulatory, methodology and project specific criteria. Table 24-1 does not define TestAmerica's approach to the application of QC samples for each regulatory program or test method.

Table 24-1. Example of Control Samples

Laboratory QC Sample Type	Use	Required Frequency
Laboratory Control Sample (LCS) (Laboratory Fortified Blank)	Measures accuracy of the method in a blank matrix	Generally 1 for each batch of samples; not to exceed 20 environmental samples.
Method Blank (MB)	Measures method contribution to any source of contamination	Generally 1 for each batch of samples; not to exceed 20 environmental samples.
Instrument Blank	Measures instrumental contribution to any source of contamination	As specified in test method
Reference Toxicant	Measure sensitivity of test organisms (Aquatic toxicology)	Annually

Field QC Sample Type	Use	Typical Frequency
Matrix Duplicate (MD)	Measures the effect of the site matrix on the precision of the method	Per 20 samples per matrix or per SAP/QAPP[1]
Matrix Spike (MS)	Measures the effect of the site matrix on the accuracy of the method	Per 20 samples per matrix or per SAP/QAPP
Matrix Spike Duplicate (MSD)	Measures the effect of the site matrix on the precision of method	Per 20 samples per matrix or per SAP/QAPP[1]
Equipment Blank (Equipment Rinsate)	Measures field equipment contribution to any source of contamination	Per SAP/QAPP
Trip Blank	Measures shipping contribution to any source of contamination (Volatiles only)	Per Cooler
Field Blank	Measures the field environment contribution to any source of contamination	Per SAP/QAPP
Field Duplicate	Measures representativeness of the sampling and the effect of the site matrix on precision	Per SAP/QAPP

[1] Either an MSD or an MD is required per 20 samples per matrix or per SAP/QAPP.

24.2 Review / Verification Procedures

The data review process at the laboratory starts at the Sample Receiving level. Sample Receiving personnel review COC forms and input the sample information and required analyses into the LIMS. A secondary review of the transaction of the COC forms and the inputted information is also performed by sample receiving personnel. The PMs perform final review of the COC forms and inputted information.

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 LIMS and add data qualifiers, if applicable. To ensure data compliance, a different analyst 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, initial calibrations, calibration verifications, blank runs, QA/QC check results, continuing calibration results, LCSs, sample data, qualifiers and spike information are evaluated. Approximately 15% of all sample data from manual methods, including manual calculations are reviewed. For automated methods, all GC/MS spectra and all manual integrations are reviewed. Manual integrations are also electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. 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.
- Isometric pairs or commonly mis-identified peaks (GC, HPLC and GCMS)

Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, PM, QA Manager or Technical Manager for further investigation. Corrective action is initiated whenever necessary.

Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements.

All data, regardless of regulatory program or level of reporting, shall be subject to a thorough review which involves a primary, secondary, and completeness review process. All levels of the review must be documented.

Any anomalous results and/or non-conformances noted during the Primary Review are documented on a data review checklist (defined by each laboratory) communicated to the Technical Manager and the PM for resolution. Resolution can require sample reanalysis, or it may require that data be reported with a qualification. Non-conformances are documented per Section 12.

24.2.1 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a

poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory must train all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP No. CA-Q-S-002, Acceptable Manual Integration Practices, as the guideline.

24.3 Development of QC Criteria, Non-Specified in Method/Regulation

Where a method or regulation does not specify acceptance and/or rejection criteria, the laboratory must develop a policy for such situations and criteria. The policy must address how the laboratory examines the data user's needs and the demonstrated sensitivity, accuracy and precision of the available test methods in determining appropriate QC criteria.

Data users often need the laboratory's best possible sensitivity, accuracy, and precision using a routinely offered test method, or are unsure of their objectives for the data. For routine test methods that are offered as part of TestAmerica's standard services, the laboratory bases the QC criteria on statistical information such as determination of sensitivity, historical accuracy and precision data, and method verification data. The method SOP includes QC criteria for ongoing demonstration that the established criteria are met (e.g., acceptable LCS accuracy ranges, precision requirements, MB requirements, initial and continuing calibration criteria, etc.).

In some cases, a routine test method may be more stringent than a specific data user's needs for a project. The laboratory may either use the routinely offered test method, or may opt to develop an alternate test method based on the data user's objectives for sensitivity, accuracy, and precision. In this case, it can be appropriate to base the QC criteria on the data user's objectives, and demonstrate through method verification and ongoing QC samples that these objectives are met.

For example, a client may require that the laboratory test for a single analyte with specific DQOs for sensitivity, accuracy, and precision as follows: Reporting Limit of 10 ppm, Accuracy $\pm$25%, and RSD <30%. The laboratory may opt to develop a method that meets these criteria and document the results of the MBs, MDL study, and LCSs that the method satisfies those objectives. In this case, both the method and the embedded QC criteria have been based on the client's DQOs.

In some cases, the data user needs more stringent sensitivity, accuracy, and/or precision than the laboratory can provide using a routine test method. In this case, it is appropriate that the laboratory provide documentation of the sensitivity, accuracy, and precision obtainable to the data user and let the data user determine whether to use the best available method offered by the laboratory, or determine whether method development or further research is required.

25.0 Reporting Results

25.1 Project Reports

All TestAmerica Project Reports that are generated under TNI requirements must contain the content as described below. This criteria applies to all Project Reports.

25.2 Project Report Content

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. At a minimum, the standard laboratory report shall contain the following information:

- A report title (e.g., Analytical Report for Samples) with a "sample results" column header.
- Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.
- A unique identification of the report (e.g., work order number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.
- A copy of the chain of custody (COC).
- The name and address of client and a project name/number, if applicable.
- Client project manager or other contact.
- Description and unambiguous identification of the tested sample(s) including the client identification code.
- Date of sample receipt, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.
- Date reported or date of revision, if applicable.
- Method of analysis including method code (EPA, Standard Methods, etc.).
- Limit of Quantitation or Reporting Limit.
- Method Detection Limits (if requested).
- Definition of Data qualifiers and reporting acronyms (e.g., ND).
- Sample results.
- QC data consisting of MB, surrogate, LCS, and MS/MSD recoveries and control limits (if requested).
- Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets.
- A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.
- A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.
- A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Laboratory Director. For AIHA-LAP, LLC, the approved signatory shall be the Technical Manager or his/her designee.
- When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

- Where a reference to AIHA-LAP, LLC or NVLAP accreditation is on the reports the final test results must clearly show which results are recognized under AIHA-LAP, LLC or NVLAP accreditation and which do not.
- Report cover page.
- Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.
- When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.
- Appropriate laboratory certification number for the state of origin of the sample, if applicable.
- If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report, or how your lab identifies it). A complete report must be sent once all of the work has been completed.
- Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

Note: Refer to the Corporate SOP No. CA-I-P-002, Electronic Reporting and Signature Policy, for details on internally applying electronic signatures of approval.

25.3 Electronic Data Deliverables

Electronic Data Deliverables (EDD) are routinely offered as part of TestAmerica's services. TestAmerica offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process outlined in Section 7. Once the laboratory has committed to providing data in a specific format that is agreeable to all parties, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained as a QC record.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Project Report Format

TestAmerica offers a wide range of project reporting formats, including EDDs, short report formats, and complete data deliverable packages modeled on the Contract Laboratory Protocol (CLP) guidelines. More information on the range of project reports available can be obtained by contacting any TestAmerica laboratory. Regardless of the level of reporting, all projects must undergo the levels of review as described in Section 24.2.

Appendix 1. List of Cited TestAmerica Corporate Policies & SOPs

Document No.	Title
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-005	Calibration Curves (General)
CW-Q-S-001	Corporate Document Control and Archives
CA-Q-S-006	Detection Limits
CA-I-P-002	Electronic Reporting and Signature Policy
CW-L-P-004	Ethics Policy
CW-Q-S-003	Internal Auditing
CW-L-S-002	Internal Investigation & Data Recall
CW-Q-S-004	Management Systems Review
CA-T-P-002	Selection of Calibration Points
CA-Q-S-001	Solvent & Acid Lot Testing & Approval
CA-L-S-002	Subcontracting Procedures

Cover Page:

Quality Assurance Manual

TestAmerica Buffalo
10 Hazelwood Drive
Amherst, New York 14228
716.504.9800
716.691.7991

www.testamericainc.com

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Title Page:
Quality Assurance Manual
Approval Signatures

Laboratory Director – Kene' Kasperek — 4/3/2015 Date

Quality Assurance Manager - Brad Prinzi — 4/3/2015 Date

Inorganic Operations Manager – Jennifer Pierce — 4/3/2015 Date

Organic Operations Manager – Michelle Freeman — 4/3/2015 Date

Organic Preparation Manager – David Evers — 4/3/2015 Date

Wet Chemistry Manager – James Rojecki — 4/3/2015 Date

GC Semivolatiles / Volatiles Manager – Gary Rudz — 4/3/2015 Date

Metals Manager – Todd Brandt — 4/3/2015 Date

GC/MS Semivolatiles – Jason Michalek — 4/3/2015 Date

Facilities Manager – Ken Kinecki — 4/3/2015 Date

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CA-L-S-002	Subcontracting Procedures
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CA-Q-S-004	Method Compliance & Data Authenticity Audits

REFERENCED LABORATORY SOPs

SOP Reference	Title
BF-GP-001	Calibration of Autopipettes and Repipetters
BF-GP-002	Support Equipment: Maintenance, Record Keeping and Corrective Actions
BF-GP-005	Sample Homogenization and Subsampling
BF-GP-012	Technical Data Review
BF-GP-013	Manual Integration
BF-GP-015	Record Storage and Retention
BF-GP-018	Strict Internal Chain or Custody

BF-GP-019	Standard Traceability and Preparation
BF-GP-020	Thermometer Calibration
BF-PM-001	Project Information Requirements
BF-PM-003	Bottle Order Set-up
BF-PM-005	Correctness of Analysis
BF-QA-001	Determination of Method Detection Limits
BF-QA-002	Quality Control Limits
BF-QA-003	Procedure for Writing, Reviewing and Revising Controlled Documents
BF-QA-004	Laboratory Personnel Training
BF-QA-005	Preventative and Corrective Action
BF-QA-006	Data Quality Review
BF-SR-001	Cooler Shipping - Bottle Kits and Samples
BF-SR-002	Receipt of Analytical Samples

SECTION 3

INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Buffalo's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards, The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025(E) In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition September 1986, Final Update I, July 1992, Final Update II A, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261. New York State Analytical Services Protocol, July 2005
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, and on-line Editions. 21st.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *U.S. Department of Energy* Order 414.1C, *Quality Assurance*, June 17, 2005.
- *U.S. Department of Energy*, *Quality Systems for Analytical Services*, Revision 3.6, November 2010.
- Toxic Substances Control Act (TSCA).

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Section 19.0. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director/Manager and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director/Manager and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. The manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing

regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & updating procedures (refer to BF-QA-003)

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 OVERVIEW

TestAmerica Buffalo is a local operating unit of TestAmerica Laboratories, Inc. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., Chief Executive Officer, Executive VP Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Buffalo is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Buffalo laboratory.

4.2.2 Laboratory Director

TestAmerica Buffalo's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

The Laboratory Director has the authority to affect those policies and procedures to ensure that only data of the highest level of excellence are produced. As such, the Laboratory Director is responsible for maintaining a working environment which encourages open, constructive problem solving and continuous improvement.

Specific responsibilities include, but are not limited to:

- Provides one or more department managers for the appropriate fields of testing. If the Department Manager is absent for a period of time exceeding 15 consecutive calendar

days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Department Manager to temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary NELAC accrediting authority must be notified in writing.

- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Pursues and maintains appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensures client specific reporting and quality control requirements are met.
- Leads the management team, consisting of the QA Manager, the Technical Manager, and the Operations Manager as direct reports.

4.2.2 Quality Assurance (QA) Manager or Designee

The QA manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director and their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA department to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.

- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems, data authenticity and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a subset of all final data reports for internal consistency.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Leads the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the

QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.

- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025.

4.2.3 Technical Manager or Designee

The Technical Manager(s) report(s) directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.

- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.

4.2.4 Operations Manager

The Operations Manager manages and directs the analytical production sections of the laboratory. He/She reports directly to the Laboratory Director. He/She assists the Technical Manager in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Technical Manager and QA Manager and in compliance with regulatory requirements.
- Is responsible for efficient utilization of supplies.
- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.5 Department Managers

Department Managers report to the Operations Manager. The Department Managers serve as the technical experts on assigned projects, provide technical liaison, assist in resolving any technical issues within the area of their expertise; and implement established policies and procedures to assist the Operations Manager in achieving section goals. Each one is responsible to:

- Ensure that analysts in their department adhere to applicable SOPs and the QA Manual. They perform frequent SOP and QA Manual review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- With regard to analysts, participates in the selection, training, and development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Human Resources

Departments. They evaluate staffing sufficiency and overtime needs. Training consists of familiarization with SOP, QC, Safety, and computer systems.

- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager, Operations Manager, and/or QA Manager. Each is responsible for 100% of the data review and documentation, non-conformance and CPAR issues, the timely and accurate completion of performance evaluation samples and MDLs, for his department.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Report all non-conformance conditions to the QA Manager, Technical Manager, Operations Manager, and/or Laboratory Director.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintain adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieve optimum turnaround time on analyses and compliance with holding times.
- Conduct efficiency and cost control evaluations on an ongoing basis to determine optimization of labor, supplies, overtime, first-run yield, capacity (designed vs. demonstrated), second- and third-generation production techniques/instruments, and long-term needs for budgetary planning.
- Develop, implement, and enhance calibration programs.
- Provide written responses to external and internal audit issues.

4.2.6 Hazardous Waste Coordinator

The Hazardous Waste Coordinator reports directly to the Laboratory Director. The duties consist of:

- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.

4.2.7 Environmental Health & Safety Coordinator

The Environmental Health and Safety Coordinator reports to the Laboratory Director and ensures that systems are maintained for the safe operation of the laboratory. The Safety Officer is responsible to:

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Safety Data Sheet (SDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is "reasonable" and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica's medical consultants.

4.2.8 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.

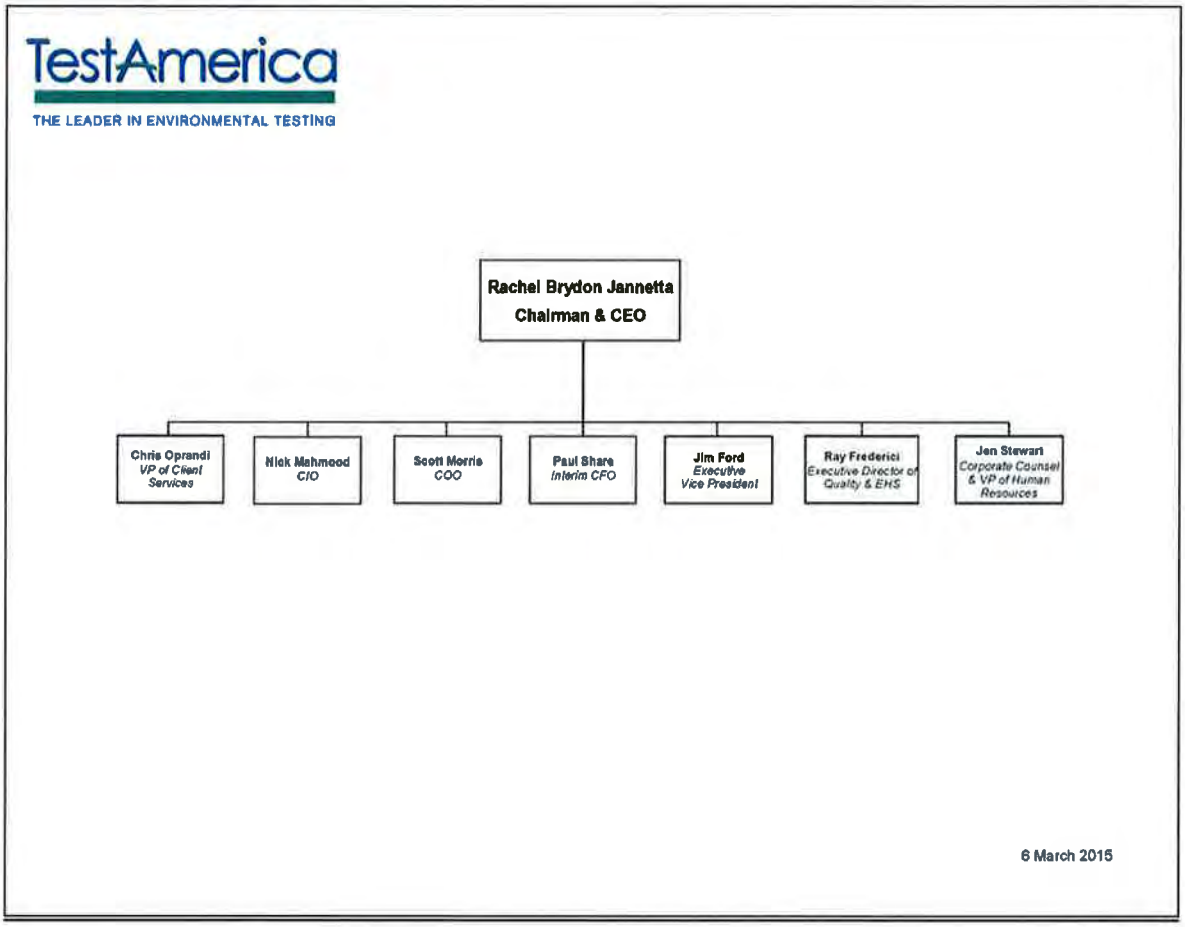
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.

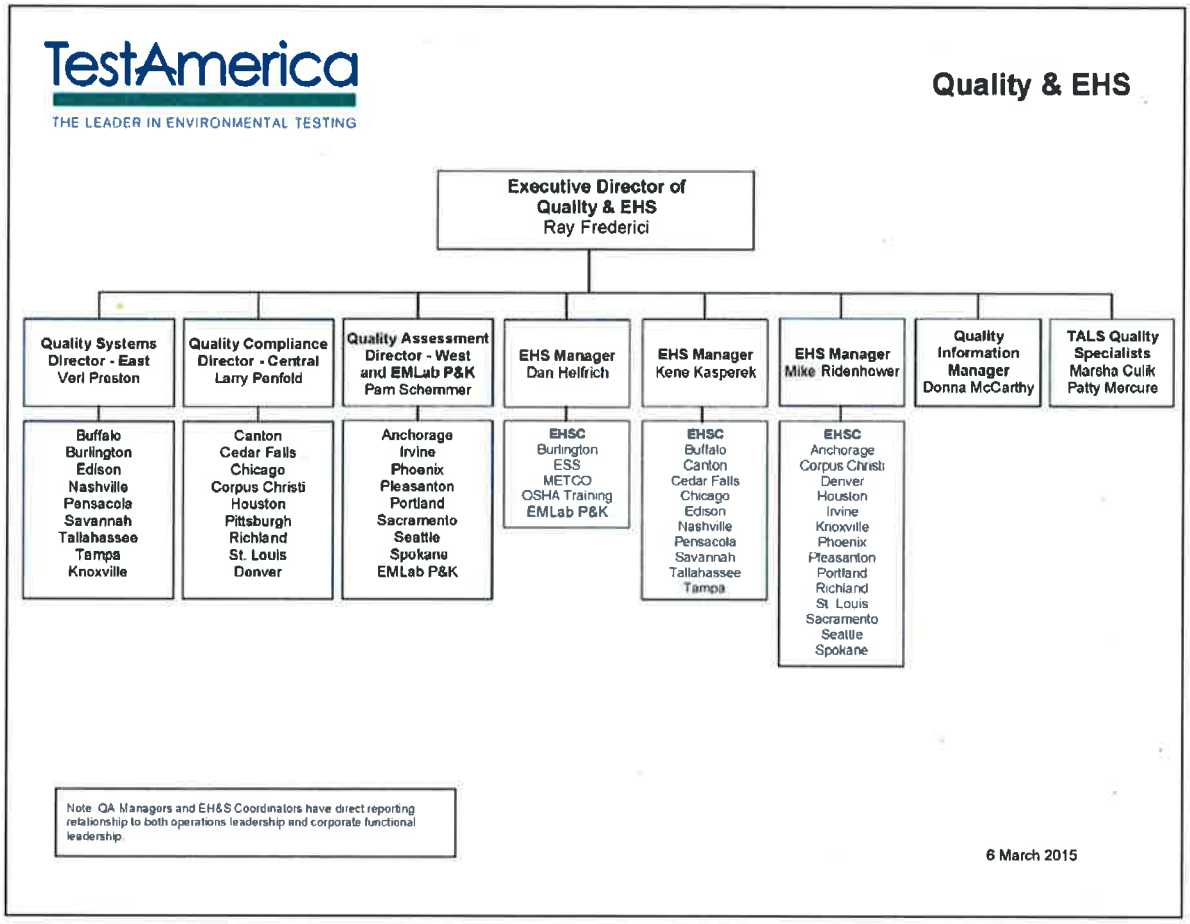
4.3 DEPUTIES

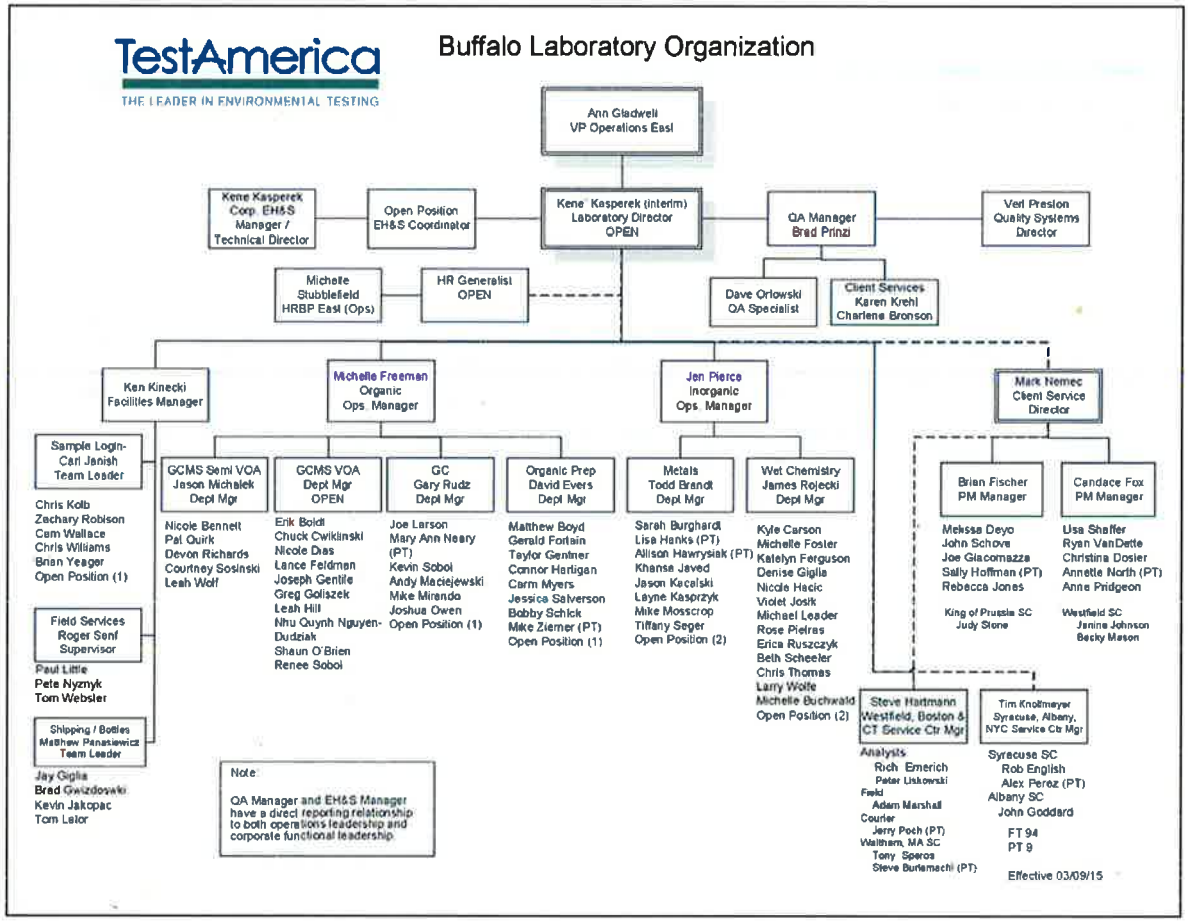
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director	Operations Manager (1) Technical Manager (2)	
QA Manager	QA Specialist (1) Operations Manager (2)	
Technical Manager	Laboratory Director (1) Operations Manager (2)	
Operations Manager	Department Manager (1) Department Manager (2)	Selected based on availability
Manager of Project Management	Project Manager (1) Client Services Director (2)	Selected based on availability
Project Manager	Project Manager (1) Project Management Asst. (2)	(1) 2° team PM (2) Team PMA
Organic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Inorganic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Data Validation / Data Packaging Manager	Data Validation Specialist Data Packaging Specialist	Selected based on department and availability
EHS Coordinator	Laboratory Director (1) EHS Manager (2)	
Sample Management Manager	Sample Custodian (1) EHS Coordinator (2)	
Bottle Preparation / Shipping Manager	Bottle Prep Technician (1) Sample Mng't Manager (2)	

Figure 4-1.
Corporate and Laboratory Organization Charts




TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
Quality & EHS
Executive Director of Quality & EHS
Ray Frederici
Quality Systems Director - East
Veri Preston
Quality Compliance Director - Central
Larry Penfold
Quality Assessment Director - West and EMLab P&K
Pam Schemmer
EHS Manager
Dan Helfrich
EHS Manager
Kene Kasperek
EHS Manager
Mike Ridenhower
Quality Information Manager
Donna McCarthy
TALS Quality Specialists
Marsha Culik
Patty Mercure
Buffalo
Burlington
Edison
Nashville
Pensacola
Savannah
Tallahassee
Tampa
Knoxville
Canton
Cedar Falls
Chicago
Corpus Christi
Houston
Pittsburgh
Richland
St. Louis
Denver
Anchorage
Irvine
Phoenix
Pleasanton
Portland
Sacramento
Seattle
Spokane
EMLab P&K
EHSC
Burlington
ESS
METCO
OSHA Training
EMLab P&K
EHSC
Buffalo
Canton
Cedar Falls
Chicago
Edison
Nashville
Pensacola
Savannah
Tallahassee
Tampa
EHSC
Anchorage
Corpus Christi
Denver
Houston
Irvine
Knoxville
Phoenix
Pleasanton
Portland
Richland
St. Louis
Sacramento
Seattle
Spokane
Note: QA Managers and EH&S Coordinators have direct reporting relationship to both operations leadership and corporate functional leadership.
6 March 2015


TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
Buffalo Laboratory Organization
Ann Gladwell
VP Operations East
Kene Kasperek
Corp. EH&S Manager / Technical Director
Open Position
EH&S Coordinator
Kene Kasperek (interim)
Laboratory Director
OPEN
QA Manager
Brad Prinzi
Veri Preston
Quality Systems Director
Michelle Stubblefield
HRBP East (Ops)
HR Generalist
OPEN
Dave Orlowski
QA Specialist
Client Services
Karen Krehl
Charlene Bronson
Ken Kinecki
Facilities Manager
Michelle Freeman
Organic Ops. Manager
Jen Pierce
Inorganic Ops. Manager
Mark Nemec
Client Service Director
Sample Login-
Carl Janish
Team Leader
Chris Kolb
Zachary Robison
Cem Wallace
Chris Williams
Brian Yeager
Open Position (1)
GCMS Semi VOA
Jason Michalek
Dept Mgr
Nicole Bennett
Pat Quirk
Devon Richards
Courtney Sosinski
Leah Wolf
GCMS VOA
Dept Mgr
OPEN
Erik Boldt
Chuck Cwiklinski
Nicole Das
Lance Feldman
Joseph Gentile
Greg Goliszek
Leah Hill
Nhu Quynh Nguyen-Dudziak
Shaun O'Brien
Renee Soboi
GC
Gary Rudz
Dept Mgr
Joe Larson
Mary Ann Neary (PT)
Kevin Soboi
Andy Maciejewski
Mike Miranda
Joshua Owen
Open Position (1)
Organic Prep
David Evers
Dept Mgr
Matthew Boyd
Gerald Fortain
Teyfor Gentner
Connor Hartigan
Carm Myers
Jessica Salverson
Bobby Schick
Mike Ziemer (PT)
Open Position (1)
Metals
Todd Brandt
Dept Mgr
Sarah Burghardt
Lisa Hanks (PT)
Allison Hawrysiak (PT)
Khansa Javed
Jason Kacalski
Layne Kasprzyk
Mike Mosscrop
Tiffany Seger
Open Position (2)
Wet Chemistry
James Rojecki
Dept Mgr
Kyle Carson
Michelle Foster
Katelyn Ferguson
Denise Giglia
Nicole Hacic
Violet Josik
Michael Leader
Rose Pietras
Erica Ruszczyk
Beth Scheeler
Chris Thomas
Larry Wolfe
Michelle Buchwald
Open Position (2)
Brian Fischer
PM Manager
Melissa Deyo
John Schove
Joe Giacomazza
Sally Hoffman (PT)
Rebecca Jones
King of Prussia SC
Judy Stone
Candace Fox
PM Manager
Usa Shaffer
Ryan VanDette
Christina Dosier
Annette North (PT)
Anne Pridgeon
Westfield SC
Janine Johnson
Becky Mason
Field Services
Roger Senf
Supervisor
Paul Little
Pete Nyznyk
Tom Webster
Shipping / Bottles
Matthew Panasiewicz
Team Leader
Jay Giglia
Brad Gwizdowski
Kevin Jakopac
Tom Lelor
Steve Hartmann
Westfield, Boston & CT Service Ctr Mgr
Analysts
Rich Emerich
Peter Liskowski
Field
Adam Marshall
Courier
Jerry Poch (PT)
Waltham, MA SC
Tony Speros
Steve Burlamachi (PT)
Tim Knollmeyer
Syracuse, Albany, NYC Service Ctr Mgr
Syracuse SC
Rob English
Alex Perez (PT)
Albany SC
John Goddard
FT 94
PT 9
Note:
QA Manager and EH&S Manager have a direct reporting relationship to both operations leadership and corporate functional leadership.
Effective 03/09/15

SECTION 5

QUALITY SYSTEM

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the NELAC Standards (2003), ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The 7 elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A training program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-L-S-002).

- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents:

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratories normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains Quality Control Limit Data in their LIMS system. A summary report is generated from LIMS to check the precision and accuracy acceptability limits for performed analyses on request. The summary report is generated and is managed by the laboratory's QA department. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are contained in Section 24.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The procedure for determining the statistical limits may be found in SOP BF-QA-002, Quality Control Limits. The analysts are instructed to use the current limits in the laboratory (dated and approved the QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory through date sensitive tables within the LIMs System. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The QA Manager periodically evaluates these to determine if adjustments need to be made or for corrective actions to methods (SOP No. BF-QA-002). All findings are documented and kept on file.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. BF-QA-003.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action notices. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item, or an 'end of document' page, the effective date, revision number and the laboratory's name. The Quality personnel are responsible for the maintenance of the system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a Department Manager submits an electronic draft to the QA Department for

suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units. Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years for the majority of procedures. Exceptions include review every 1 year for Drinking Water programs and the Kentucky CWA program. Changes to documents occur when a procedural change warrants.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual, refer to SOP No. BF-QA-003, "Writing, Reviewing and Revising Controlled Documents". Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. A controlled electronic copy of the current version is maintained on the laboratory Intranet site and is available to all personnel.

For changes to SOPs, refer to SOP No. BF-QA-003, "Writing, Reviewing and Revising Controlled Documents".

Forms, worksheets, work instructions and information are organized by department and are maintained electronically by QA. There is a table of contents. As revisions are required, a new version number and revision date is assigned. Controlled electronic copies are made available on a public server for laboratory staff to access.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. BF-GP-015.

SECTION 7

SERVICE TO THE CLIENT

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relations Manager or Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002, Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Contact Administrator
- VP of Operations
- Laboratory Project Manager
- Laboratory and/or Corporate Technical Managers
- Corporate Information Technology Managers/Directors
- Regional and/or National Account representatives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Contracts Department maintains copies of all signed contracts. The Project Managers at the TestAmerica Buffalo facility also maintains copies of these documents.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal a PM is assigned to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements. Specific information related to project planning may be found in SOP BF-PM-001, Project Information Requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the management staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department Manager.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers/Designees are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service.

TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8

SUBCONTRACTING OF TESTS

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOP's on Subcontracting Procedures (CA-L-S-002).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Client Service Managers (CSM), or Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies, such as the Department of Energy and the USDA, may require notification prior to placing such work.

Approval may be documented through reference in a quote / contract or e-mail correspondence.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM, Account Executive (AE) or Client Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be
- as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica. A listing of all approved subcontracting laboratories is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab. Verify necessary accreditation, where applicable (e.g. on the subcontractors TNI, A2LA accreditation or State certification.
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- TNI or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work-sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs.

When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager/Designee begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. Once all documents are reviewed for completeness, the Corporate QIM will forward the documents to the Purchasing Manager for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and
- Corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report (Form No. CW-F-WI-009).
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories and Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Laboratory Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Corporate Counsel can tailor the document or assist with negotiations, if needed. The PM (or AE or CSM, etc.) responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented on a Subcontract Laboratory Certification Verification Form (Figure 8-1) and the form is retained in the project folder. For TestAmerica laboratories, certifications can be viewed on the company TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples workshared

within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilities successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data are incorporated into the laboratories EDD (i.e. imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. . The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

Figure 8-1 Subcontracting Laboratory Approval Form (Initial / Renewal)

SUBCONTRACTING LABORATORY APPROVAL

Reference: Section 8 – Quality Assurance Manual

Date: _____
Laboratory: _____
Address: _____

_____

Contact and e-mail address: _____
Phone: Direct _____ Fax _____

Requested Item[3]	Date Received	Reviewed/ Accepted	Date
1. Copy of State Certification[1]			
2. Insurance Certificate			
3. USDA Soil Permit			
4. Description of Ethics Program[3]			
5. QA Manual[3]			
6. Most Recent (and relevant) 2 Sets of WP/WS Reports with Corrective Action Response[1,3]			
7. State Audit with Corrective Action Response (or NELAC or A2LA Audit)[3]			
8. Sample Report[3]			
9. SOQ or Summary list of Technical Staff and Qualifications[3]			
10. SOPs for Methods to Be Loadshifted[2,3]			
11. For DoD Work: Statement that Lab quality system complies with QSM.			
12. For DoD Work: Approved by specific DoD Component laboratory approval process.			

1 - Required when emergency procedures are implemented.
2 - Some labs may not submit copies due to internal policies. In these cases, a copy of the first page and signature page of the SOP is acceptable. This requirement may also be fulfilled by supplying a table of SOPs with effective dates.
3 – If the laboratory has NELAC accreditation, Item #s 4 through 10 are not required.

On Site Audit Planned: YES NO If yes, Date Completed: _____ By Whom: _____

Comments: _____

Lab Acceptable for Subcontracting Work: YES NO Limitations: _____

QA Manager (Signature): _____ Date: _____

□ Forwarded to Contract Coordinator, by: _____ Date: _____

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Company-Wide Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001 and TestAmerica Buffalo SOP on Solvent Purity, SOP BF-OP-013.

9.3.1 Purchasing

Chemical reagents, solvents, glassware and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. Purchase requisitions are

placed into the J.D. Edwards system by designated departmental personnel. The listing of items available in the J.D. Edwards system has been approved for use by the corporate purchasing staff. Each purchase requisition receives final approval by the laboratory Operations Manager or purchasing coordinator before the order is submitted.

The analyst may also check the item out of the on-site consignment system that contains items approved for laboratory use.

9.3.2 Receiving

It is the responsibility of the purchasing manager/designee to receive the shipment. It is the responsibility of the department that ordered the materials to date the material when received. Once the ordered reagents or materials are received, the department that submitted the order compares the information on the label or packaging to the original order to ensure that the purchase meets quality level specified. Safety Data Sheets (SDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOP expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date cannot not be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.

- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The comparison studies are maintained along with the calibration raw data for which the reagent was used.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- umho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Department Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in the LIMS system, files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. DOC No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, is followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Department Managers, Operations Manager and/or Technical Manager.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurements & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers /vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the

problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form (available on the intranet site).

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Manager are consulted with vendor and product selection that have an impact on quality.

SECTION 10

COMPLAINTS

10.1 OVERVIEW

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, e.g., communications, responsiveness, data, reports, invoicing and other functions expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing with both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented in the laboratory SOP related Corrective Action (BF-QA-005).

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to BF-QA-005.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likely hood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 13. In addition, Corporate Management, Sales and Marketing and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16)

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory standard procedures, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the department manager for resolution. The department manager may elect to discuss it with the Technical Manager, QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's non-conformance and corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director, Technical Manager, Operations Manager or QA Manager, documented and included in the project folder. Deviations must also be noted on the final report with a statement that the compound is not reported in compliance with the analytical method requirements and the reason.

11.2 RESPONSIBILITIES AND AUTHORITIES

TestAmerica's Corporate SOP entitled Internal Investigation of Potential Data Discrepancies and Determination for Data Recall (SOP No. CW-L-S-002) outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances the Laboratory Director, the Technical Manager, the Operations Manager or a member of the QA team may exceptionally authorize departures from documented procedures or policies. The departures may be a result of procedural changes due

to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's non-conformance and corrective action procedures described in Section 12. This information may also need to be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility senior laboratory management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, Technical Manager, and QA Manager. Suspected misrepresentation issues may also be reported to any member of the corporate staff as identified in Ethics Policy, CA-L-P-001. The data integrity hotline (1-800-736-9407) may also be used. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & EHS and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, Executive VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CW-L-S-002 distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i.e., Project Management, Log-in, etc...). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager, Operations Manager, QA Manager, Department Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12

CORRECTIVE ACTION

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memo (NCM) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Project Management concerns regarding specific analytical results
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the monthly review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and External Audit Findings

- Failed or Unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A NCM or CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Department Manager, Operations Manager, Technical Manager, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Department Manager, Operations Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Department Managers and the Operations Manager are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is entered into the Laboratory Information Management System (LIMS) and each CAR is entered into a spreadsheet (Figure 12-1) for tracking and trending purposes for review to aid in ensuring that the corrective actions have taken effect.
- The QA Manager reviews monthly NCMs and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.
- Also refer to Section 15.1.4, Special Audits)

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of a NCM or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, work instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly at a minimum by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, not obliterated (e.g. no white-out), and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example – Corrective Action Notice

TestAmerica Buffalo
Corrective Action Summary

#	Source	Type	Audit Organization	Dept.	Method	Repeat Finding?	Category	Finding, Deficiency, Area Needing Improvement or Recommended Action	Laboratory Investigation Summary	Root Cause of Deficiency	Laboratory Corrective Action Plan	Resp. Person	Date Opened	Response Due	CA Due Date	Date Lab Closed	Follow up notes	Follow Up Date	Follow-up Closed By
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
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Table 12-1.

Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst, Department Manager)*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Department Manager)*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in LIMs.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. -For matrix spike or duplicate results outside criteria the data for the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in LIMs.	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) When the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Department Manager)*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Internal / External Audits *(QA Manager, Department Manager, Operations Manager, Technical Manager, Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc.	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors *(Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department Manager, QA Manager, Corporate QA, Corporate Management)*	- SOP CW-L-S-002, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002.
Client Complaints *(Project Managers, Lab Director, Sales and Marketing, QA Manager)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 17 for an example) *(QA Manager, Lab Director, Operations Manager Department Managers)*	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation *(EH&S Coordinator, Lab Director, Operations Manager, Department Manager)*	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through EH&S office.

Note: 1. Except as noted below for certain compounds, the method blank should be below the reporting limit. Concentrations up to five times the reporting limit will be allowed for the

ubiquitous laboratory and reagent contaminants: methylene chloride, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the reporting limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and the other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit.

SECTION 13.0

PREVENTIVE ACTION / IMPROVEMENT

13.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management system reviews, review of monthly QA Metrics Report, evaluation of internal or external audits, results & evaluations of proficiency testing (PT) performance, review of control charts and QC results, data analysis & review processing operations, client complaints, staff observation, etc.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly be the laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's Corrective Action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.

- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvment.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/Process Improvement is incorporated into the monthly QA reports, corrective action process and management review

13.1.2 Any Preventive Actions/Process Improvements undertaken or attempted shall be taken into account during the Annual Management Systems Review (Section 17). A highly detailed report is not required; however a summary of success and failure within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes.

SECTION 14.0

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. TestAmerica Buffalo SOP BF-GP-015, Record Storage and Retention specify additional storage, archiving and retention procedures.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database which is backed up as past of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Hardcopy technical records are maintained by the Laboratory Director and the QA Department while electronic technical records are maintained by the IT Administrator.

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - Policy Memorandums - SOPs - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* Data Investigation: 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	All HR docs have different retention times: Refer to HR Manual
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained according to BF-GP-015 and in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. Records are maintained for a minimum of five years unless other wise specified by a client or regulatory requirement. All records shall be protected against fire, theft, loss, environmental deterioration and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to the data is limited to laboratory and company employees and shall be documented with an access log.

If records are archived off-site they are to be stored in a secure location where a record is maintained of any entry into the storage facility.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data. Specific Information related to archival of data for greater than 5 years may be found in TestAmerica Buffalo SOP BF-GP-015.

Table 14-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	5 years (project records) 10 years-Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	5 years
NY Potable Water NYCRR Part 55-2	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements are noted with the archive documents or addressed in TestAmerica Buffalo facility-specific records retention procedure BF-GP-015.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. TestAmerica Buffalo SOP BF-GP-015 also contains specific information for archival of scanned data.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (any records stored off site should be accessible within 2 business days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory

transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with the project file and the Job Number in TALS. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set). Instrument data is stored sequentially by instrument. Calibration data for a given sequence are maintained in the order of the analysis. Sample data are stored on a job number basis in the project file or as part of the daily batch or sequence. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks, bench sheets or excel spreadsheets are used to record and file data. Standard and reagent information is recorded in logbooks or on the raw data for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for this verification can be found in TestAmerica SOP BF-GP-015.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to

enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing of results.

14.2.2 Observations, data and calculations are recorded real-time.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code;
- Date of analysis; time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a bench sheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in the method specific SOPs, in the instrument method detail records or the instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods, ID codes, volumes, weights, instrument printouts, meter readings, temperatures, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries.
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- Procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

14.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

14.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

14.5.3 Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

14.5.4 The laboratory has a record management system (also known as document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per instrument or analysis basis, and are numbered sequentially as they are issued. No instrument or analysis has more than one active notebook at a time, so all data are recorded sequentially within a series of sequential notebooks. Bench sheets and raw data sequence files are filed sequentially by date. Standard and reagent information is maintained in LIMS and logbooks which are maintained on a departmental basis and are numbered sequentially as they are issued or as they are archived by QA.

14.5.5 Records are considered archived when noted as such in the records management system (also known as document control). Access to archived hard-copy information is documented with an access log and in/out records is used to note data that is removed and returned.

14.5.6 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.7 Records Disposal

14.5.7.1 Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

14.5.7.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records Management Company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15

AUDITS

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee or Corporate QA	All areas of the laboratory annually
Method Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CA-Q-S-003)	Methods Audits Frequency: All methods are reviewed annually 50% of methods receive a QA Technical Audit 50% of methods receive a SOP Method Compliance Audit
Special	QA Department or Designee	Surveillance or spot checks performed as needed to monitor specific issues
Performance Testing	Coordinated by Corporate QA	Two successful per year for each TNI -NELAC field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The

audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, Chrom AuditMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Non-potable Water, Soil, and Air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. . When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16

MANAGEMENT REVIEWS

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Director prepares a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Manager, Operations Manager, and QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-004 & Work Instruction No. CA-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective; therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.

- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate VP of Operations and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes.

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. The TestAmerica Corporate Data Investigation/ Recall SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's CEO, VP of Quality, Technical & Operations Support, VP of Client and Technical Services, VPs of Operations and Quality Directors receive a monthly report from the Exec. Director of Quality & EHS summarizing any current data integrity or data recall investigations. The VPs of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staff that possesses a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are

located in the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, pipette, quantitation techniques, etc. are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC)	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Managers/Department Managers – <u>General</u>	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Department Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 20).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- The Human Resource office maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in TestAmerica Buffalo SOP BF-QA-004, Laboratory Personnel Training.

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive

training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy No. CW-L-P-004 and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 OVERVIEW

TestAmerica Buffalo is a 32,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for field operations, bottle kit preparation, sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. Key equipment has been provided with back-up power supply in the event of a power outage.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Building pass cards and alarm codes are distributed to all facility employees.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. [The reason for this is that it is important to know who is in the building in case of a safety emergency. The visitors logbook is used to ensure that everyone got out of the building safely.] In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and

vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19.0

TEST METHODS AND METHOD VALIDATION

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 STANDARD OPERATING PROCEDURES (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory:

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP CW-Q-S-002, Writing a Standard Operating Procedure (SOP) and Laboratory SOP BF-QA-003, Procedure for Writing, Reviewing and Revising Controlled Quality Documents (QAM, SOP, etc)
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

19.4.1.1 The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM); Non-polar Material) by Extraction and Gravimetry, EPA-821-R-98-002, February 1999*
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 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. Supplement I: EPA-600/R-94/111, May 1994.*

- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th / 21st/ 22nd/on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)* ***(DW labs only)***
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*
- *New York State DEC Analytical Services Protocol, 2005*
- *New York State DOH Methods Manual*
- *Massachusetts Contingency Plan 310 CMR 40, April 25, 2014*
- *Connecticut Reasonable Confidence Protocol, July 2006*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

19.4.2.1 A demonstration of capability (BF-QA-004) is performed whenever there is a significant change in instrument type (e.g., new instrumentation), method or personnel.

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

19.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Operations Manager/Designee and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

19.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).

- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Procedures for generation of IDOCs are detailed below and in laboratory SOP BF-QA-004, Laboratory Personnel Training.

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 20.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (see Figure 19-1) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision

guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 19.7.10). Generally the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each

of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. To allow for some flexibility, this low level standard may be analyzed every batch or every week or some other frequency rather than doing the study all at once. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP No. BF-QA-001 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

19.8.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

19.8.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation. (For CLP procedures, the IDL is determined using the standard deviation of 7 replicate spike analyses on each of 3 non-consecutive days.)

19.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

19.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, CVAA, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified or see section 20.7.9 for other options. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

19.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirement.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time

window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory's SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, and specific electrode response factors.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 ±0.5 mg/L.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g. 524.2, 525, etc) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 SAMPLE REANALYSIS GUIDELINES

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as "reanalysis") may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Department Supervisor or Laboratory Director/Manager if unsure.

19.14 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the 'TALS Data System' which is a LIMs system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes a SQL server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity

Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, and data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability

Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality

Ensure data confidentiality through physical access controls such as password protection or website access approval, when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The data review sheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the project job folder, computer file, and/or run log. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, final inorganic results are reported to 2 significant figures for values less than 10 and 3 significant figures for values greater than 10 on the final report. Organic results are generally reported to 1 significant figure for values less than 10 and 2 significant figures for values greater than 10 on the final report. The number of significant figures may be adjusted based on client or project requirements.

19.14.2.4 For those methods that do not have an instrument printout, an instrumental output or a calculation spreadsheet upload compatible with the LIMS System, the final results and dilution factors are entered directly into LIMS by the analyst, and the software formats the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is automatically transferred to the network server and, eventually, to a back-up tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several laboratory SOPs (e.g. BF-SR-002, "Receipt of Analytical Samples", BF-GP-012, "Technical Data Review", and BF-PM-001, "Project Information Requirements") to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data (BF-GP-013, Manual Integration). The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review –The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

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

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manger, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the 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.

19.14.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report and creates the invoice. When complete, the report is issued to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using SOP CA-Q-S-002 as the guidelines.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder

needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1.
Example - Demonstration of Capability Documentation

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

BF-QA-DOC-004
DOC Cert. Statement
Rev.0 2/27/13

TESTAMERICA LABORATORIES, INC.

TRAINING & DEMONSTRATION OF CAPABILITY CERTIFICATION STATEMENT

Employee: _____ Page _____ of _____

Method Number: _____ Date: _____

Parameters or Analytes: _____

Initial Demonstration of Capability: ☐

SOP Number: _____ Revision # _____ Date Read _____

Trained By: _____

Date training began: _____ Date training completed: _____

Continued Demonstration of Capability: ☐

SOP Number: _____ Revision # _____ Date Read _____

I CERTIFY that I have read, understand and agree to use the SOP identified above. I have also submitted data associated with the demonstration of capability.

_____ _____
Employee Signature Date

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method(s) was performed by the analyst(s) identified on this certification.

3. A copy of the test method(s) and the laboratory-specific Sops are available for all personnel on-site.

4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory.

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at this facility, and that the associated information is well organized and available for review by authorized assessors.

_____ _____ _____
Operations Manager Signature Date

_____ _____ _____
Quality Assurance Manager Signature Date

SECTION 20

EQUIPMENT (AND CALIBRATIONS)

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory equipment and instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

20.2.1 The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

20.2.2 Routine preventive maintenance procedures and frequency, such as lubrication, cleaning, and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

20.2.3 Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

20.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

20.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

20.2.4.2 Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrumentation records.

20.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

20.2.5 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses

20.2.6 In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance. Laboratory SOPs BF-GP-001,"Calibration of Autopipettes and Repipetters" and BF-GP-002, "Support Equipment: Maintenance, Record Keeping and Corrective Actions of Analytical Balances, Temperature Control Devises and Reagent Water" provide additional detail on the monitoring and record keeping for support equipment.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All reusable thermometers are calibrated on an annual basis with a NIST-traceable thermometer at temperatures bracketing the range of use. Disposable thermometers are discarded upon expiration and replaced with newly purchased thermometers. IR thermometers should be calibrated over the full range of use, including ambient, iced (4 degrees) and frozen (0 to -5 degrees), per the Drinking Water Manual. The IR thermometers are verified daily and calibrated quarterly. Digital probes and thermocouples are calibrated quarterly.

The NIST Mercury thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST digital thermometer is recalibrated every one year (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories) and have ranges applicable to method and certification

requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the laboratory SOP BF-GP-020, "Thermometer Calibration".

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0°C and ≤ 6 °C.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically at a minimum on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated monthly (or if not utilized monthly, immediately prior to its usage) by setting the sample volume to 100ml and recording the volume received. The results are filed

in a logbook/binder. The Auto Sampler is programmed to run three (3) cycles and each of the three cycles is measured into a graduated cylinder to verify 100ml are received.

If the RSD (Relative Standard Deviation) between the 3 cycles is greater than 10%, the procedure is repeated and if the result is still greater than 10%, then the Auto Sampler is taken out of service until it is repaired and calibration verification criteria can be met. The results of this check are kept in a logbook/binder.

Additional calibration and use information is detailed in laboratory SOP BF-FS-006, "Calibration of Field Meter".

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

20.4.1.1 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

20.4.1.2 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

20.4.1.3 The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules are methods where the referenced method does not specify two or more standards.

20.4.1.4 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.2 Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and NELAC (2003) standard, Section 5.5.5.10. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met i.e., RPD, per NELAC (2003) Standard, Section 5.5.5.10 and 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a).when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b).when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.2.1 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs.) Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the 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 samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements 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. See laboratory SOP's BF-MB-005 and BF-MV-007 for guidelines for making tentative identifications

Note:
For general reporting if TICs are requested, the ten (10), largest non-target analyte peaks whose area count exceeds 10% of the nearest internal standard will be termed "Tentatively Identified Compounds" (TICs). More or fewer TICs may be identified based on client requirements.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Laboratory Equipment and Instrumentation – TestAmerica Buffalo

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Buffalo Instrument List

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS Instrumentation	Agilent	5975	US83110163	2013	good
GC/MS Instrumentation	Agilent	5973	US02450141	2013	good
GC/MS Instrumentation	Agilent	5975	CN10833020	2009	good
GC/MS Instrumentation	Agilent	5975	US80838844	2008	good
GC/MS Instrumentation	Agilent	5973	US44621446	2005	good
GC/MS Instrumentation	Agilent	5973	US52420646	2005	good
GC/MS Instrumentation	Agilent	5973	US41720721	2004	good
GC/MS Instrumentation	Agilent	5973	US35120354	2004	good
GC/MS Instrumentation	Agilent	5973	US41720707	2004	good
GC/MS Instrumentation	Agilent	5973	US10241053	2003	good
GC/MS Instrumentation	Agilent	5973	US30965634	2003	good
GC/MS Instrumentation	Agilent	5973	US03965692	2003	good
GC/MS Instrumentation	Agilent	5973	US05060076	2001	good
GC/MS Instrumentation	Agilent	5973	US05060084	2001	good
GC/MS Instrumentation	Agilent	5973	US03950346	2001	good
GC/MS Instrumentation	Agilent	5973	US82321636	2001	good
GC Instrumentation	Perkin Elmer	Clarus 608 dual uECD	680S10042901	2012	good
GC Instrumentation	Perkin Elmer	Clarus 600 dual FID	665S10020401	2012	good
GC Instrumentation	Agilent	6890 dual uECD	CN10520009	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10520010	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10448015	2005	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53126	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A63465	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53464	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53463	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A54409	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A54408	1994	good
GC Instrumentation	Hewlett Packard	5890II FID/FID	3115A34892	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A60622	1994	good
GC Instrumentation	Hewlett Packard	5890II Hall/PID	3235A54089	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A53465	1994	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3336A53727	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3310A47661	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53325	1993	good

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GC Instrumentation	Hewlett Packard	5890II PID/FID	3133A37157	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3203A42206	1992	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3019A28433	1991	good
GC Instrumentation	Hewlett Packard	5890II Hall/PID	3121A35782	1990	good
Metals Instrumentation	Perkin Elmer	Elan 9000 ICP-MS	P0230202	2002	good
Metals Instrumentation	Leeman	PS200 II	HG9045	2000	good
Metals Instrumentation	Leeman	PS200 II	HG0033	2000	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094603	2010	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094602	2010	good
Water Quality Instrumentation	Metrohm	IC Model 881	4111	2013	good
Water Quality Instrumentation	Konelab	Aqua20	SEA032	2009	good
Water Quality Instrumentation	Flash Point Analyzer	HFP 339	Herzog	2007	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	A54TB0578P	2006	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	E616130020E	2006	good
Water Quality Instrumentation	Thermo	ECA 1200 TOX	2006.0373	2006	good
Water Quality Instrumentation	Horizon	Speed Vap	03-0415	2005	good
Water Quality Instrumentation	Konelab	20XT	E3719731	2005	good
Water Quality Instrumentation	Thermo	ECA 1200 TOX	2004.901	2004	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	20126	2004	good
Water Quality Instrumentation	Konelab	20	S5019455	2004	good
Water Quality Instrumentation	Glastron	CN Midi-distillation	2502	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2069	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2053	2003	good
Water Quality Instrumentation	Labtronics	BOD Autoanalyzer	270H3XB531	2004	good
Water Quality Instrumentation	Mantech	BOD Autoanalyzer	MT-184-216	2014	good
Water Quality Instrumentation	ManTech	PC Titrator	MS-OK2-607	2003	good
Water Quality Instrumentation	HACH	Spectrophotometer #DR/2500	30200004886	2003	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	2060196	2002	good

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Water Quality Instrumentation	Spectronic	Genesis 4001/4	3SGC199091	2000	good
Water Quality Instrumentation	Lachat	Quickchem 8000 Autoanalyzer	A83000-1527	2000	good
Water Quality Instrumentation	Lachat	Quickchem 8500 Autoanalyzer	40300001665	2014	good
Water Quality Instrumentation	Lachat	Quickchem 8000 Autoanalyzer	A83000-1439	1999	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	99010157	1999	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	99110569	1999	good
Water Quality Instrumentation	BOD chamber		Revco	1994	good
Sample Preparation Equipment	CEM	Microwave MARS	MD3978	2013	good
Sample Preparation Equipment	Gilson	Fractionator Model GX-274	40579	2013	good
Sample Preparation Equipment	TurboVap	II	TV0529N12427	2006	good
Sample Preparation Equipment	TurboVap	II	TV0529N12428	2006	good
Sample Preparation Equipment	TurboVap	II	TV9445N5816	1996	good
Sample Preparation Equipment	TurboVap	II	TV9427N4133	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5819	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5820	1996	good
Sample Preparation Equipment	TurboVap	II	TV0024N9623	2000	good
Sample Preparation Equipment	TurboVap	II	TV0022N9604	2000	good
Sample Preparation Equipment	TurboVap	II	TV0312N11592	2003	good
Sample Preparation Equipment	TurboVap	II	TV0312N11591	2003	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16902	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16907	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16913	1999	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1647/C5659	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2665/C5674	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2620/C5660	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2245/C6328	1995	good

TestAmerica
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Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2621/C6733	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2713/C6732	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1643/C6837	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2742/C6842	1995	good

Table 20-2.

Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check tubing for wear	Daily
	Fill rinse tank with 10% HCl	Daily
	Change dryer tube	As Needed
	Fill reductant bottle with 10% Stannous Chloride	Daily
ICP & ICP/MS	Check pump tubing	Daily
	Check liquid argon supply	Daily
	Check fluid level in waste container	Daily
	Check re-circulator levels	Monthly
	Clean or replace filters	As required
	Check torch	Daily
	Check sample spray chamber for debris	Monthly
	Clean and align nebulizer	Monthly
	Change pump oil	Monthly
	Change Cones	As required
	Change printer cartridge	As required
	Replace pump tubing	As required
UV-Vis Spectrophotometer	Clean ambient flow cell	As required
	Precision check/alignment of flow cell	As required
	Wavelength verification check	Annually
Auto Analyzers	Clean sampler	Daily
	Check all tubing	Daily
	Clean inside of colorimeter	Daily
	Clean pump well and pump rollers	Quarterly
	Clean wash fluid receptacle	Weekly
	Oil rollers/chains/side rails	Weekly
	Clean optics and cells	Quarterly

Instrument	Procedure	Frequency
Agilent GC/MS	Pump oil-level check	Monthly
	Pump oil changing	Annually
	Analyzer bake-out	As required
	Analyzer cleaning	As required
	Resolution adjustment	As required
	COMPUTER SYSTEM AND PRINTER:	
	Air filter cleaning	As required
	Change data system air filter	As required
	Printer head carriage lubrication	As required
	Paper sprocket cleaning	As required
	Drive belt lubrication	As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration	Daily
	Check carrier gas flow rate in column	Daily via use of known compound retention
	Check temp. of detector, inlet, column oven	Daily
	Septum replacement	As required
	Glass wool replacement	As required
	Check system for gas leaks with SNOOP	W/cylinder change as required
	Check for loose/frayed power wires and insulation	As Required
	Bake injector/column	As Required
	Change/remove sections of guard column	As Required
	Replace connectors/liners	As Required
	Change/replace column(s)	
Electron Capture Detector (ECD)	Detector wipe test (Ni-63)	Semi-annually
	Detector cleaning	As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings	As required
	Clean lamp window	As required
HPLC	Change guard columns	As required
	Change lamps	As required
	Change pump seals	Semi-annually or as required
	Replace tubing	As required
	Change fuses in power supply	As required
	Filter all samples and solvents	Daily
	Change autosampler rotor/stator	As required

Instrument	Procedure	Frequency
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
Centrifuge	Check brushes and bearings	Every 6 months or as needed

Table 20-3.

Periodic Calibration

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using "S" NIST traceable weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	± 0.2%	Clean, check level, insure lack of drafts, and that unit is warmed up, recheck. If fails, call service.
Top Loading Balance	Accuracy determined using "S" NIST traceable. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	± 0.5%	Clean. Replace.
NIST Certified Weights	Accuracy determined by accredited weights and measurement laboratory.	1 year	As per certificate.	Replace.
NIST-Traceable Thermometer-Mercury	Accuracy determined by accredited measurement laboratory.	3 years	As per certificate.	Replace.
NIST-Traceable Thermometer-Digital	Accuracy determined by accredited measurement laboratory.	1 year	As per certificate	Replace.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 1.2°C	Replace
Minimum-Maximum Thermometers	Against NIST-traceable thermometer	Yearly	± 1.5°C	Replace

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
InfraRed Temperature Guns	Against NIST-traceable thermometer Accuracy determined by accredited measurement laboratory.	Daily at appropriate temperature range for intended use. Annual	± 1.5°C	Repair/replace
Dial-type Thermometers	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 1.5°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again in two hours.	0-6°C	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Freezer	Temperature checked using NIST-traceable thermometer	Daily. If out of range, check again in two hours.	(-10)-(-20)°C	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	104 ± 1°C (drying) 180 ± 2°C (TDS)	Adjust. Replace.
Water Bath	Temperature checked using NIST-traceable thermometer.	When in use.	± 2°C	Adjust. Replace.
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic dilutor or dispensing devices)	One delivery by weight. Using DI water or solvent of use, dispense into tared vessel. Record weight with device ID number. Calibrate using 4 replicate gravimetric measurements	Each day of use Quarterly	± 2% Calculate accuracy by dividing weight by stated volume times 100 for percent.	Adjust. Replace.

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Glass Microliter Syringes	None	Accuracy must be initially demonstrated if syringe was not received with a certificate attesting to established accuracy.	± 1%	Not applicable.
Deionized Water	Check in-line conductivity meter on system with conductivity meter in Inorganics Department.	Daily	<1.0 µmho at 25°C	Record on log. Report discrepancies to QA Manager, Operations Manager or Technical Manager.

SECTION 21

MEASUREMENT TRACEABILITY

21.1 OVERVIEW

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. For certain programs Microsyringes are verified semi-annually or disposed of after 6 months of use. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g. bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory accreditation Cooperation) or APLAC (Asia – Pacific Laboratory Accreditation Cooperation)..A certificate and scope of accreditation is kept on file at the laboratory.

The calibration report or certificate submitted to ***TestAmerica Buffalo*** contains, in a well designed format, a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. Opinions and interpretations of results are presented along with the basis upon which they were made and identified as such. The report may be submitted by facsimile or other electronic means as long as the requirements of the International Standard are achieved. If significant amendments are made to a calibration certificate, a supplemental certificate for the serial-number-specified piece of equipment is so identified. When a new certificate is offered, it uniquely identifies and references the one it replaces. All calibration reports are filed in the QA Office.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. Method specific information may also be found in the laboratory method SOPs in the "Standards and Reagents" sections. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. Refer to SOP No. CA-Q-S-001, Solvent and Acid Lot Testing and Approval.

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained by each department in bound or electronic folders. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer laboratory SOP BF-GP-019, "Standard Traceability and Preparation" and also to the method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory department's chemical history log and are assigned a unique identification number. Preparation of working standards or reagents prepared from the stock is documented in the laboratory Department's Standard Preparation Log. The following information is typically recorded:

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date

- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment section

Records are maintained for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date
- Standard ID from LIMS.
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained in the LIMS system.

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOPs.

SECTION 22.0

SAMPLING

22.1 OVERVIEW

The laboratory provides sampling services. Sampling procedures are described in the following SOPs:

BF-FS-001	Chain of Custody Documentation
BF-FS-003	Groundwater Sampling Field Data Collection
BF-FS-004	Equipment Decontamination
BF-FS-005	Groundwater/Surface Water Sampling
BF-FS-006	Calibration of Field Meter
BF-FS-007	Low Flow Sampling Procedures
BF-FS-008	Surface and Subsurface Soil/Sediment Sampling

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory online.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the chain-of-custody (COC) form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in

"days" (e.g. 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g. 6 hours, 24 hours, etc.) are measured from date and time zero. Holding times for analysis include any necessary reanalysis. However there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is. These programs will be addressed on a case-by-case basis.

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times, this info is in the SOP or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

The following information provides general guidance for homogenization and subsampling. For laboratory specific procedures refer to SOP BF-GP-005, "Sample Homogenization and Subsampling".

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The shipping documents are retained with the project files.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC or in the project notes, sample management will initiate Strict Chain of Custody procedures as defined in SOP BF-GP-018, "Strict Internal Chain-of-Custody".

23.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

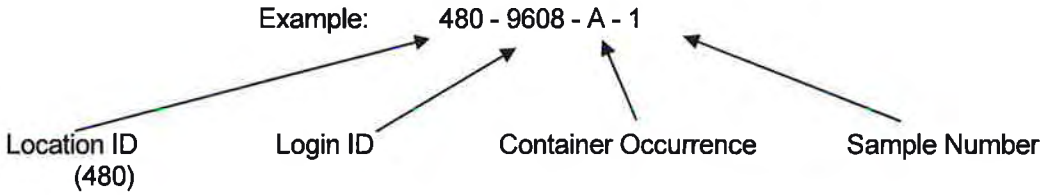
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on the Sample Login Form – and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Buffalo Laboratory (Location 480). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: XXX - 9608 - A - 1 - **A** ← **Secondary Container Occurrence**

Example: 220-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);

- sample holding times must be adhered to (Sampling Guide);
- every sample cooler is given a radiation screen with a standardized Radiation Monitor (Monitor 4 model). This screen has no analytical repercussions; it is just a gross screen for employee safety purposes. Contact TestAmerica Buffalo's Technical Manager, Environmental Health and Safety Coordinator or Sample Control Manager immediately if screening indicates radioactivity in excess of 0.02 mR/hr.;
- The project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks described in Section 23.1.1.1 that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. BF-SR-002.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Aqueous samples designated for metals analysis are stored at ambient temperature. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed at a minimum of every two weeks.

Analysts and technicians provide a request form to the cooler custodian who then retrieves the requested samples. In the absence of the cooler custodian, the analysts may personally retrieve the sample containers allocated to their analysis from the designated refrigerator. The samples are placed on carts, transported the analytical area and analyzed. Following analysis

the remaining sample is returned to the refrigerator from which it originally came. All unused portions of samples are returned to the secure sample control area. All samples are kept in the refrigerators for two to four weeks after analysis, which meets or exceeds most sample holding times. After two to four weeks the samples are moved to dry room temperature, sample archive area where they are retained a minimum of 2 weeks after the final report has been issued to the client at which time disposal occurs. Special arrangements may be made to store samples for longer periods of time. Extended archival periods allow additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

To minimize exposure to personnel and to avoid potential accidents, samples which are known or suspected to be hazardous are segregated and a notification is issued to all laboratory personnel.
All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm. All soil samples, including foreign soil samples are heat treated or incinerated in accordance with USDA permit requirements and are transported / disposed by USEPA approved facilities.

Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). For sample shipments which include water/solid volatile organic analyses (see Note), a trip blank is enclosed when required by method specifications or state or regulatory programs. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will analyze the trip blanks that were supplied.

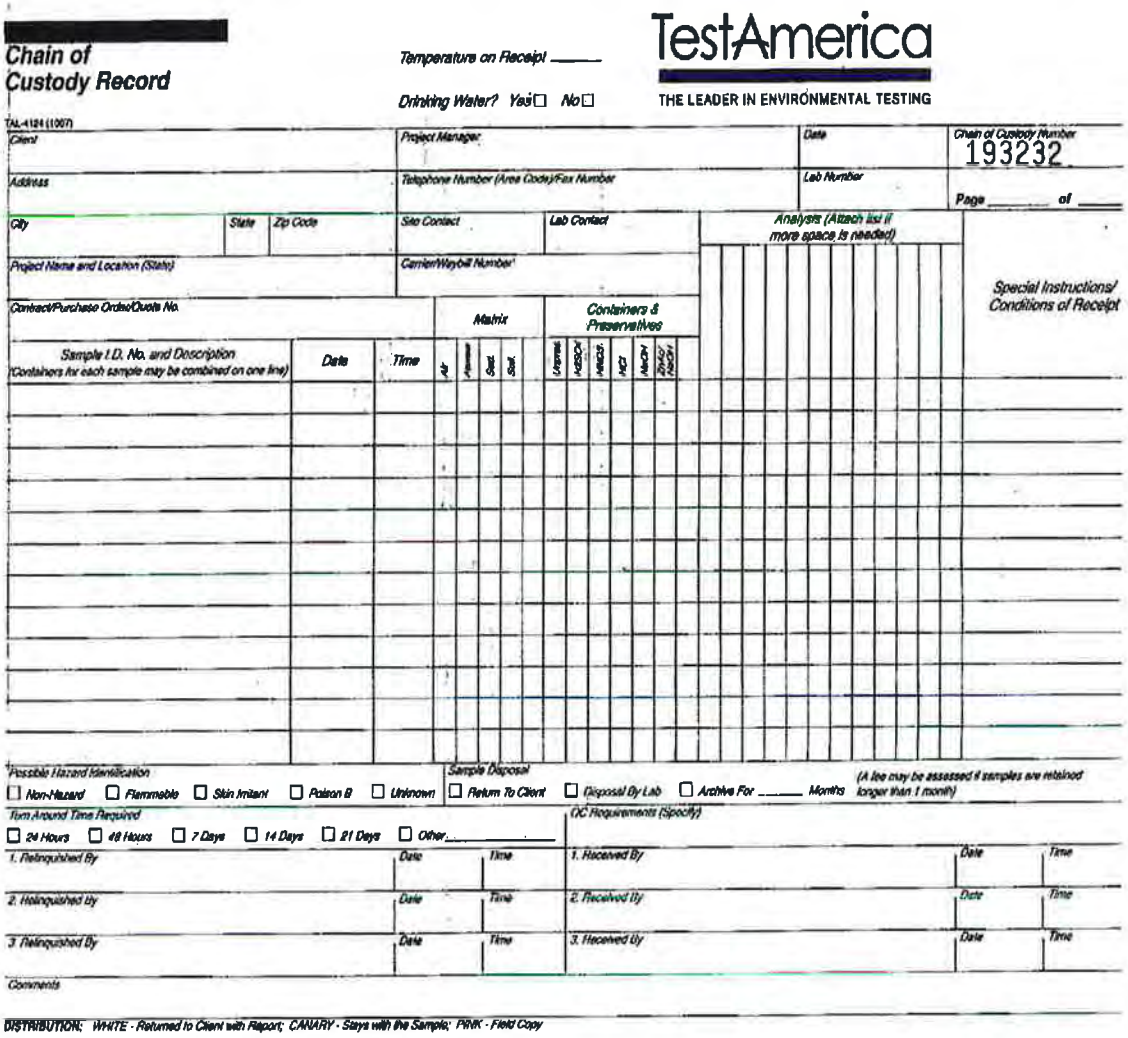
23.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: BF-WM-001, "Waste Management".) All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than six weeks from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample may request to participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal and nature of disposal (such as sample depletion, hazardous waste facility disposal, and return to client). All disposal of sample containers is accomplished through incineration. A Waste Disposal Record should be completed.

Figure 23-1.

Example: Chain of Custody (COC)



Chain of Custody Record

Temperature on Receipt _____

Drinking Water? Yes☐ No☐

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TAL-4124 (1007)

Client | Project Manager | Date | Chain of Custody Number 193232

Address | Telephone Number (Area Code)/Fax Number | Lab Number | Page _____ of _____

City | State | Zip Code | Site Contact | Lab Contact | Analysis (Attach list if more space is needed)

Project Name and Location (State) | Carrier/Waybill Number

Contract/Purchase Order/Quote No. | Matrix | Containers & Preservatives | Special Instructions/ Conditions of Receipt

Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Air | Aqueous | Sed. | Soil | Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/ NaOH

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

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other_____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By			1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Figure 23-2.

Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - *Client name, address, phone number and fax number (if available)*
   - *Project name and/or number*
   - *The sample identification*
   - *Date, time and location of sampling*
   - *The collectors name*
   - *The matrix description*
   - *The container description*
   - *The total number of each type of container*
   - *Preservatives used*
   - *Analysis requested*
   - *Requested turnaround time (TAT)*
   - *Any special instructions*
   - *Purchase Order number or billing information (e.g. quote number) if available*
   - *The date and time that each person received or relinquished the sample(s), including their signed name.*
   - ***The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.***
   - **Information must be legible**

2) Every sample cooler is given a radiation screen with a standardized Radiation Monitor (Monitor 4 model). This screen has no analytical repercussions; it is just a gross screen for employee safety purposes. Contact TestAmerica Buffalo's Technical Manager, Environmental Health and Safety Coordinator or Sample Control Manager immediately if screening indicates radioactivity in excess of 0.02 mR/hr.

3) Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or

courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

4) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - **Information must be legible**

5) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

6) Samples must be preserved according to the requirements of the requested analytical method. See lab Sampling Guide.
   Note: Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

   - Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

   - For Volatile Organic analyses in drinking water (Method 524.2). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:
     - 1. Test for residual chlorine in the field prior to sampling.
       - If no chlorine is present, the samples are to be preserved using HCl as usual.
       - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.
     - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.
   - **FOR WATER SAMPLES TESTED FOR CYANIDE – for NPDES samples by Standard Methods or EPA 335**
     - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.

       - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements

or the laboratory can analyze the samples as delivered and qualify the results in the final report.

- It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

7) Sample Holding Times

- TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time to ensure analysis.

- Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis.

8) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply this blank with the bottle order.

9) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.

10) Recommendations for packing samples for shipment.

- Pack samples in Ice rather than "Blue" ice packs.

- Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.

- Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.

- Fill extra cooler space with bubble wrap.

Figure 23-3.
Example: Cooler Receipt Form

BF-SC-LF-003
Rev. 1
6/10/2013

SAMPLE LOGIN

Project_____Event _____

Analysis Groups_____

TAT ____ # SAMPLES: _____ TRIP BLANK? Y/N ___ #/date _____

Custody Seal Intact Y/N NONE Rad Check <0.02 mR/hr Y/N

Residual Chlorine Check Y/N/ NA Pres Checked Y/N/NA

Workshare/Subcontract Y/N Lab_____ _____ SO/ICOC #_____

Received out of hold: Samples _____Analysis_____

Checklist/NCM's_____

Temperature(s) #of coolers_____ IR Gun 1 2 3

RUSH **TIME CRITICAL**

Section 24.0

ASSURING THE QUALITY OF TEST RESULTS

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 NEGATIVE CONTROLS

Table 24-1.

Control Type	Details
Method Blank (MB)	Are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	Are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1.

Control Type	Details
Instrument Blanks	Are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank [1]	Are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan) Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	Are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	Are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

24.4.1.1 The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

24.4.1.2 The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard may be reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

24.4.1.3 Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

24.4.1.4 The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

24.4.1.5 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). In order to meet this requirement, TestAmerica Buffalo spikes with the Corporate Standard Standards primary mix for each analysis. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

24.4.1.5.1 For methods that have 1-10 target analytes, spike all components.

24.4.1.5.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

24.4.1.5.3 For methods with more than 20 target analytes, spike at least 16 components.

24.4.1.5.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

24.4.1.5.5 Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 SAMPLE MATRIX CONTROLS

Table 24-5. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	Essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

24.6.1 As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

24.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

24.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

24.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

24.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

24.6.3.3 The lowest acceptable recovery limit will be 10% (the analyte must be detectable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable.

24.6.3.4 The maximum acceptable recovery limit will be 150%.

24.6.3.5 The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

24.6.3.6 If either the high or low end of the control limit changes by $\leq$ 5% from previous, the data points are inspected and, using professional judgment, the limits may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits. This process is outline in BF-QA-002.

24.6.4.1 The control limits are maintained in the laboratory LIMs system. The limits for each analyte/method/matrix combination are assigned effective and expiration dates. The QA department is able to query the LIMs system and print an active list of control limits based on this database. The most current laboratory limits (based on the effective/expiration dates) are reflected on the laboratory worksheets and final reports unless superseded by project specific limits.

24.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 13) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

24.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

24.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

24.7.1 The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples.

24.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

24.7.3 Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

24.7.4 Selection of appropriate reagents and standards is included in Section 9 and 22.

24.7.5 A discussion on selectivity of the test is included in Section 5.

24.7.6 Constant and consistent test conditions are discussed in Section 19.

24.7.7 The laboratories sample acceptance policy is included in Section 23.

SECTION 25.0

REPORTING RESULTS

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. A variety of report formats are available to meet specific needs. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report) with a "sample results" column header.

25.2.2 Each report cover page is printed on company letterhead which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. job number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as # / ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Practical quantitation limits or client reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits (if requested).

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda). Sample temperatures are recorded in the report case narrative and on the COC. Deviations from normal conditions (e.g., preservation, breakage) are recorded in the report case narrative.

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.21 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.24 When Soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample if applicable.

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g, partial report). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as an addendum to the report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 Certification Summary report, where required, will document that unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

25.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Buffalo offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including results for the method blank, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. All faxed reports are followed by hardcopy. Procedures used to ensure client confidentiality are outlined in Section 26.7.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD . TestAmerica Buffalo offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report

25.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

25.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

25.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

25.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in Section 8.

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. It is our policy that facsimiles are intended for and should be used for business purposes only. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this

communication is strictly prohibited. If you have received this communication in error, please notify the sender.

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "R". The revised report will have the word "revised" appended to the cover letter.

When the report is re-issued, a notation of "revised" is placed on the cover/signature page of the report. A brief explanation of reason for the re-issue is included in the report case narrative.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

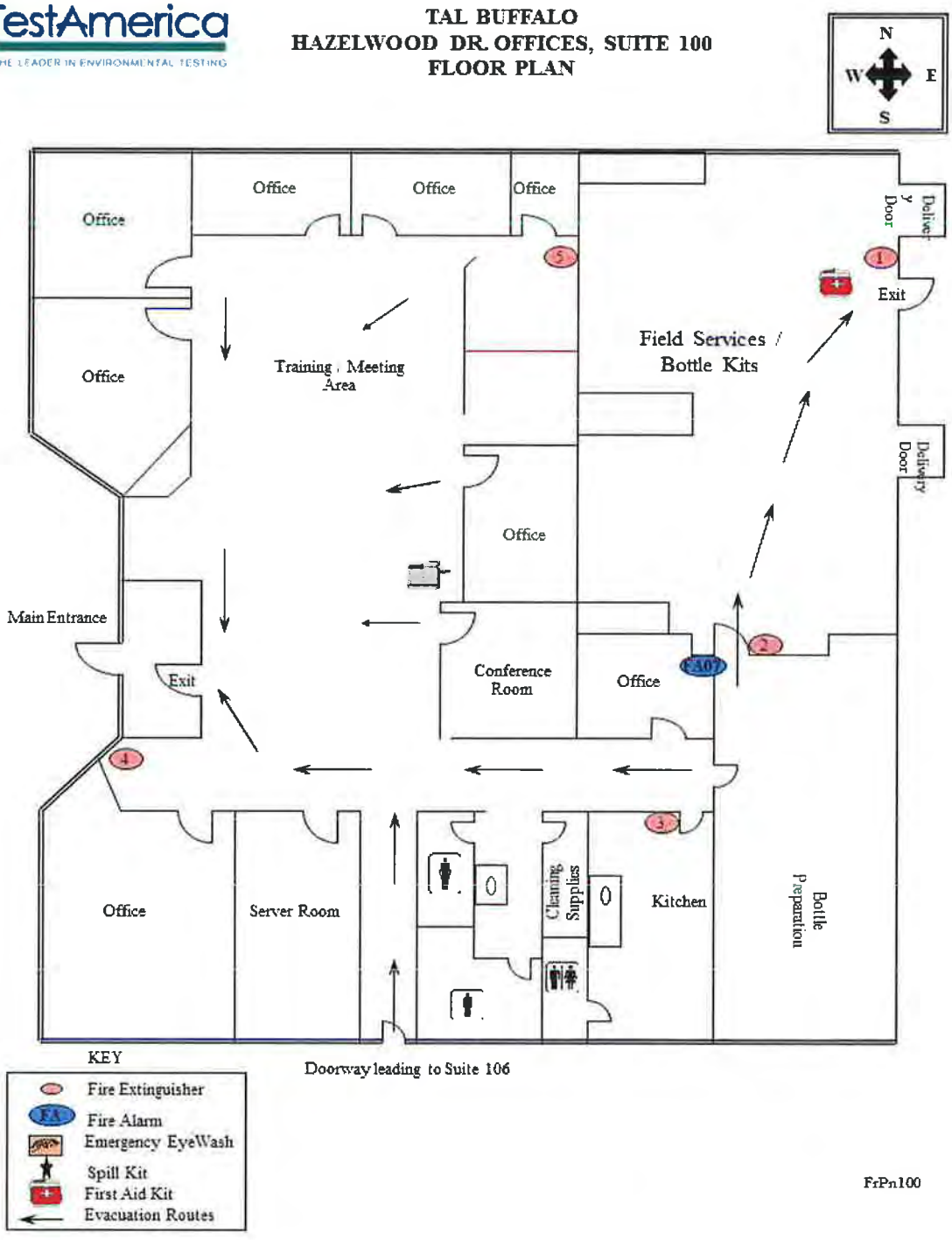
25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

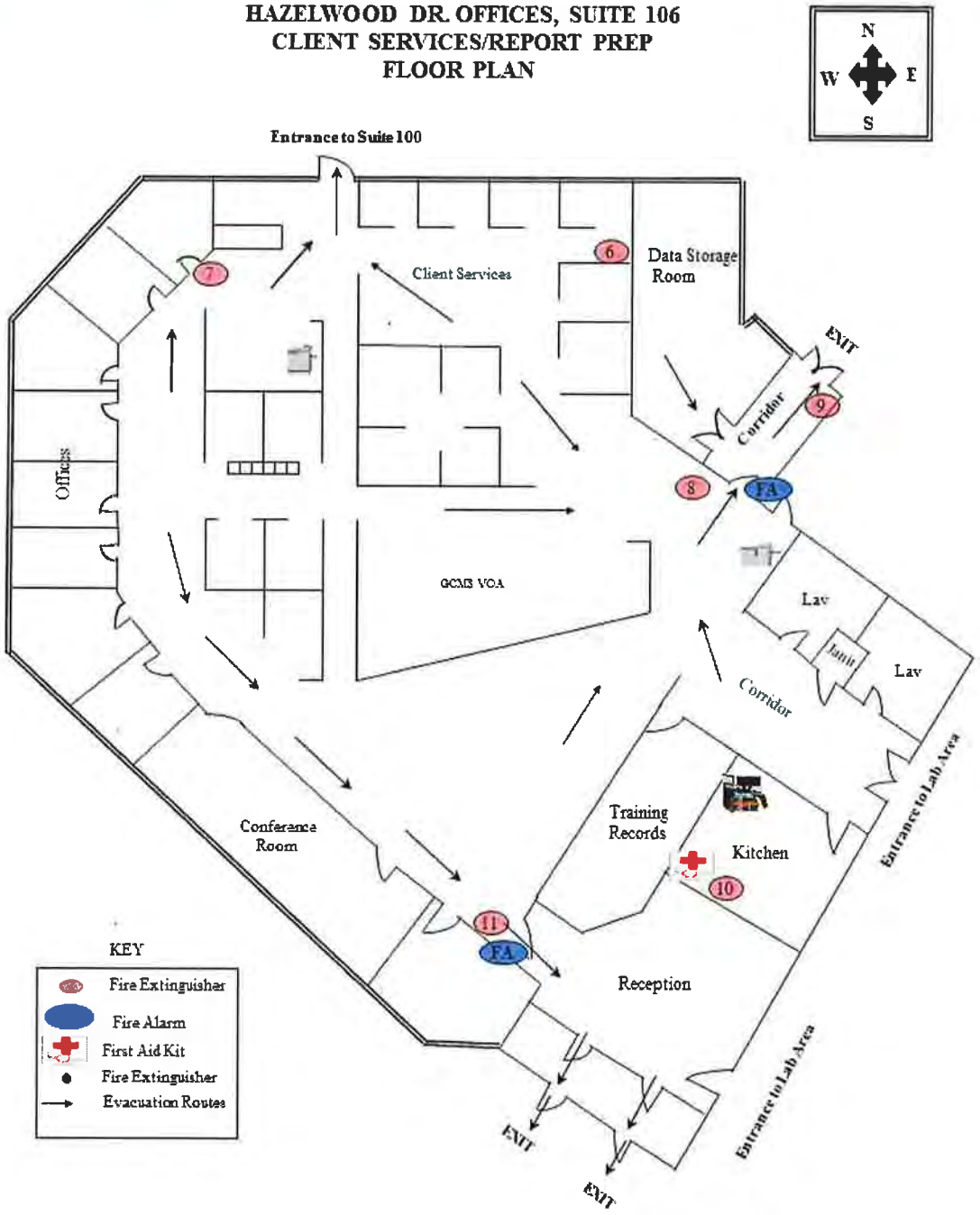
TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 100
FLOOR PLAN



FrPn100

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

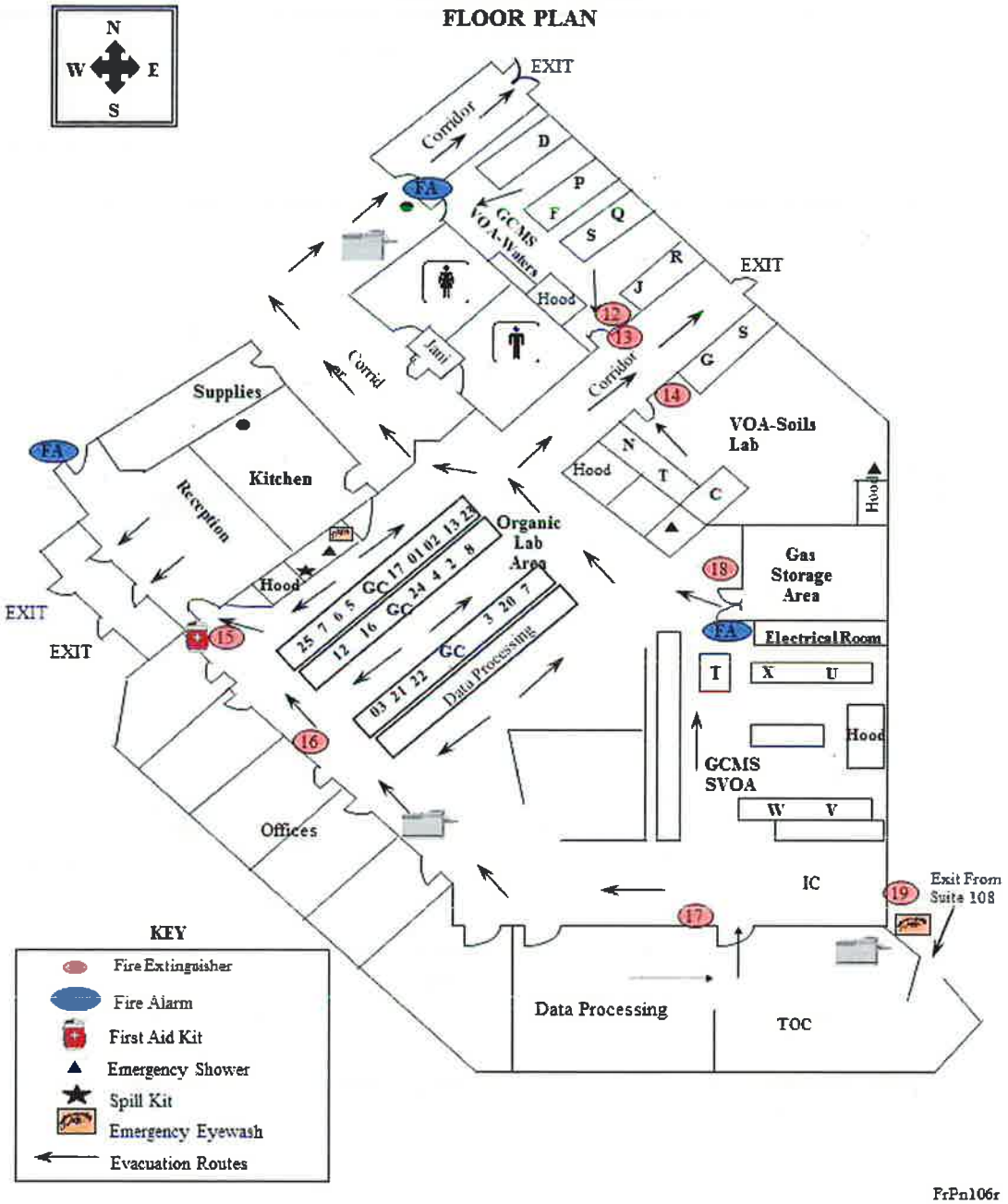
TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 106
CLIENT SERVICES/REPORT PREP
FLOOR PLAN



FrP1106L
3/2005

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

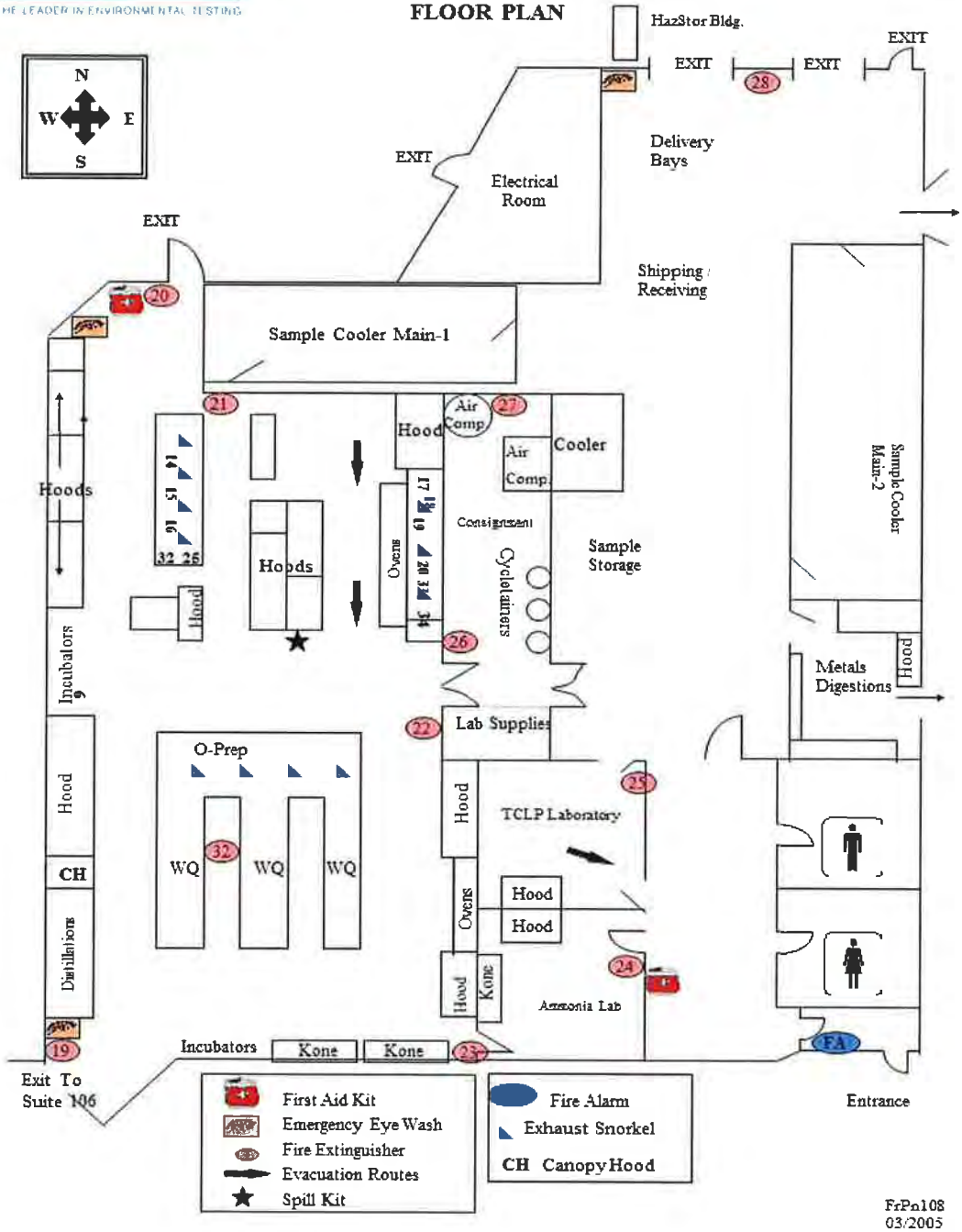
TAL BUFFALO
HAZELWOOD DR. NY OFFICES, SUITE 106
LABORATORY AREA
FLOOR PLAN



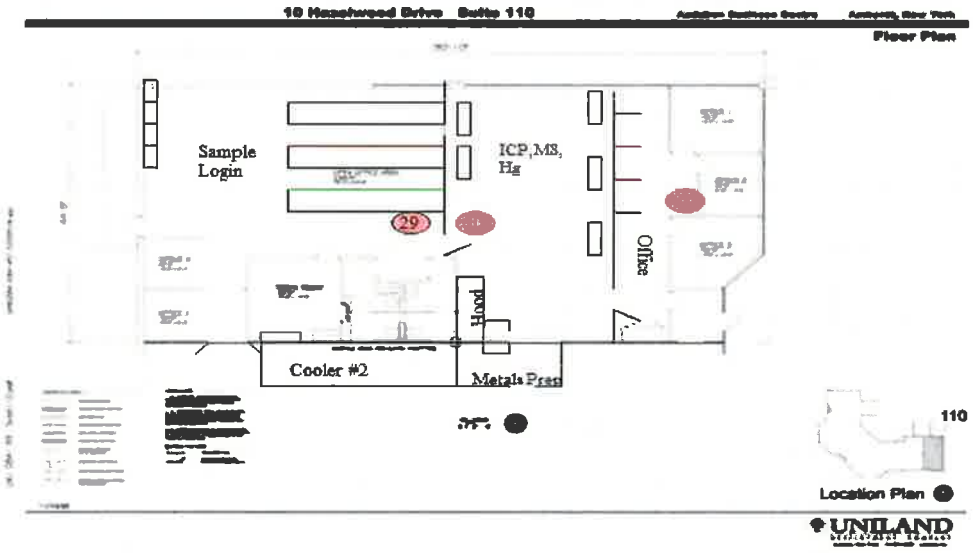
FrPn106r
03/2005

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 108
FLOOR PLAN



FrPn108
03/2005


Floor Plan
Sample Login
ICP,MS, Hg
29
Office
Hood
Cooler #2
Metals Prep
110
Location Plan
UNILAND

Appendix 2. Glossary/Acronyms

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (TNI)

Accrediting Authority: The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (TNI)

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (TNI)

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI).

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (TNI)

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength
Derivitization
Mass spectral interpretation
Alternative detectors or
Additional Cleanup procedures
(TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (TNI)

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In

order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for Inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% Settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% Settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (NELAC)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which

an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (TNI)

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (TNI)

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (TNI)

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (TNI)

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (NELAC)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI) [2.1]

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of NELAC standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or and which is accepted as the method for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not

available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS-ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate

LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
NELAC – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SDS - Safety Data Sheet
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Buffalo maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

State	Program	Cert # / Lab ID
Arkansas	CWA, RCRA, SOIL	88-0686
California*	NELAP CWA, RCRA	01169CA
Connecticut	SDWA, CWA, RCRA, SOIL	PH-0568
Florida*	NELAP CWA, RCRA	E87672
Georgia*	SDWA,NELAP CWA, RCRA	956
Illinois*	NELAP SDWA, CWA, RCRA	200003
Iowa	SW/CS	374
Kansas*	NELAP SDWA, CWA, RCRA	E-10187
Kentucky	SDWA, CWA	90029
Kentucky UST	UST	30
Louisiana*	NELAP CWA, RCRA	2031
Maine	SDWA, CWA	NY0044
Maryland	SDWA	294
Massachusetts	SDWA, CWA	M-NY044
Michigan	SDWA	9937
Minnesota	SDWA,CWA, RCRA	036-999-337
New Hampshire Primary*	NELAP SDWA, CWA, RECRA	2973
New Hampshire Secondary*	NELAP SDWA, CWA, RECRA	2337
New Jersey*	NELAP,SDWA, CWA, RCRA,	NY455
New York*	NELAP, AIR, SDWA, CWA, RCRA	10026
North Dakota	CWA, RCRA	R-176
Oklahoma	CWA, RCRA	9421
Oregon*	CWA,RCRA	NY200003
Pennsylvania*	NELAP CWA,RCRA	68-00281
Rhode Island	SDWA, CWA	LAO00328
Tennessee	SDWA	02970
Texas*	NELAP CWA, RCRA	T104704412-08-TX
USDA	FOREIGN SOIL PERMIT	S-41579
Virginia	SDWA	278
Washington*	NELAP CWA,RCRA	C1677
Wisconsin	CWA, RCRA	998310390
West Virginia	CWA,RCRA	252

The certificates and accredited parameter lists are available for each State/Program at www.testamericainc.com under Analytical Services Search – Certifications.

Quality Assurance Manual Cover Page

TestAmerica Burlington
30 Community Drive, Suite 11
South Burlington, VT, 05403
Phone: (802) 660-1990
Fax : (802) 660-1919
www.testamericainc.com

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Facility Distribution No. Electronic **Distributed To: Facility Server**

Title Page:

Quality Assurance Manual
Approval Signatures

Laboratory Director – Kirstin L. Daigle	October 6, 2014 Date
Quality Assurance Manager – Sara S. Goff	October 6, 2014 Date
Technical Manager – Bradley W. Chirgwin	October 6, 2014 Date

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CW-Q-S-003	Internal Auditing
CA-Q-S-006	Detection Limits
CW-Q-S-004	Management Systems Review
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-L-S-002	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CW-L-P-004	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-T-P-001	Qualified Products List
CW-F-S-007	Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

SOP Reference	Title
BR-QA-003	Document Control & Updating (However Named, Sec. 3.4.1)
BR-QA-004	Complaint Resolution (However Named, Sec .10.1)
BR-QA-011	Lab Training (However Named, Sec. 17.3)
BR-QA-011	DOCs (However Named, Sec. 19.4.2)
BR-QA-005	MDLs (However Named, Sec. 19.7)
BR-QA-006	MI (However Named, Sec. 19.14.1)
BR-QA-020	Subsampling (However Named, 22.5)
BR-SM-001	Sample Receipt / Login, etc… (However Named, Sec. 23.2.1.3)

SECTION 3 INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

TestAmerica Burlington's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *U.S. Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0, July 2013.*
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005) (DW labs only)*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for* the Examination of Water and Wastewater, 18th Edition, 19th, 20th, 21st, and on-line Editions.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *U.S. Department of Energy* Order 414.1C, *Quality Assurance*, June 17, 2005.
- *U.S. Department of Energy*, *Quality Systems for Analytical Services*, Revision 3.6, November 2010.
- U.S. Department of Defense, *Air Force Center for Environmental Excellence Quality Assurance Project Plan (QAPP),* Version 4.0.02, May 2006.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.2 Terms and Definitions

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations.

The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge, soils, sediment, tissue and other biological matrices. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in the Laboratory Information Management System (TALS). The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures SOP No. BR-QA-003, Document Control.

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Burlington is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., Chief Executive Officer (CEO), Executive Vice President (VP) Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Burlington is presented in Figure 4-1.

4.2 Roles and Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Burlington laboratory.

4.2.2 Laboratory Director

TestAmerica Burlington's Laboratory Director is responsible for ensuring compliance and integration of facility operation with corporate and regulatory policies and procedures. These policies include but are not limited to quality, safety, financial, technical, human resource and service performance. The Laboratory Director reports to their respective VP. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

4.2.3 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director and has access to Corporate QA for advice and resources. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officers to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.

- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a percentage of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Captains the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025.
- Compliance with DoD ELAP.

4.2.4 Technology Manager and Department Manager

The Technical and Department Managers report directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision and for

compliance with the ISO 17025 Standard. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i.e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources and the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.
- Compliance with ISO 17025.
- Compliance with DoD ELAP.

4.2.5 Analyst

The Analyst performs environmental analyses and/or preps of samples using standard analytical techniques in compliance with TestAmerica's Quality Assurance programs and SOPs.

4.2.6 Health and Safety Coordinator

The Health and Safety Coordinator is responsible for administering the EH&S program that provides a safe, healthy working environment for all employees and the environment. Monitors all areas for unsafe conditions, acts, and potential hazards. Enforces environmental, health, and safety policies and procedures. Maintains regulatory compliance with local, state, and federal laws. Makes safety and health recommendations to laboratory management in conjunction with the facility safety committee. Develops the facility Integrated Contingency Plan and coordinates the facility's Emergency Response Team.

4.3 Deputies

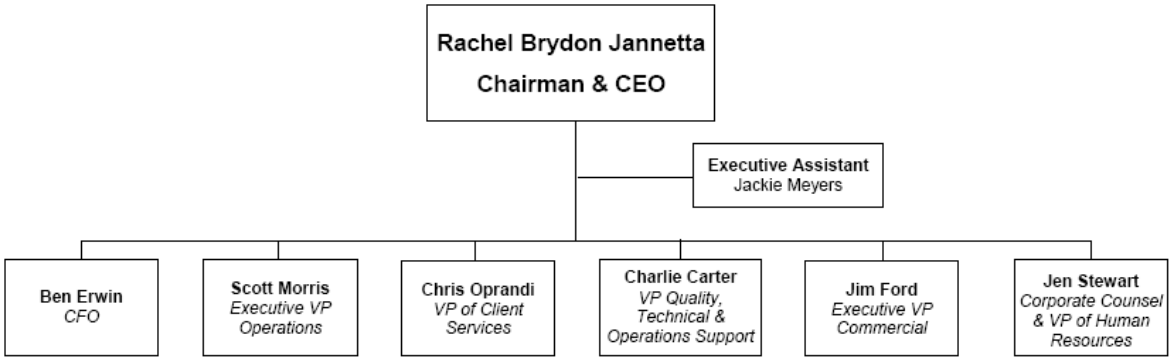
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Kirstin L. Daigle Laboratory Director	Quality Manager Technology Manager
Sara S. Goff Quality Manager	Laboratory Director Technology Manager Quality Specialist
Brad W. Chirgwin Technology Manager	Laboratory Director Quality Manager
Kris A. Dusablon HPLC & GC/MS Semivolatiles Manager	Laboratory Director Technology Manager
Nick J. Rosner Inorganics Manager	Laboratory Director Technology Manager
Chris G. Callahan Extractions, Geotechnical, Sample Management Manager	Laboratory Director Technology Manager
Ryan J. Hammond GC/MS Volatiles & Air Manager	Laboratory Director Technology Manager
Dan W. Helfrich EHS Coordinator	Laboratory Director Technology Manager

Figure 4-1. Corporate and Laboratory Organization Charts

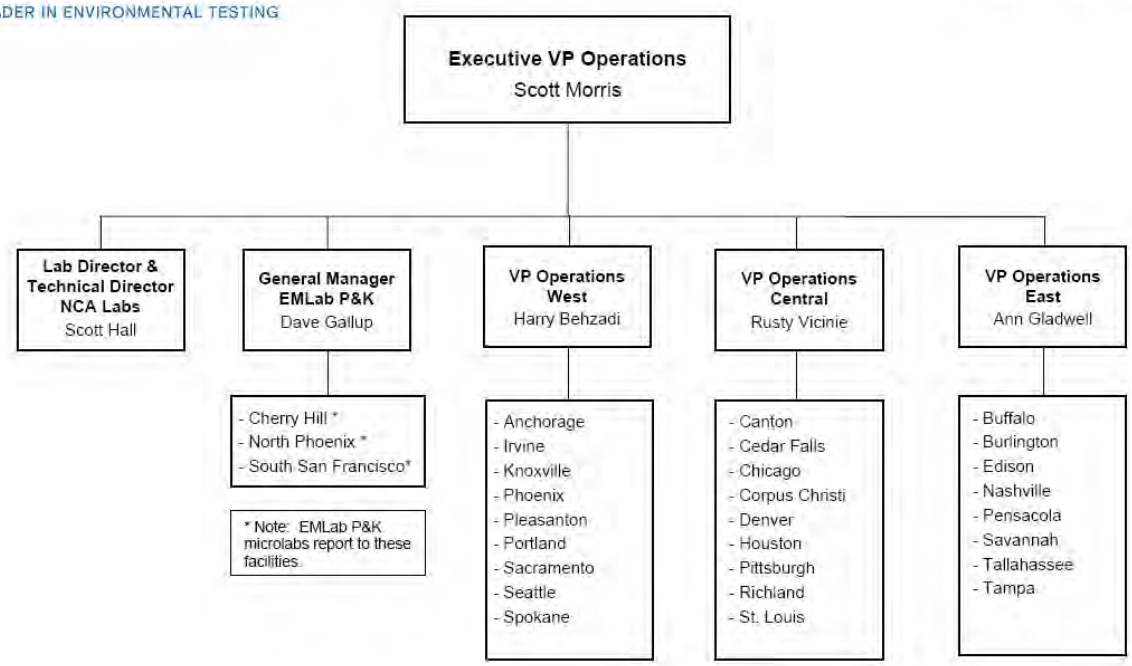
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

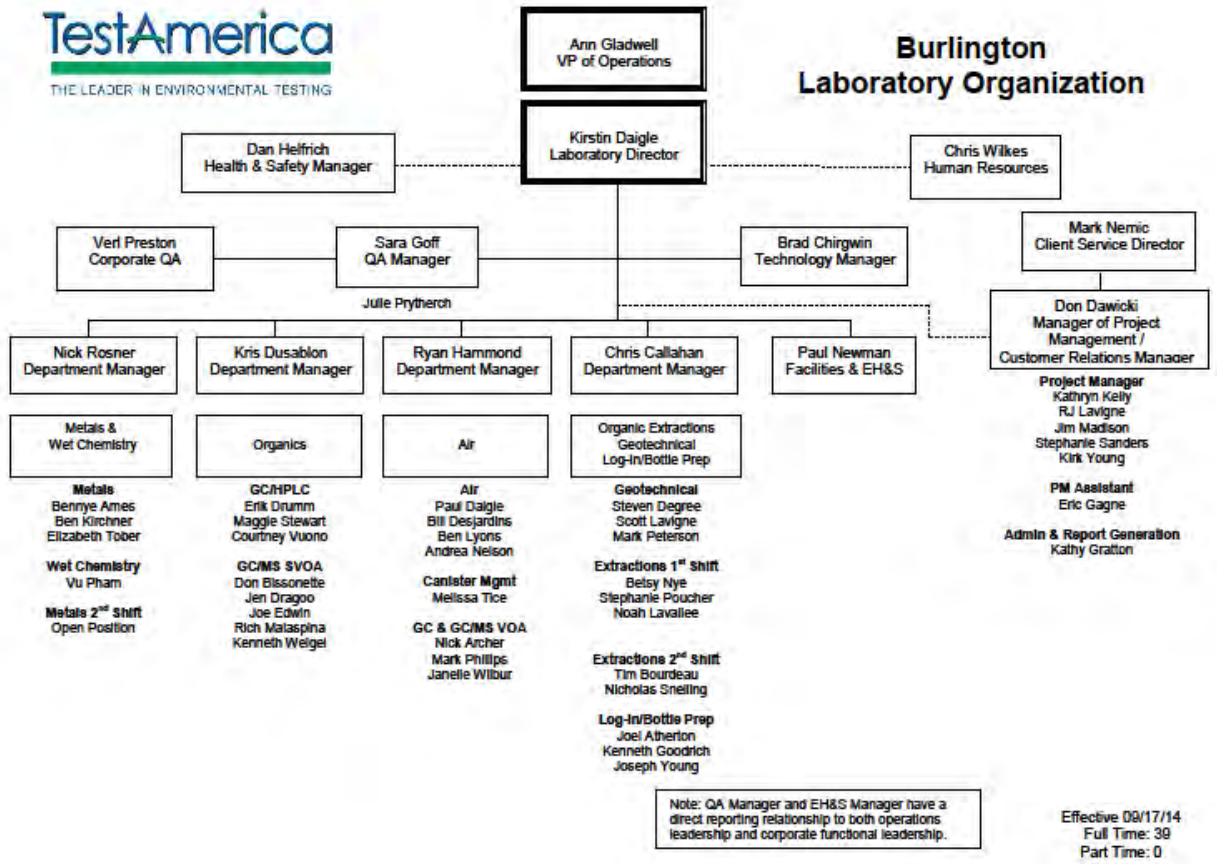
Executive Committee



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Operations





SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.

- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.

- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.

- Provide clients with the highest level of professionalism and the best service practices in the industry.

❖ To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics and Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-L-S-002).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab-specific quality assurance manual.
- Corporate SOPs and Policies – Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives for the Measurement of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated

from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria for Quality Indicators

The laboratory maintains a *Quality Control Limit Summary in LIMS* that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in BR-QA-013, Control Charts, Trend Analysis and In-House Limits.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technology Manager and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The laboratory's procedures for the creation of control charts are described in the laboratory SOP BR-QA-013, Control Charts, Trend Analysis and In-House Limits. Control charts are created from data stored in the LIMS. The charts are evaluated by QA or technical staff to

determine if limits need to be updated or to assess the need for corrective actions to improve method performance.

5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in BR-QA-003, Document Control.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 Document Approval and Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, the department manager or any employee with approval from the department manager submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file. That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed annually and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, refer to SOP No. BR-QA-003. Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. Electronic copies are stored on the Public server in the QA folder (or define location) for the applicable revision.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP or list your labs SOP on this topic.

Forms, worksheets, work instructions and information are organized by department in the QA office in accordance with procedures specified in laboratory SOP No. BR-QA-003 .

6.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. BR-QA-003.

SECTION 7. SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to

perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence and Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to

the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Sales Directors, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above. Appropriate personnel include but are not limited to:

- Contract Administrator
- VP of Operations
- Customer Relations Manager
- Manager of Project Management
- Project Manager
- Laboratory and/or Corporate Technology Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The *Sales Director, Contract Administrator, Account Executive, Customer Relations Manager, Manager of Project Management, Project Manager or Proposal Coordinator* then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements. The laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility. The project Manager, Sales

- The Contracts Department maintains copies of all signed contracts. A copy is also retained at the facility by the C*ustomer Relations Manager, Manager of Project Management, or Project Manager.*

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. Records of review are organized and kept by the designated project manager (PM).

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. These records are retained by the laboratory PM.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties. Such changes are also communicated to laboratory staff.

Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Technology Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all

client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

Note: ISO/IEC 17025 states that a laboratory "shall afford clients or their representative's cooperation to clarify the client's request". This topic is discussed in Section 7.

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technology Manager and the Quality Assurance Manager are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work

sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOPs on Subcontracting Procedures (CA-L-S-002).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Customer Relations Manager (CRM) or Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts (e.g., certain USACE projects) may require notification prior to placing such work.

8.2 Qualifying and Monitoring Subcontractors

Whenever a PM, *Account Executive (AE) or Customer Relations Manager (CRM)* becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica: A listing of all approved subcontracting laboratories is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab. Verify necessary accreditation, where applicable, (e.g., on the subcontractors TNI, A2LA accreditation or State Certification).
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- TNI or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if

acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs.

When the potential sub-contract laboratory has not been previously approved, management staff may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. Once all documents are reviewed for completeness, the Corporate QIM will forward the documents to the Purchasing Manager for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Laboratory Directors, QA Managers and Sales Personnel.

8.3 Oversight and Reporting

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and Corporate Counsel can tailor the document or assist with negotiations, if needed. The PM responsible for the project must advise and obtain client consent to the subcontract as

appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented and the form is retained in the project folder. An example form that may be used is a Subcontracted Sample Form (Figure 8-1). For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples subcontracted within TestAmerica. Client CoCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client CoCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

Figure 8-1.

Example - Subcontracted Sample Form *[Insert your form or you can use this example]*

Date/Time: _____

Subcontracted Laboratory Information:

- Subcontractor's Name: _____
- Subcontractor Point of Contact: _____
- Subcontractor's Address: _____
- Subcontractor's Phone: _____
- Analyte/Method: _____
- Certified for State of Origin: _____
- TNI Certified: Yes_____No_____
- **USDA Permit (__Domestic __ Foreign) Yes_____No_____**
- A2LA (or ISO 17025) Certified: Yes_____No_____
- CLP-like Required: Yes_____No_____
  (Full doc required)
- Requested Sample Due Date: _____
  (Must be put on COC)
- **Client POC Approval on-file to Subcontract Samples to Sub Laboratory: Yes_____No_____**

Project Manager: _____

Laboratory Sample # Range: _____
(Only of Subcontracted Samples)

Laboratory Project Number (Billing Control #): _____

All subcontracted samples are to be sent via bonded carrier and Priority Overnight. Please attach tracking number below and maintain these records in the project files.

PM Signature_____**Date**_____

SECTION 9. PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Company-Wide Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

9.3.2 Receiving

It is the responsibility of the manager to receive the shipment. It is the responsibility of the manager or their designee who ordered the materials to document the date materials where

received. Once the ordered reagents or materials are received the information on the label or packaging is compared to the original order to ensure that the purchase meets the quality level specified. Safety Data Sheets (SDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOP's expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained in each laboratory section.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The minimum total pressure must be 120psig for Helium, 100psig for liquid Argon, and 30 psig for Nitrogen. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25^{o}C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than

the specified limit, the Facility Manager and appropriate Technology Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technology Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Director and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with IT. The manufacturer's operation manual is retained in the laboratory.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technology Manager. The service providers that perform the services are approved by the Technology Manager, Department Manager, or Quality Assurance Manager.

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their

financial stability. The QA Department and/or the Technical Services Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following laboratory SOP No. BR-QA-004.

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to laboratory SOP No. BR-QA-004.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. Any modification to the procedure are documented in the project record and described in the case narrative submitted with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Any project specific modifications to the procedure are documented in the project record.

11.2 Responsibilities and Authorities

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CW-L-S-002) outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances, the Laboratory Director, a Technology Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time

procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, QA Manager, Department Managers and the Technology Manager. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, Executive VP of Operations, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CW-L-S-002) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

11.4 Prevention of NonConforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule. The QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technology Manager, Department Managers, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Reports (NCR) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc..

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Report (NCR) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips**.**

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCRs.
- Issues found while reviewing NCRs that warrant further investigation.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCR or CAR must be initiated, someone is assigned to investigate the issue and the

event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.

- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technology Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCR or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technology Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technology Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.

- Corrective Actions are tracked by the QA Department.
- The QA Manager reviews monthly NCRs and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCR or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to specific method SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCR and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 Basic Corrections

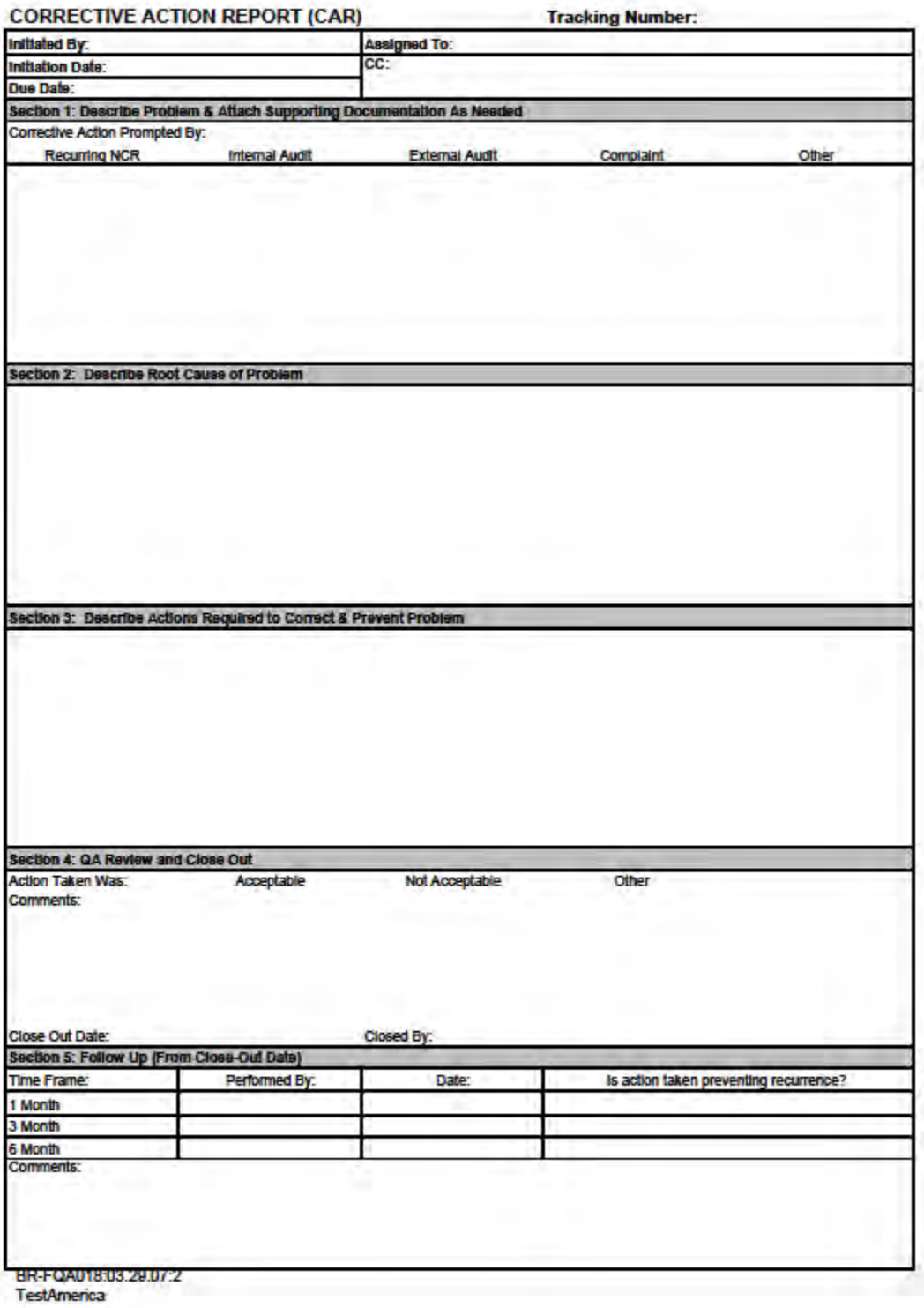
When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored

electronically, the original “uncorrected” file must be maintained intact and a second “corrected” file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report



CORRECTIVE ACTION REPORT (CAR) **Tracking Number:**

Initiated By:	**Assigned To:**
Initiation Date:	CC:
Due Date:	

Section 1: Describe Problem & Attach Supporting Documentation As Needed

Corrective Action Prompted By:

Recurring NCR | Internal Audit | External Audit | Complaint | Other

Section 2: Describe Root Cause of Problem

Section 3: Describe Actions Required to Correct & Prevent Problem

Section 4: QA Review and Close Out

Action Taken Was: Acceptable | Not Acceptable | Other

Comments:

Close Out Date: Closed By:

Section 5: Follow Up (From Close-Out Date)

Time Frame:	Performed By:	Date:	Is action taken preventing recurrence?
1 Month			
3 Month			
6 Month			

Comments:

BR-FQA018.03.29.07.2
TestAmerica

Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technology Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technology Manager(s))*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in *TALS*.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in *TALS*.	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technology Manager(s))*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technology Manager(s), Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc..	- Non-conformances must be investigated through CAR system and necessary corrections must be made.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technology Managers, QA Manager, Corporate QA, Corporate Management)	- SOP CW-L-S-002, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002 or BR-QA-016.
Client Complaints *(Project Managers, Lab Director/Manager, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, *Technology Manager(s)*)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director/Manager, *Technology Manager(s)*)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

Note:
1. Except as noted below for certain compounds, the method blank should be below the reporting limit**.** Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates **provided** they appear in similar levels in the reagent blank and samples. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and client satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the monthly QA Metrics Report, evaluation of internal or external audits, results & evaluation of proficiency testing (PT) performance, data analysis & review processing operations, client complaints, staff observation, etc..

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc.. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory such as the addition of new equipment or personnel. Procedures for minimization of potential risks inherent with a new event or change are described in various laboratory standard operating procedures.

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database, which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by *each laboratory section.*

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* Data Investigation: 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	5 years (project records) 10 years - Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio VAP	10 years and State contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The chain of custody would indicate the name of the sampler.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes. Instrument data is stored by instrument. Run logs are maintained for each instrument. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as “sampled by,” “prepared by,” “reviewed by”, or “analyzed by”.

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory’s ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 19.14.1 ‘Computer and Electronic Data Related Requirements’**.**

14.2 Technical and Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet;
- Instrumentation identification and instrument operating conditions/parameters.
- analysis type**;**
- all manual calculations and manual integrations**;**
- analyst's or operator's initials/signature**;**
- sample preparation**;**
- test results**;**
- standard and reagent origin, receipt, preparation, and use**;**
- calibration criteria, frequency and acceptance criteria**;**

- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions**;**
- quality control protocols and assessment**;**
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements.

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review periodically.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records)**;**
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value**;**
- copies of final reports**;**
- archived SOPs**;**
- correspondence relating to laboratory activities for a specific project**;**
- all corrective action reports, audits and audit responses**;**
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. The procedure for document control are described in laboratory SOP No. BR-QA-003.

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory

operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and**,** when requested**,** to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CW-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technology Manager or Designee (Refer to CW-Q-S-003	Technical Audits Frequency: 50% of methods annually
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technology Manager or Designee (Refer to CW-Q-S-003	SOP Compliance Review Frequency: • Every 2 years • 100% of SOPs annually (DoD Labs)
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI-field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems**,** client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of

results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technology Manager, Department Manager, Quality Assurance Manager, or qualified designee.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, Soil, Air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and

systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, their Quality Director as well as the VP of Operations.

All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technology Manager, Department Managers, and QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CW-Q-S-004 & Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the “big picture” by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.

- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/Recall SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's CEO, Executive VP of Operations, VP of Client & Technical Services, VPs of Operations and Quality Directors receive a monthly report from the Corporate Quality and EHS Director summarizing any current data integrity or data recall investigations. The VPs of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technology Managers – General	Bachelor's Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified peer or supervisor, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Laboratory Training SOP No. BR-QA-011.

17.4 Data Integrity and Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CW-L-P-004) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.

- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 22,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building cards are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook. Signs are posted in the laboratory designating employee only areas - "Authorized employees beyond this point".

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002.
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 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. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*

- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst hasn't performed the test within the last 12 months).

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Technology Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (refer to Figure 19-1) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL) / Limits of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL

Refer to the laboratory SOP No. BR-QA-005 for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification of Detection and Reporting Limits

Once an MDL is established, it must be verified, on each instrument used for the given method. TestAmerica defines the DoD QSM Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL is not successful, then the laboratory will redevelop their MDL or perform and pass two consecutive MDLVs at a higher concentration and set the LOD at the higher concentration.

Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to laboratory SOP No. BR-QA-005 for further details.

The laboratory quantitation limit is equivalent to the DoD Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects. For DoD projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. Complete details are available in the laboratory SOPs.

19.11 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation of Uncertainty of Measurement

19.12.1 Uncertainty is "A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value." (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly,

and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L.

19.12.5 In the case where a well-recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within ± 1 reporting limit for samples ≤ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

19.14 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in corporate IT procedure and policies. The laboratory is currently running TALS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes an SQL database which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 **Maintain the Database Integrity:** Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 **Ensure Information Availability:** Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 **Maintain Confidentiality:** Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices* and laboratory SOP No. BR-QA-006.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction

will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%**.** Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to the number of significant figures programmed in the LIMS formatter selected by the PM.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.

- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are outlined in several SOPs to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data, SOP No. BR-QA-006. The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 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. The Project Managers perform final review of the chain-of-custody forms and inputted information.

19.14.4.2 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 LIMS and add data qualifiers if applicable. To ensure data compliance, a different analyst 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, qualifiers 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. Approximately 15% of all sample data from manual methods and from automated methods, all GC/MS spectra and all manual integrations are reviewed. Manual integrations are also electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. 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

19.14.4.3 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Department Manager, Project Manager, Quality Assurance Manager, or Technology Manager for further investigation. Corrective action is initiated whenever necessary.

19.14.4.4 The results are then entered or directly transferred into the computer database and a report is prepared for the client.

19.14.4.5 As a final review prior to the release of the report, the Project Manager reviews the report 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.

19.14.4.6 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP No. BR-QA-006, entitled Manual Integration Requirements.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters

(calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

Analyst Demonstration of Capability

TestAmerica Burlington

Maggie Stewart

4/4/2014

Preparation Method(s): 3510C
Analytical Method(s): 8081B
Matrix: Water
Method Description: Organochlorine Pesticides (GC)

Preparation SOP No: BL-EX-005
Analytical SOP No: BR-GC-006_8081

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the laboratory's Quality Assurance Plan, has completed the Demonstration of Capability (DOC).
2. The test method(s) was performed by the analyst identified on this certificate.
3. A copy of test method(s) and laboratory SOPs are available for all personnel on-site.
4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility. The associated information is organized and available for review.

Maggie Stewart	Maggie Stewart	4/4/14
Bradley S. Crugni		4/4/14
Technical Director	**Signature**	**Date**
Sara Gott	Sara Gott	4/8/14
Quality Assurance Officer	**Signature**	**Date**

SECTION 20. EQUIPMENT and CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may be also outlined in analytical SOPs or instrument manuals.

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on '*date*' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer at temperatures bracketing the range of use. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The mercury and digital NIST thermometers are recalibrated every five years and one year respectively (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. On non-working days the minimum and maximum temperatures during the time of last temperature reading and the next working day is monitored.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate

that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.
All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12-hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions and reported based upon discussion and approval of the client:

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the

samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the 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 samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements 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.

20.6 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Example: Instrumentation List

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Analytical Balance	Mettler	AE200	L17317	2013	Used
Analytical Balance	Mettler	ML204	1123452701	2010	NEW
Analytical Balance	Metler	ML204	1123452699	2010	NEW
Automated Distillation Apparatus	Westco	Easy Dist	1090	2002	NEW
Automated Distillation Apparatus	Westco	Easy Dist	1091	2002	NEW
COD Reactor	HACH	45600-00	11000022452	UNKNOWN	UNKNOWN
Conductivity Meter	Oakton	CON110	297661	2004	NEW
CVAA	Leeman (CV3)	HydraAA112-0064-1	2031	2003	NEW
CVAA	Leeman (CV4)	HydraAA112-0064-1	8015	2008	NEW
GC/ECD/ECD	Agilent (7424)	6890N	US10332093	2003	NEW
GC/ECD/ECD	Agilent (3283)	6890N	US10805001	2008	NEW
GC/EDC/ECD	Hewlett-Packard (8263)	6890	US00028263	UNKNOWN	UNKNOWN
GC/ECD/ECD	Agilent (7227)	6890N	CN10602095	2006	NEW
GC/ECD/ECD	Agilent (0825)	6890N	US10202136	2002	NEW
GC/ECD/ECD	Agilent (1031)	7890A	CN10301031	2010	NEW
GC/ECD/ECD	Agilent (5253)	6890N	CN10723008	2007	NEW
GC/ECD/ECD	Agilent (0911)	6890N	US10230082	2002	NEW
GC/ECD/ECD	Agilent (5005)	6890N	CN10615005	2009	USED
GC/FID/ECD	Hewlett-Packard (Screen)	5890	GC 2415A01109	UNKNOWN	UNKNOWN
GC/FID/FID	Hewlett-Packard (3012)	5890II	3235A45259	1984	UNKNOWN
GC/FID/FID/TCD	Varian (CP3800)	CP-3800	S/N 10328	2003	NEW
GC/FID/TCD	Varian (2866)	VR-3600	2866	1998	UNKNOWN

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/FPD/FPD	Hewlett-Packard (2860)	5890II	2950A27078	1990	UNKNOWN
GC/MS	Hewlett-Packard (N)	5890II / 5971	3203A40979	1998	NEW
GC/MS	Agilent (B)	6890N/ 5973	CN10317006	2003	NEW
GC/MS	Agilent (C)	6890N / 5973	CN10424016	UNKNOWN	NEW
GC/MS	Agilent (G)	6890N / 5973	CN10437065	UNKNOWN	USED
GC/MS	Agilent (E)	6890N / 5973	CN10453004	2005	NEW
GC/MS	Agilent (F)	6890N/ 5973	CN10531065	2005	NEW
GC/MS	Agilent (S)	7890A/5975	CN10211095	2010	NEW
GC/MS	Agilent (T)	7890A/5975	CN10211037	2010	USED
GC/MS	Hewlett-Packard (L)	5890II / 5971	3203A40982	1998	NEW
GC/MS	Agilent (D)	6890N / 5973	CN10439015	2004	NEW
GC/MS	Hewlett-Packard (P)	5890II / 5971	3203A40985	1992	USED
GC/MS	Hewlett-Packard (Q)	5890II / 5971	3203A40983	1992	NEW
GC/MS	Hewlett-Packard (R)	5890II / 5971	3203A40984	1992	NEW
GC/MS	Hewlett-Packard (U)	5890II Plus/ 5972	3336A61535	1997	NEW
GC/MS	Agilent (H)	6890N / 5975	CN10608102	2006	NEW
GC/MS	Agilent (Z)	6890A/ 5973	US00036343	2000	NEW
GC/MS	Agilent (J)	6890N / 5973	CN10430052	2009	USED
GC/MS	Agilent (AA)	6890 / 5973	US00035345	2013	USED
GC/MS	Hewlett-Packard (AB)	6890 / 7673	US00004214	2013	USED
GC/MS	Hewlett-Packard (AC)	6890 / 5973	US00030199	2013	USED
GC/MS	Agilent (W)	7890A / 5975B	CN1231116	2012	USED
GC/MS	Agilent (X)	6890N / 5975	CN10526012	2013	USED
GC/FID	Hewlett-Packard (6453-K) Screen	5890 II	3203A41768	UNKNOWN	UNKNOWN
GPC	J2 Scientific (I)	Autoinject 110	02D-1030-2.1	2002	NEW
GPC	J2 Scientific (H)	Autoinject 110	02D-1031-2.1	2001	NEW
GPC	J2 Scientific (J)	AccuPrep	03G1076-3.0	2003	NEW
HPLC/UV	Dionex (1488)	P680	1680407	1991	UNKNOWN
HPLC/UV/PDA	Waters (1208)	600	60004790RP	1988	NEW
Hydrogen Generator	Parker Hannafin	H2-1200	H2-100492	2013	NEW
ICP-MS	Thermo Elemental (2)	X7	X0288	2003	NEW
ICP-OES	Thermo Electron Corp (7)	iCAP 6000	ICP20063302	2006	NEW
ICP-OES	Varion	720-ES	EL06053837	2013	USED
LC/MS/MS	Waters (1111)	Acquity/Quattro micro	QAA929	2005	NEW
HPLC	Waters (3062)	616	MX5NM6829M	UNKNOWN	NEW
Particle Size Analyzer	Malvern	MasterSizer 2000	MAL101709 MAL110286	UNKNOWN	UNKNOWN
pH Meter	Denver Instruments	UB-5	UB503B365	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXA)	SE3AS306A	4012396	UNKNOWN	UNKNOWN

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Soxtherm	Gerhardt (SOXB)	SE3AS306A	4022047	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXC)	SE3AS306A	4022046	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXD)	SE3AS306A	4022045	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXE)	SE3AS306A	4022030	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXF)	SE3AS306A	4012397	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXG)	SE-416	4051586	2012	USED
Soxtherm	Gerhardt (SOXH)	SE-416	4031739	2012	USED
Soxtherm	Gerhardt (SOXI)	SE-416	4031738	2012	USED
Soxtherm	Gerhardt (SOXJ)	SE-416	4031737	2012	USED
TKN Digestion System	Aim Lab	AIM600 Block	5048A23014	2011	NEW
Elemental Analyzer (TOC)	Carlo Erba	NA 1500	220465	1991	UNKNOWN
Elemental Analyzer (TOC)	Carlo Erba	EA1108	249146	1991	UNKNOWN
Nitrogen/Protein Analyzer	Costech	4010	231009973	2005	UNKNOWN
TOC Analyzer	Shimadzu	TOC-V CPH	H5131480032AE	2011	NEW
Turbidimeter	HF Scientific	Micro 100	208463	2001	UNKNOWN
Spectrophotometer	Genesys	Spectronic 20	3SGEO38002	1999	UNKNOWN
Spectrophotometer	Genesys	Spectronic 20	3SGE165024	2002	UNKNOWN
Flow Injection Analyzer	Lachat	QuikChem 8000	A83000-2167	2000	UNKNOWN

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check Peristaltic Pump tubing	As required
	Lubricate Autosampler rods	Monthly
	Clean Autosampler	Weekly
	Check and fill Rinse Vessel	As required
	Check and fill Stannous Chloride	As required
	Check Waste Vessel	Daily
	Empty Waste Vessel	As required
ICP	Check Peristaltic Pump tubing	As required
	Clean Torch	Daily
	Replace Torch	As required
	Check and fill Rinse Vessel	As required
	Check and fill IS Vessel	As required
	Fill Standards Cup	Daily
	Check Waste Vessel	Daily
	Empty Waste Vessel	As required
	Check and clean Cones	As required
	Perform Auto Peak Adjustment	As required

Instrument	Procedure	Frequency
ICP MS	Check Peristaltic Pump tubing	As required
	Clean Torch	As required
	Check and fill Rinse Vessel	As required
	Check and fill IS Vessel	As required
	Fill standards cup	Daily
	Check Waste Vessel	Daily
	Empty Waste Vessel	As required
	Check and clean Cones	As required
UV-Vis Spectrophotometer	Clean ambient flow cell	As required
	Wavelength verification check	As required
	Clean Cuvette with Cuvette Cleaning Solution	As required
Hewlett Packard GC/MS (VOA)	Clean Injection Port and Liner	As required
	Change Septa	As required
	Cut 2-3 inches from GC Column	As required
	Fill Autosampler rinse vials	As required
	Clean Purge and Trap mount and purge vessel	As required
	Check Purge Flow	As required
Hewlett Packard GC/MS (SVOA)	Clean Injection Port and Liner	Daily
	Change Septa	Daily
	Replace or clip Guard Column	Daily
	Replace or clip Analytical Column	Daily
	Fill Autosampler rinse vials	Daily
Hewlett Packard GC/MS (Air)	Check GC / Entech Column Interface	As required
	Check Nitrogen Tank Volume	As required
	Check Nitrogen Valves Software and Valves	As required
	Cut 2-3 inches from GC Column	As required
Gas Chromatograph	Replace Septa	As required
	Clean and replace Injection Port Liner	As required
	Replace or clip Guard Column	As required
	Replace or clip Analytical Column	As required
	Bake, Re-foil, Refurbish Detector	As required
Zero Air Generator	Change pre-filter cartridge	Annually
	Replace catalyst module	Indicator Light Blinks
	Check Indicator Beads in Moisture Filters	Daily
	Bake and Refill Mol Sieve Dry Rite Beads	As required
Hydrogen Generator	Fill Water Reservoir	Daily
	Replace Water in Water Reservoir	Semi-Annually
	Replace Ionic Bags in Water Reservoir	Semi-Annually
HPLC	Change Transfer Lines	As required
	Replace Guard Column	As required
	Replace Analytical Column	As required
	Replace or clean Pump Head Check Valves	As required
	Change Plunger Seals	As required
	Change Suppressor	As required
	Change Eluent Generator Cartridge and CR-ATC	As required

Instrument	Procedure	Frequency
LC/MS/MS	Replace Guard Column Replace Analytical Column Replace or clean Pump Head Check Valves Change Plunger Seals Change In Line Filter Clean or Change Sample Cone Clean Source	As required As required As required As required As required As required As required
Balances	Class "1" traceable weight check Clean pan and check if level Field service	Daily, when used Daily Annually
Lachat	Change Tubing Replace Bulb	As required As required
Conductivity Meter	Calibrate	Daily
Turbidimeter	Calibrate Check light bulb	As required Daily, when used
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
pH/Specific Ion Meter	Calibrate Clean electrode	Daily As required
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water baths	Temperature monitoring Water replaced	Daily, when used Monthly or as needed

SECTION 21. MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia–Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the ‘true’ value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained as a pdf file in the LIMS. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to laboratory SOP No. BR-QA-002.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Preparer's name
- Final volume
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)

- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID *from LIMS*
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained on the company's intranet an din test method SOP**.**

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

The laboratory does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness provided by the supplier are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time "zero". As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need

consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located SOP No. BR-QA-020 and test method SOPs.

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available

- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If the client requests legal COC sample management personnel will initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

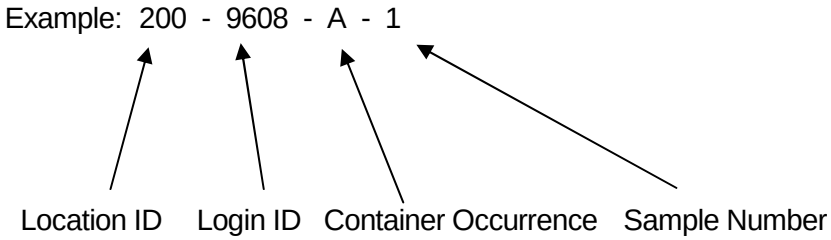
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented in a NCM and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Burlington Laboratory (Location 200). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 200 - 9608 - A - 1 - A

Secondary Container Occurrence

Example: 200-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);

The project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. BR-SM-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed weekly.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample, and return the remaining sample or empty container to the refrigerator from which it originally came. All unused portions of samples, including empty sample containers, are returned to the secure sample control area.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only. For any sample that is known to be hazardous at the time of receipt or, if after completion of analysis the result exceeds the acceptable regulatory levels, a Hazardous Sample Notice must be completed by the analyst. This form may be completed by Sample Control, Project Managers, or analysts and must be attached to the report. The sample itself is clearly marked with a red stamp, stamped on the sample label reading “HAZARDOUS” or “FOREIGN SOIL” and placed in a colored and/or

marked bag to easily identify the sample. The date, log number, lab sample number, and the result or brief description of the hazard are all written on the Hazardous & Foreign Soil Sample Notice. A copy of the form must be included with the original COC and Work Order and the original must be given to the Sample Control Custodian. Analysts will notify Sample Control of any sample determined to be hazardous after completion of analysis by completing a Hazardous Sample Notice. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures, SOP No. BR-EH-001. All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample

depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1. Example: Chain of Custody (COC)

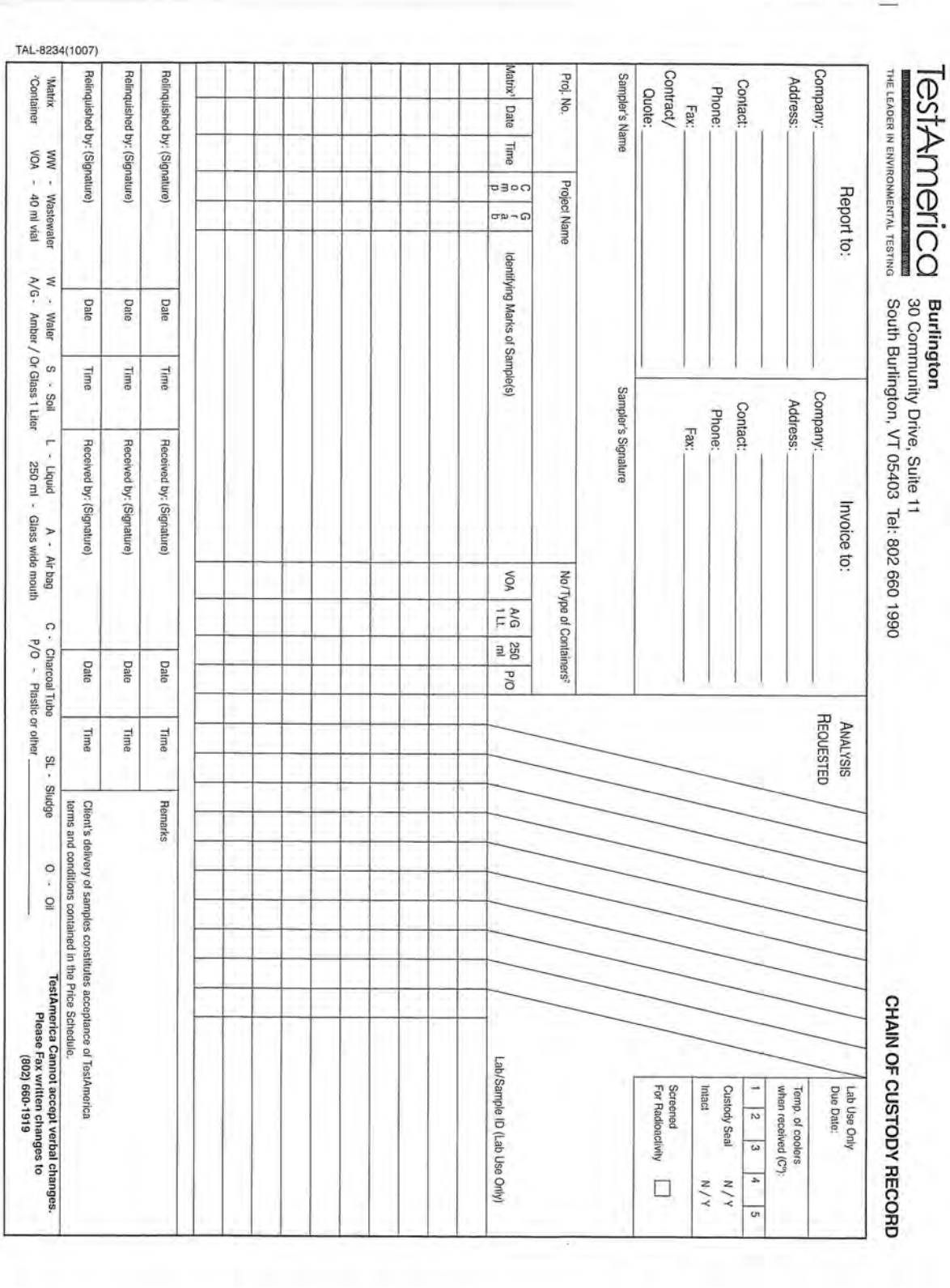


Figure 23-2. Example: Sample Acceptance Policy

The receipt of samples is acknowledged on the chain of custody (COC) form with the signature and date/time of the sample custodian. The condition of samples upon receipt is documented on checklists designated for this purpose. Any deficiencies identified during sample receipt are recorded and communicated to the laboratory project manager (PM), who will contact the client and fully document any decision to proceed with analysis in the project record. Consultation with the client should be immediate and timely (next business day or as specified in the project plan). Correspondence records and/or the disposition of rejected samples are maintained in the project record, and should be maintained in association with the sample receipt checklist. All data associated with samples that did not meet the sample acceptance criteria must be qualified with a Non-Conformance Report (NCR) and/or noted in the project narrative that accompanies the final test report.

Sample receipt is considered deficient when the following conditions are observed:

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

Sample receipt is considered deficient when the following conditions are observed:

- Shipping cooler and/or samples are received outside the temperature specification
- Sample bottles are received broken or leaking
- Samples are received beyond holding time
- Samples are received without the appropriate preservation
- Samples are not received in appropriate containers
- Chain of Custody does not match the samples received
- Chain of Custody was not received or is incomplete*
- Custody seals are broken
- Evidence of tampering with the cooler and/or samples
- Headspace in 40mL or 22 mL VOA vials
- Seepage of extraneous water or other material into the samples
- Inadequate sample volume
- Illegible, impermanent ink, or non-unique sample labeling
- One or more coolers missing from a multi parcel shipment
- Shipping container is damaged

**Complete documentation shall include sample identification, the location date/time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample.*

Figure 23-3. Example: Cooler Receipt Form

PRE-LOG IN SAMPLE RECEIPT & HANDLING CHECKLIST

Tracking Information				
Log-In #	**Project #**			
PM:	**Client :**			
Log-In Date:	**INTERNAL COC (ICOC) Required? □ Yes □ No**			
Log-In Performed By:	*If yes, attach a copy of ICOC Form to Checklist*			
Sample Receipt Information				
Date Recived:	Received By: (Print Name)			
Time Received:	*Signature:*			
Delivery Type: □ Shipping Service □ Courier □ Hand # Coolers Received:				
Condition of Shipping Coolers/ Containers	Yes	No	NA	Comments
There is no evidence of tampering?				
Custody seals are present and intact?				
Are custody seal numbers provided?				
If yes, list cutody seal numbers:				
Packing Material: □ Bubble Wrap □ Cardboard □ Corrugated Paper □ Shredded Paper □ Styrofoam □ Vermimiculite □ None				
□ Foam Insert □ Other (specify)				
Check Performed By: Check Recorded By:				
Temperature Check				
Thermal Preservation: ☐ Wet Ice ☐ Blue Ice ☐ None ☐ Other (Specify)				
If none, is thermal preservation required?				
IR Gun ID:	IR Readings Taken By:			
IR Gun Corection Factor (CF):	IR Readings Recorded By:			
Is a temperature blank provided? ☐ Yes ☐ No *If yes, use temperature blank for measurement*				
If no, specify the sample ID used to take measurement for each cooler for which measurement was taken.				
Record the observed temp reading below. Record the adjusted temp reading in TALS. To calculate the adjusted temp, subtract or add the IR Gun CF to the observed temp.				
Cooler 1 ℃	ID & Bottle Type:			
Cooler 2 ℃	ID & Bottle Type:			
Cooler 3 ℃	ID & Bottle Type:			
Cooler 4 ℃	ID & Bottle Type:			
Cooler 5 ℃	ID & Bottle Type:			
Criteria: Routine: ≤6℃ CLP SOW: ≤10℃ Summa Canisters / Tedlar Bags & Geotechnical: Ambient Samples should not be frozen unless freezing does not impact integrity of sample, such as for biota or biological tissue. Some programs require 4±2℃ or other criteria; the PM must apply the proper criteria to their project and notify client of outliers. Criteria for samples delivered same day of collection: Evidence of chilling, such as ice in the shipping cooler.				
pH Check for Aqueous Inorganic Samples	Yes	No	NA	Comments
pH is within criteria for all methods?				
If no, does client require pH adjustment?				
If yes, was pH adjustment performed?				
Does 24 hour wait time apply for metals?				
If pH adjustment performed, attached a copy fo the preservation sheet to this checklist.				
pH Checks Performed By:				
Paperwork Review	Yes	No	NA	Comments
Is receipt paperwork complete & legible?				
CLP: Is Traffic Report / COC Present?				
Notify PM of discrepancies.				
Scan COC and Airbill to PDF				
Check Performed By:				
Secondary Label Review Performed By: **Date:**				
Comments				

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SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	Used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	Prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	Blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content..
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike

(MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.

- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-2. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

- The maximum acceptable recovery limit will be 150%.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager or project manager assistant. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report For Samples) with a “sample results” column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc.).

25.2.11 Practical quantitation limits or reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.19 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.20 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.21 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.22 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.23 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report or preliminary). A complete report must be sent once all of the work has been completed.

25.2.24 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.25 A Certification Summary Report, where required, will document that, unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 Reporting Level or Report Type

The laboratory offers four levels of quality control reporting.

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus QC summary information.

- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

The format of each report type is specific to the client or regulatory program and is therefore not included in the QAM. The reporting specifications for CLP contract samples must comply with the specifications for CSF organization, preparation and review as specified in the SOW. Procedures for preparation of the CSF are provided in laboratory SOP BR-RM-001.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. ***TestAmerica Burlington*** offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If

so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to which it is addressed, and may contain information that is privileged and confidential. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please

notify us immediately by telephone at the 1-800-765-0980 (or for e-mails: please notify us immediately by e-mail or by phone (1-800-765-0980) and delete this material from any computer).

25.7 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report will have the word "revised" or "amended" next to the date rather than the word "reported".

When the report is re-issued, a notation of "report re-issue "is placed on the cover/signature page of the report *or at the top of the narrative page* with a brief explanation of reason for the re-issue and a reference back to the last final report generated. *For Example*: *Report was revised on 11/3/08 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/08 at 10:47am.*

25.9 Policies on Client Requests for Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

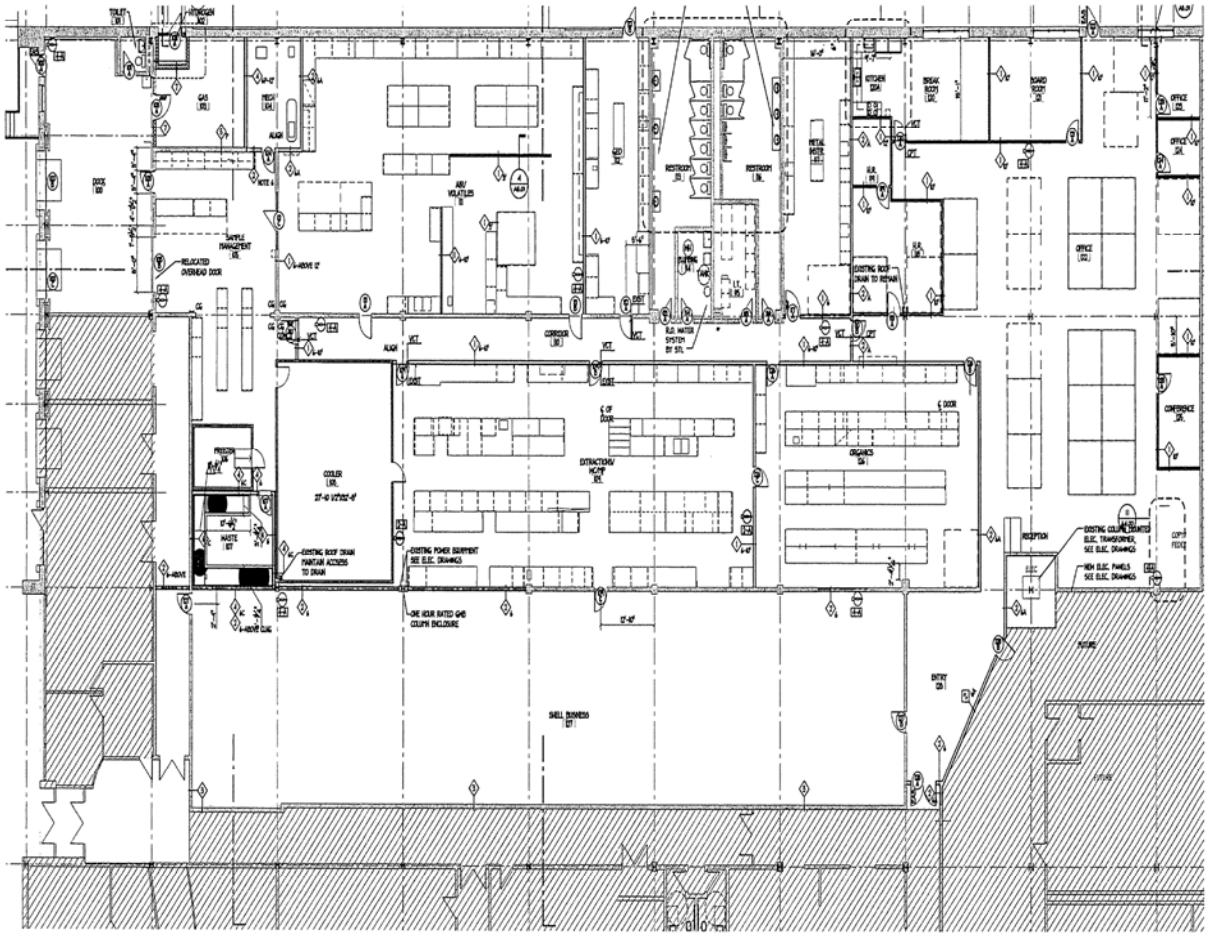
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan



Appendix 2. Glossary/Acronyms (EL-V1M2 Sec. 3.1)

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguard identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is $\pm$ 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.

Drinking Water: Any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test

result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technology Manager**:** A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Burlington maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

Laboratory	Lab ID	Program	Authority
Burlington	L2336	DoD ELAP	L-A-B
Burlington	LE-058448-0	Federal	US Fish & Wildlife
Burlington	P330-11-00093	Federal	USDA
Burlington	E87467	NELAP	Florida
Burlington	050-999-436	NELAP	Minnesota
Burlington	2006	NELAP	New Hampshire
Burlington	VT972	NELAP	New Jersey
Burlington	10391	NELAP	New York
Burlington	68-00489	NELAP	Pennsylvania
Burlington	460209	NELAP	Virginia
Burlington	PH-0751	State Program	Connecticut
Burlington	NA	State Program	DE Haz. Subst. Cleanup Act (HSCA)
Burlington	VT00008	State Program	Maine
Burlington	LAO00298	State Program	Rhode Island
Burlington	VT-4000	State Program	Vermont

The certificates and accredited parameter lists are available for each State/Program at www.testamericainc.com under Analytical Services Search – Certifications.

Title: Analytical Methods for the Analysis of GC/MS Volatiles [SW-846 Method 8260C]

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

Denise Giglia — 1/13/15	Kenneth Kasperek — 1/13/15
Denise Giglia — Date	Kenneth Kasperek — Date
Department Manager	EHS Manager
Brad Prinzi — 1/13/15	Christopher Spencer — 1/13/15
Brad Prinzi — Date	Christopher Spencer — Date
Quality Assurance Manager	Laboratory Director

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1.0 Scope and Application

1.1 Analytes, Matrix(s), and Reporting Limits

1.1.1 Methods 8260C -5 mL aqueous purge, 8260C – 5gr soil and 8260C – medium level soil.

1.1.2 Applicable matrices include all aqueous samples, sediment, and soil.

1.1.3 The standard reporting limit (RL) is established at or above the low-level standard in the calibration curve. For a 5-ml purge volume, the RL for the majority of compounds is 1 ug/l.

On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in the Quality Assurance Manual.

2.0 Summary of Method

2.1 This analytical method is utilized for the analysis of water, sediment and soil from hazardous waste sites for the organic compounds listed in Table 1.

2.2 The method includes sample preparation and analyses by purge and trap gas chromatograph/mass spectrometer (GC/MS). Method can be used for 5mL purge.

2.3 Volatile compounds are extracted from sample matrix by the purge and trap method. Analytes are desorbed onto a capillary column. An appropriate ramping temperature program is applied to maximize separation and achieve the correct resolution between the analytes. A mass spectrometer detector (MSD) interfaced to the gas chromatograph (GC) is utilized to detect analytes of interest.

2.4 Analytes eluted from the capillary column are introduced into the mass spectrometer via a direct connection. Identification of target analytes is accomplished by comparing their mass spectra with the electron impact spectra of authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a minimum of a five-point calibration curve.

3.0 Definitions

3.1 **MB - Volatile blank**: MB's are made from laboratory produced volatile free water. They are analyzed before samples to ensure a clean laboratory environment and analytical system.

3.2 **IBLK – Instrument Blank:** IBLK's are made from laboratory produced volatile free water. They are analyzed after high level samples to verify that the system is clean and demonstrate the absence of carryover.

3.3 **LCS – Laboratory Control Sample:** An LCS consists of a sample of volatile free water that is spiked with a group of target compounds representative of the method analytes. It is used to monitor the accuracy of the analytical process, independent of matrix effects.

3.4 **Surrogates (System Monitoring Compounds):** Surrogates are organic compounds which are similar to the target analytes in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples. Each sample, MB, LCS and MS/MSD are spiked with surrogates.

3.5 **MS/MSD – Matrix Spike/Matrix Spike Duplicate:** A Matrix Spike is an environmental sample which is spiked with a group of target compounds representative of the method analytes. A Matrix Spike Duplicate is a second aliquot of the same sample, which is spiked with the same target compounds. These samples are used to evaluate accuracy and precision in environmental samples.

3.6 **Batch:** A batch is a set of 18 field samples using the same procedures within the same time period. Using this method each BFB analysis will start a new batch. Batches for medium level soils are defined at the sample preparation stage and may be analyzed on multiple instruments over multiple days, although reasonable effort must be made to keep the samples together.

4.0 Interferences

4.1 Airborne contamination may result from solvent vapors. MBs and IBLKs will be utilized to demonstrate a clean system and laboratory environment.

4.2 Some volatile compounds can permeate through a sample septum seal during storage or shipment. A weekly volatile holding blank is stored in all sample incubators to monitor contamination.

4.3 Contamination by carryover can occur whenever a sample with high concentrations of target compounds precedes a sample with low levels. The purging device, syringe and lines are flushed between every analysis to reduce carry over contamination. The trap is baked between each analysis.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

5.1.1 The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

5.1.2 The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

5.1.3 There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2 Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material	Hazards	Exposure Limit (1)	Signs and symptoms of exposure
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
1 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Instrumentation

6.1.1 Purge and trap devices

- Varian Archon Auto sampler
- Encon Concentrator
- O/I Analytical Auto sampler and Concentrator
- Centurion Auto sampler

6.1.2 Trap Packing

- Vocarb 3000
  - Carbpack B
  - Carboxen 1000
  - Carboxen 1001
- OI #10
  - Tenax
  - Silica Gel
  - cms
- Other traps may be used if the Quality Control criteria are met.

6.1.3 Gas Chromatograph/Mass Spectrometer (GC/MS) - GC: HP5890, MS:

- Gas chromatograph Column - J&W Scientific DB-624 or Phenomenex ZB-624
- Internal diameter: 0.25mm or 0.18mm
- Length: 20m, 30m or 60m.
- Coating: Cyanopropylphenyl Methyl Silicone
- Film thickness: 1.0um or 3.0μm

6.1.4 Data System

- Computer with Chemstation enviroquant software
- Gas Chromatograph/Mass Spectrometer (GC/MS)-GC: HP6890 or HP7890, MS: Hewlett-Packard/Agilent 5973N or 5975.
- ProLab Resources software

6.1.5 Analytical Balance Mettler - Toledo Inc. Mettler AE160

6.2 Supplies

- Syringes - Hamilton Syringes size, 10ul, 25ul, 50ul, 100ul, 500ul, 1ml, 5ml, 10ml, 25ml
- Pasteur Pipettes – disposable
- Vials and caps - 2ml disposable
- Vials and caps - 40ml disposable
- Volumetric flasks - Pyrex 2ml, Pyrex 10ml, Pyrex 50ml, Pyrex 100ml
- pH paper - wide range -.EM Science

7.0 Reagents and Standards

7.1 Reagent Water - For volatile analysis, the reagent water is volatile free and is prepared by passing water through a carbon trap.

7.2 Methanol - Burdick & Jackson, purge and trap grade

7.3 Stock Standards - Are purchased as certified standard mixtures. Traceability is documented following the procedures in the "Standards Traceability and Preparation Logbooks" SOP# BF-GP-019. Individual compounds are prepared using reagent grade chemicals following the "Primary Standards Preparation" SOP# BF-MV-010.

7.3.1 Stock Target Compound Mix – Is composed of two different mixtures.

7.3.1.1 Gas Mix (See Table 8 for component list) is purchased at a concentration of 2000ug/ml.

7.3.1.2 8260 Mega Mix (See Table 9 and 10 for component list) is purchased and is composed of five separate mixtures.

- 8260 List 1/ Standard 1 is purchased at a concentration of 2000ug/ml.
- 8260 List 1/Standarad 2 is purchased at a concentration of 10000ug/ml.
- 8260 List 1/ Standard 4 is purchased at a concentration of 2000ug/ml.
- 8260 List 1/Standard 5 is purchased at a concentration of 20000ug/ml.

- 8260 List 1/Standard 6 is purchased at a concentration of 4000ug/ml.

7.3.1.3 **8260 Add Mix** (See Table 13 for component list) is purchased and is composed of six separate mixtures.

- 8260 List 2/ Standard 1 is purchased at a concentration of 2000ug/ml.
- 8260 List 2/Standarad 2 is purchased at a concentration of 2000ug/ml.
- 8260 List 2/ Standard 3 is purchased at a concentration of 20000ug/ml.
- 8260 List 3/Standard 1 is purchased at a concentration of 20000ug/ml.
- Buffalo Add Mix A is purchased at a concentration of 5000ug/ml.
- Buffalo Add Mix B is purchased at a concentration of 1000ug/ml.

7.3.2 **Stock Calibration Verification Mix** – Is composed of two different mixtures.

7.3.2.1 **Second Source Gas Mix** (See Table 11 for component list of 8260 second source standards) is purchased at a concentration of 2000ug/ml.

7.3.2.2 **Second Source 8260 Mega Mix** is purchased and is composed of five separate mixtures.

- Second source 8260 List 1/ Standard 1 is purchased at a concentration of 2000ug/ml.
- Second source 8260 List 1/Standarad 2 is purchased at a concentration of 10000ug/ml.
- Second source 8260 List 1/ Standard 4 is purchased at a concentration of 2000ug/ml.
- Second source 8260 List 1/Standard 5 is purchased at a concentration of 20000ug/ml.
- Second source 8260 List 1/Standard 6 is purchased at a concentration of 4000ug/ml.

7.3.3 **Stock Internal Standard Solution** – A mixture of 1,4-Dichlorobenzene-d4, Chlorobenzene-d5 and Fluorobenzene in Methanol is purchased at a concentration of 2500ug/ml.

7.3.4 **Stock System Monitoring Solution** – A mixture of Toluene-D8, 4-Bromofluorobenzene, Dibromofluoromethane and 1,2-Dichloroethane-d4 in Methanol is purchased at a concentration of 2500ug/ml.

7.3.5 **Stock BFB Solution** – A solution of 4-Bromofluorobenzene in Methanol is at a concentration of 25000ug/ml.

7.4 Working Standards

7.4.1 Intermediate Calibration Solution (Two individual mixtures)

7.4.1.1 250ul of stock standard Gas Mix solution (2000ug/ml) is added to approximately 4 ml of purge and trap methanol in a 5ml Class A volumetric, and then brought up to a final volume of 5ml with additional purge and trap grade methanol for a final concentration of 100ng/ul.

7.4.1.2 1000ul of each of the five stock standard 8260 Mega Mixes are added to approximately 5ml of purge and trap methanol in a 10ml Class A volumetric, and then brought up a final volume of 10ml with additional purge and trap grade methanol.

7.4.2 A Full List Matrix Spike Standard is made from stock Calibration Standards and is composed of two mixes.

7.4.2.1 250ul of stock standard Gas Mix solution (2000ug/ml) is added to approximately 4 ml of purge and trap methanol in a 5ml Class A volumetric, and then brought up a final volume of 5ml with additional purge and trap grade methanol for a final concentration of 100ng/ul.

7.4.2.2 1000ul of each of the five stock standard 8260 Mega Mixes are added to approximately 5ml of purge and trap methanol in a 10ml Class A volumetric, and then brought up a final volume of 10ml with additional purge and trap grade methanol.

7.4.3 Working Internal Standard and System Monitoring Compound Solutions – for auto injection by instrument.

7.4.3.1 **Working Internal Standard Solution** - An Internal Standard Mixture is made from IS stock standard (2500ug/ml). For water analysis a concentration between 20 and 30ng/ul is prepared, depending on sample loop size of the auto sampler, to produce a final concentration of 25ug/L in the sample. For low level soil analysis a concentration between 45 and 55ng/ul is prepared, depending on sample loop size of the auto sampler, to produce a final concentration of 50ug/Kg in the sample.

7.4.3.2 **Working System Monitoring Calibration Solution** - A System Monitoring Compounds Mixture is made from Surrogate stock standard (2500ug/ml). For water analysis a concentration between 20 and 30ng/ul is prepared, depending on sample loop size of the auto sampler, to produce a final concentration of 25ug/L in the sample. For low level soil analysis a concentration between 45 and 55ng/ul is prepared, depending on sample loop size of the auto sampler, to produce a final concentration of 50ug/Kg in the sample.

7.4.4 **Tuning Mixture** - 4ul of stock solution 4-Bomofluorobenzene (BFB) tuning mixture is added to approximately 1 ml of purge and trap grade methanol in a 2 ml Class A volumetric, and then brought up to final volume of 2 ml with additional purge and trap grade methanol for a final concentration of 50ng/ul.

7.4.5 **Working Initial Calibration Standards**

7.4.5.1 **Water: 5 mL (7 point curve)**

7.4.5.1.1 50ul, 25ul, 12.5ul, and 5ul each of Intermediate Calibration Solution (7.4.1) is added to reagent water in each of four 50ml volumetric flasks for multi-point surrogate calibration. The flasks are brought to volume with reagent water to prepare the 100, 50, 25 and 10 ug/L standards respectively. Single point surrogate calibration, the instruments' auto sampler introduces 25ug/L of System Monitoring Compounds into all calibration points.

7.4.5.1.2 2.5ul, 1ul and 0.5ul of each Intermediate Calibration Solution (7.4.1) are added to reagent water in each of the 100ml volumetric flask. The flask is brought to volume with reagent water to prepare the 5ug/L, 1ug/L and the 0.5ug/L standard.

7.4.5.1.3 The standard is then transferred into a 40ml vial and loaded onto the auto sampler.

7.4.5.2 **Soil: (7 point curve)**

7.4.5.2.1 100ul, 50ul, 25ul, and 10ul each of Intermediate Calibration Solution (7.4.1) is added to reagent water in each of four 50ml volumetric flasks for multi-point calibration. The flasks are brought to volume with reagent water to prepare the 200, 100, 50, and 20 ug/kg, standards respectively. Single point surrogate calibration, the instruments' auto sampler introduces 25ug/L of System Monitoring Compounds into all calibration points.

7.4.5.2.2 10ul, 5ul and 2.5ul of each Intermediate Calibration Solution (7.4.1) are added to reagent water in each of the 100ml volumetric flask. The flask is brought to volume with reagent water to prepare the 10, 5.0 and 2.5 ug/Kg standards respectively.

7.4.5.2.3 5 ml of each standard is then transferred into seven individual 40ml vials and loaded onto the auto sampler.

7.4.6 Continuing Calibration Standard

7.4.6.1 Water: 5 ml

7.4.6.1.1 12.5ul of stock target compound mix is added to approximately 49mls of reagent water in a 50ml volumetric flask. The volumetric is brought to a final volume of 50ml to make a final concentration of 25ppb. Pour the standard into a 40ml vial. The auto sampler adds the internal standard and system monitoring compounds.

7.4.6.2 Soil:

7.4.6.2.1 25ul of stock target compound is added to approximately 49mls of reagent water in a 50ml volumetric flask. The volumetric is brought to a final volume of 50ml to make a final concentration of 50ppb. Take 5ml and transfer it into a 40ml vial. The auto sampler adds the internal standard and system monitoring compounds.

7.5 Storage of Standards

7.5.1 Stock standards are stored in flame sealed ampoules at 22^0 C to -20^0 C according to the vendor's specifications.

7.5.2 Secondary dilution standards are stored in Teflon-sealed crimp cap vials at $< 0^0$ C.

7.5.3 Aqueous standards are stored in Teflon-sealed vials at 4^0 C $\pm$ 2^o C.

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 Samples are collected in 40 mL vials with caps and septa, preserved to a pH < 2 with Hydrochloric Acid and stored at 4±2 degrees C until time of analysis.

8.2 Holding time for unpreserved samples is 7 days from sample date. For preserved samples the holding time is 14 days from sample date.

8.3 For some clients, regulatory agencies or QAPPS, the specified holding times may be different than those described in 8.2. In those cases, consult the specific Protocol/Method/QAPP or Project Manager for holding time details.

8.4 Sample Storage

- Volatile samples are stored at 4±2^{0}C from the time of collection until analysis.
- Volatile samples are stored together in refrigerators specifically designated for volatiles only.
- Storage blanks are stored with samples until analysis.
- Samples and extracts are stored separately.
- Volatile samples and standards are stored separately.

8.5 Preparation Of MS/MSD Samples

8.5.1 Water Samples**:** 40ml vial is spiked 11ul of 100ng/ul for the 5ml purge. This corresponds to a final concentration in the samples of 25ug/L. Analysis proceeds according to procedures described for water analysis.

8.5.2 Low Level Soil/Sediment Samples: 2.5ul of 100ng/ul of matrix spiking solution is added to a 5g aliquot of sample. This corresponds to a final concentration in the samples of 50 ug/kg. Analysis proceeds according to procedures described for low-level soil/sediment samples.

8.5.3 Medium Level Soil/Sediment Samples: 1ml of methanol containing the soil spiking solution is combined with 50 mL of water. Sample analysis proceeds according to procedures described for medium level soil/sediment samples.

9.0 Quality Control

9.1 Blank Analysis

9.1.1 Method Blank: A method blank consisting of a clean reference matrix (reagent water or purified quartz sand) must be analyzed prior to the analysis of samples but following any standard analysis.

- Target compounds detected in a method blank must fall below the reporting limit, unless specified in client QAPP.
- If internal standard or systems monitoring compound recoveries are not met, the method blank must be reanalyzed before the analysis of samples.

9.1.2 Storage (Holding) Blank: A weekly holding blank is analyzed to determine if cross contamination occurs within the volatile holding area. The results are reviewed by the quality assurance department and deemed acceptable or not acceptable. Corrective action, if necessary, will be taken.

9.1.3 Instrument Blank: An instrument blank consisting of a clean reference matrix analyzed after the analysis of samples containing target compounds which exceed the calibration range. Multiple instrument blanks are shot until the instrument blank meets the criteria for method blanks.

9.2 **Matrix Spike Blank (LCS)** An aliquot of clean reference material spiked with the matrix spiking solution is analyzed with each analytical batch.

9.2.1 If a compliant Second Source Calibration Verification (ICV) has already been analyzed, then standards from the primary (CCV) source may be used. The solution is spiked at a concentration of 25ug/L for 5ml analysis and 50ug/Kg for soil analysis.

9.2.2 Alternatively, a standard that is purchased from an alternate vender (or where not available from a second vendor an alternate lot will be used) from the continuing (CCV) standard may be used. The solution is spiked at a concentration of 25ug/L for 5ml analysis and 50ug/Kg for soil analysis.

9.2.3 The LCS must fall within internally derived statistical control limits or where applicable the limits specified by a project QAPP.

9.2.4 Analytes that have been identified as a Poor Performing Compounds (Table 5) will be considered compliant as long as their percent recovery exceeds 10%.

9.2.5 The LCS a 'full-compound' spike will be prepared and the LCS will be spiked with all compounds of interest. Due to the potentially large number of target compounds for method 8260C, it is possible that a few of the spiking compound could fall outside limits in the LCS. If a compound falls outside limits biased high and that compound is not found in the samples, a comment will be made in the case narrative and the data will be found to be acceptable.

9.2.6 If the results of sample matrix spikes fall outside of the quality control range due to matrix, the MSB is used to verify that the laboratory can perform a spike on a clean matrix.

9.3 **Matrix Spike And Matrix Spike Duplicate Analysis** A matrix spike and matrix spike duplicate consisting of an actual field sample which has been spiked with the matrix spiking solution.

9.3.1 Matrix spike and matrix spike duplicate analysis will not be performed on rinsates or field/trip blanks.

9.3.2 If a sample has not been designated for MS/MSD analysis by the client, a sample will be selected at the analyst's discretion. MS/MSD analysis will be performed at a minimum of every 20 samples.

9.3.3 If insufficient sample was received for a designated MS/MSD the client will be contacted with the laboratories in-house designated sample for MS/MSD analysis. If no MS/MSD is required, the instance will be documented in the SDG narrative.

9.3.4 If medium level analysis is required on the client designated sample, the laboratory analyst will choose a low level sample on which to perform the quality control analysis. Medium level QC will also be performed.

9.4 Data Assessment & Acceptance Criteria for QC Measures

9.4.1 Technical Acceptance Criteria For Initial Calibration

9.4.1.1 Minimum Response Factors

9.4.1.2 See Table 6 in this SOP for the 8260C method specific minimum response factors. If the % RSD of any of the target analytes should be 20% or less, the average response factor is assumed constant and the average response factor may be used for quantitation. Due to the large number of compounds, some compounds will fail to meet these criteria; any samples with positive detection under this calibration must be flagged as estimated. If more than 10% of the compounds fail to meet the criteria a new calibration is required. Alternate Quant ions maybe used per instrument per initial calibration to maximize RRF factors.

OR

If the % RSD of a target analyte is greater than 20%, linear regression or quadratic regression may be used providing the coefficient of determination is greater than or equal to 0.99. If quadratic regression is used, a minimum of 6 calibration points must to be analyzed.

9.4.1.3 Non-standard analytes are sometimes requested for analysis by this method. For these analytes it is acceptable to analyze a single point standard at the reporting limit with each continuing calibration rather than a five point calibration. If the analyte is not detected in the associated samples a non-detect will be reported and no further action is required. If the analyte is detected in any of the samples, a five point calibration will be analyzed and the samples with a positive detection will be re-analyzed against this compliant curve.

9.4.1.4 For linear curve fit analytes in the initial calibration a read back concentration of the low level calibration standard is evaluated. The read back concentration for linear fit analytes should be 30% of the true value.

9.4.1.5 **Second Source Calibration Verification** The initial calibration should be verified by analysis of a standard from a second source immediately following the calibration. This is also referred to as an ICV.

9.4.1.5.1 Following the analysis of an acceptable initial calibration curve, an aliquot of this independent standard is analyzed at the CCV level.

9.4.1.5.2 Recoveries of all compounds shall fall within ±30% of the expected values or up to 50% for our defined poor performing compounds listed in Table 5a.

9.4.2 Technical Acceptance Criteria For Continuing Calibration

9.4.2.1 Minimum Response Factors - An initial calibration check or CCV is made daily or during every 12 hour analytical shift. Each compound must meet its minimum response factor (see Initial Calibration Criteria). If the minimum response factors are not met, then the system should be evaluated and corrective actions must be taken prior to sample analysis.

9.4.2.2 Percent Difference - Used to check the validity of the initial calibration. The % Difference for each compound shall be less than or equal to 20% from the initial calibration for the continuing calibration to be valid. Due to the large number of compounds in a calibration, some compounds may fail this criterion. If more than 20% of the compounds fail to meet this criterion a new calibration is required. For any sample detections for an analyte that fails high in the CCV every effort will be made to reanalyze the samples under a compliant CCV. If re-analysis is not possible the analytes will be flagged as estimated and noted in the case narrative. Any sample non-detects for an analyte that fails low in the CCV criterion must have an MDLV standard analyzed to demonstrate sensitivity to the reporting limit. The criterion for the RL standard is that the analyte be detected only. If an analyte is found in the poor performers list in Table 5a fails the 20% criterion no corrective action will be taken until the %D is greater than 50%.

9.4.2.3 Internal Standard Retention Time – The retention times for all internal standards must be evaluated to make sure that they are no more than 10 seconds from that of the midpoint of the initial calibration. If the retention time shift is greater than 10 seconds, the system must be inspected for malfunctions and maintenance must be performed, as required.

9.4.2.4 Internal Standard Response – The EICP area for all internal standards must be evaluated to make sure that they have not change by a factor greater than two (-50% to +100%) from that of the midpoint of the initial calibration. If the response exceeds these limits, the system must be inspected for malfunctions and maintenance must be performed, as required.

9.4.3 Technical Acceptance Criteria of Quality Control Samples

Samples, blanks, matrix spikes, and matrix spike duplicates must meet internal standard and system monitoring compound recovery limits. Where the Internal Standard recovery limit equals sample internal standard characteristic ion area (EICP) divided by the CCV internal standard characteristic ion area (EICP), multiplied by 100.

9.5 Corrective Action for Out-of-Control Data

9.5.1 Corrective Actions For MS/MSD

9.5.1.1 If the recoveries of the internal standards and system monitoring compounds do not agree with the unspiked sample (i.e. the sample recoveries were within control limits and MS/MSD recoveries were outside of control limits) the MS/MSD will be evaluated. The analyst will use their technical judgment to determine if the non-conformance is due to sample matrix or laboratory error. If it is determined that the QC failure was due to laboratory error, then reanalysis will occur.

9.5.1.2 If the recoveries of the internal standards and system monitoring compounds agree with the unspiked sample (i.e. both the sample and MS/MSD recoveries were outside of control limits) re-analysis is not required. The instance will be documented in the SDG narrative.

9.5.1.3 The laboratory on an annual basis establishes limits for the matrix spiking compounds. If the concentrations determined in the MS/MSD do not meet the control limits, no corrective action is necessary as long as the LCS was within control limits. The instance will be documented in the job narrative.

9.5.2 Corrective Actions For Initial Calibration

9.5.2.1 If technical acceptance criteria cannot be met, it may be necessary to re-analyze the initial calibration. If after re-analysis, the criteria have not been met, it may be necessary to inspect the GC/MS system for possible problems.

9.5.2.2 Corrective actions may require one or several of the following procedures:

- Open new/remake standard mixes
- The ion source may be cleaned
- The column may be cut at the injection port end
- Change the purge trap on the purge and trap unit
- Correct purge gas flow to optimize response
- The column may be baked out
- The purge trap may be baked out
- The column may be replaced

9.5.3 Corrective Actions for Failure to Meet the Continuing Calibration Acceptance Criteria

9.5.3.1 If the technical acceptance criteria given above are not met, it may be necessary to re-analyze the continuing calibration check. If, after re-analysis, the given criterion has not been met, it may be necessary to re-analyze the initial calibration.

9.5.3.2 A single point standard at the reporting limit may be analyzed before the analysis of any samples. If the analyte is not detected in the associated samples a non-detect will be reported and a comment in the case narrative will be made. If the analyte is detected in any of the samples, a five point calibration will be analyzed and the samples with a positive detection will be re-analyzed against this compliant curve.

9.5.3.3 Other Corrective actions may be taken. The following details possible corrective actions:

- Open new/remake standard mixes
- The ion source may be cleaned
- The column may be cut at the injection port end
- The trap on the purge and trap unit may be replaced
- The purge gas flow may be adjusted
- The column may be baked out
- The trap may be baked out
- The column may be replaced

9.5.4 Corrective Actions For Samples

9.5.4.1 If the internal standard or system monitoring criteria are not met, the sample must be re-analyzed to insure that it was not an internal problem that affected recoveries. If, after re-analysis, recoveries are outside of control limits, a matrix effect can be assumed.

9.5.4.2 When dilutions are performed, target compound concentration must fall within the upper range of the initial calibration. If any target compound exceeds the calibration range, the sample would require dilution. The sample immediately following a sample with target compounds above the calibration range must be monitored to insure that there is no carryover present. If there is a possibility of carryover, that sample must be re-analyzed.

9.5.4.3 If matrix effects exist, and both analyses exhibit recoveries outside of control limits, both analyses will be reported and documented in the job narrative.

9.5.4.4 If, after re-analysis, recovery criteria are met, only the second analyses will be reported. If the second analyses occur outside of the contract required holding time, both analyses will be reported in that instance.

9.5.4.5 In the case of a matrix spike or matrix spike duplicate, these samples should only be reanalyzed if an error was identified in preparation or analysis of the sample. Failures will be documented in the SDG narrative.

9.5.5 Corrective Actions for Failure to Meet the Laboratory Control Sample (Matrix Spike Blank) Acceptance Criteria

9.5.5.1 The laboratory on an annual basis establishes limits for the matrix spiking compounds. The LCS must fall within these control limits. The LCS will be spiked with 8260 Mega Mix compounds. Due to the potentially large number of target compounds for method 8260C, it is possible that a few of the spiking compounds could fall outside limits in the LCS. If a compound falls outside limits biased high and that compound is not found in the samples, a comment will be made in the case narrative and the data will be found to be acceptable.

9.5.5.2 If the technical acceptance criteria are not met, it may be necessary to re-analyze the matrix spike blank. If, after re-analysis, the given criterion has not been met, it may be necessary to re-analyze the initial calibration.

9.5.5.3 Other Corrective actions may be taken. The following details possible corrective actions:

- Open new/remake standard mixes
- The ion source may be cleaned
- The column may be cut at the injection port end
- The trap on the purge and trap unit may be replaced
- The purge gas flow may be adjusted
- The column may be baked out
- The trap may be baked out
- The column may be replaced

9.5.6 Corrective Actions for Failure to Meet the Method Blank (MB) Acceptance Criteria

9.5.6.1 If the technical acceptance criteria are not met, it may be necessary to re-analyze the associated samples.

9.5.6.2 If the analyte is a common laboratory contaminant (Methylene Chloride, Acetone, 2-Butanone) the data may be reported with qualifiers if the concentration of the analyte is less than five times the reporting limit.

9.5.6.3 If the target analyte is not greater than the reporting limit in the samples with the non-compliant blank, the data may be reported with the analyte qualified.

9.5.6.4 If surrogate recoveries are not acceptable, the data may be evaluated to determine if the method blank has served the purpose of demonstrating that the analysis is free of contamination.

9.5.7 Contingencies for Handling Out-of-Control or Unacceptable Data

- Inform project manager for client input and fill out job exception report.
- Rerun samples to confirm results.
- Resample if client or project manager requests.

10.0 Procedure

10.1 Calibration & Standardization

10.1.1 Instrument Tuning and Performance Check:

The GC/MS system is calibrated using Perflurotributylamine (PFTBA) according to the recommended tuning conditions suggested by the vendor.

An instrument performance check of Bromofluorobenzene (BFB) is analyzed at the beginning of each 12-hour analysis period.

The analysis of the instrument performance check is performed using the following procedure:

- 1ul of a 50ng/ul solution is directly injected, resulting in a 50ng injection of BFB into the GC/MS.
- A blank containing 50 ng BFB is purged.

10.1.2 The mass spectrum of BFB is acquired using the following procedure:

- The apex scan, one scan immediately preceding the apex and one scan immediately following the apex are averaged. The spectrum is background subtracted using a single scan no more than 20 scans prior to the elution of BFB.

- A scan across the peak at one half the peak height may be averaged. The spectrum is background subtracted using a single scan no more than 20 scans prior to the elution of BFB. Background correction cannot include any part of the target peak.

- A single scan of the peak may also be used for the evaluation of the tune. The spectrum is background subtracted using a single scan no more than 20 scans prior to the elution of BFB. Background correction cannot include any part of the target peak

- The mass spectrum of BFB must pass the technical acceptance criteria given in Table 2.

10.1.3 Initial Calibration (ICAL):

The instrument performance check must meet the technical acceptance criteria prior to the analysis of an initial curve or samples. The GC/MS system is calibrated using a minimum of five levels of concentrations. All compounds of interest are included. (See section 9.4 for initial calibration acceptance criteria.)

Solutions containing target compounds and system monitoring compounds are analyzed at the following concentrations:

5 ml Purge Analysis

Standard	Solvent	Working Standard Conc.	Amount Added (ul)	Final Vol. (mL)	Final Conc. (ug/L)
VSTD0005	MEOH	100ng/ul	0.5	100	0.5
VSTD001	MeOH	100ng/ul	1	100	1
VSTD005	MeOH	100ng/ul	5	100	5
VSTD010	MeOH	100ng/ul	5	50	10
VSTD025	MeOH	100ng/ul	12.5	50	25
VSTD050	MeOH	100ng/ul	25	50	50
VSTD100	MeOH	100ng/ul	50	50	100

5 gram (soil) Purge Analysis

Standard	Solvent	Working Standard Conc.	Amount Added (ul)	Final Vol. (mL)	Final Conc. (ug/kg)
VSTD00025	MEOH	100ng/ul	2.5	100	2.5
VSTD005	MeOH	100ng/ul	5.0	100	5
VSTD010	MeOH	100ng/ul	10	100	10
VSTD020	MeOH	100ng/ul	10	50	20
VSTD050	MeOH	100ng/ul	25	50	50
VSTD100	MeOH	100ng/ul	50	50	100
VSTD200	MeOH	100ng/ul	100	50	200

10.1.4 Continuing Calibration Verification (CCV):

Every 12 hours of sample analysis the laboratory must demonstrate that the instrument has drifted or changed minimally by performing an instrument performance check and continuing calibration verification. (See section 9.4 for continuing calibration acceptance criteria.)

10.2 Before Analysis

10.2.1 Once initial calibration criteria has been met, and prior to analyzing samples and required blanks, Each GC/MS system must be routinely checked by analyzing a Continuing Calibration Verification (CCV) standard containing all compounds (including internal standards and system monitoring compounds) at a concentration of 25ug/L for 5ml analysis or 50ug/Kg for soil.

10.2.2 If time remains after initial calibration criteria have been met, it may not be necessary to perform a CCV. The 25 ug/L (50ug/Kg for soil) standard may be evaluated against the new initial curve and used as the CCV.

10.2.3 If there is no time remaining in the 12-hour period, the instrument performance check (BFB) must be analyzed along with a new CCV.

10.2.4 Procedure for Continuing Calibration:

10.2.4.1 5ml Water: 12.5ul of target compound mixture is added to a 50ml volumetric flask. A 5ml aliquot is analyzed. Internal standards and system monitoring compounds are added by the auto sampler prior to analysis.

10.2.4.2 Soil: 25ul of target compound mixture is added to a 50ml volumetric flask. A 5ml aliquot is transferred to a sample vial. Internal standards and system monitoring compounds are added by the auto sampler prior to analysis

10.3 Sample Analysis

10.3.1 BFB tuning criteria and GC/MS calibration verification must be met before sample analysis begins.

10.3.2 The acquisition time of the BFB tune establishes a 12hr. batch. The CCV, MSB, and MB must be analyzed within 12hrs, unless specified by the client request. The remaining time in the 12hr batch is utilized to run samples of similar matrix. The time of initiation of purging is considered the injection time. All aqueous samples are considered a water matrix. All solid samples, with the exception of sludges, are considered soil matrix. Sludges are run medium level.

10.3.3 Samples and standard solutions are brought to ambient temperature before analysis.

10.3.4 Prior to the analysis of samples, a method blank must be analyzed in accordance with the associated procedures for a given matrix. Technical criteria for method blanks must be met prior to sample analysis.

10.3.5 Within the analytical batch an LCS must be analyzed in accordance with the associated procedures for a given matrix. Technical criteria for the LCS must be met with each batch.

10.4 Water Sample Analysis

10.4.1 A 5ml sample aliquot is spiked with internal and system monitoring compounds to a final concentration of 25 ug/L each. The spike may be performed manually with a Hamilton gas tight syringe or the auto sampler may be used. The sample is then loaded onto the auto sampler where it is in turn transferred to the purge chamber.

10.4.2 The sample is purged for 11.0 $\pm$ 1 minute at ambient temperature.

10.4.3 At the end of the purge time, the sample is desorbed onto the gas chromatograph column by rapidly heating the trap from 190C to 250^{0}C (depending on manufacturer specifications) while the trap is back flushed with Helium between 20 - 60 ml/minute according to the manufactures specifications. The sample is desorbed onto the column and the gas chromatograph temperature ramping program is initiated.

10.4.4 While the trap is in the bake mode, the purge chamber is flushed with two 5ml aliquots of reagent water in order to avoid possible contamination from carryover of target compounds.

10.4.5 After the sample has desorbed, the trap is conditioned from 190^{0}C to 260^{0}C according to the manufactures specifications. After baking, the trap is ready for the next sample.

10.4.6 Dilutions may be necessary if the concentration of any target compound exceeds the working range of the calibration.

10.4.7 In the event that a dilution is required, a measured volume of sample is added to a volumetric flask then brought to volume with reagent water and inverted 3 times. The sample in the neck portion is discarded and the remainder of the sample is transferred into a 40ml VOA vial. Analysis may then proceed as previously described.

10.5 Low Level Soil/Sediment Sample Analysis

10.5.1 The bulk low level soil method is based on a heated purge of a 5g sample mixed with reagent water containing a final concentration of 50 ug/L of internal and system monitoring compounds.

10.5.2 For the bulk soil, if a dilution of the soil/sediment is required, a smaller portion of soil may be used. The smallest amount of soil that may be used is 0.5g. If a higher dilution is required, the sample must be analyzed as a medium level soil/sediment.

10.5.3 Initial and continuing calibrations that are used for the quantitation of low soils/sediments are analyzed using the same purge and trap conditions as samples.

10.5.4 Internal standards and system monitoring compounds are added to the sample immediately prior to heating and purging by the auto sampler.

10.5.5 After reagent water is added, the soil/sediment sample is heated to 40^0C $\pm$ 1^0C then purged for 11 $\pm$ 1 minutes.

10.5.6 For the EnCore TM sampling devices, at least three per sampling point should be received and require preparation within 48hrs of sampling. Two of the sampling devices are removed and immediately placed into 40mL vials. The weight is taken and directly uploaded into the preparation batch in TALs for GCMS. To these vials 5mL of volatile free water is added and the vials are capped. The soil from the third Encore device is removed and immediately placed into a 20mL vial. The sample weight is then directly uploaded into the preparation batch in TALs for GCMS. The soil is then spiked with the appropriate surrogate standard. 10mL of Purge and Trap grade Methanol for Mass Spectroscopy is added to the vial and the cap is applied. The vial is then shaken for 2 minutes. The vials are then stored at >= -7degrees C in an incubator specifically for 5035 volatile samples.

10.5.7 The Terracore TM sampling process is a kit of 3 pre-weighed vials, 2 with 5mL water and 1 with 5mL methanol, are sent out to the field. The samplers use the soil sampler provided to add approximately 5 grams of soil to each of the 3 vials. The vials are then shipped back to the lab and frozen with in 48 hours of sampling. Prior to analysis the samples are thawed and brought to room temperature. The weight is taken and directly uploaded into the preparation batch in TALs for GCMS.

10.5.8 The soil/sediment sample is heated 40 40^0C $\pm$ 1^0C then purged for 11 $\pm$ 1 minutes.

10.5.9 After purging, the sample is subjected to desorbing as described for water analysis.

10.6 Medium Level Soil/Sediment Samples

10.6.1 The medium level bulk soil/sediment method is based on an extraction of a 5gram sample with methanol.

10.6.2 1ml of system monitor compound mixture is then added to the sample.

10.6.3 A 9ml aliquot of methanol is quickly added to the sample, bringing the final volume to 10ml. The vial is capped and the sample are either left in methanol for 1 day or sonicated @ 40 deg for 30 minutes prior to analysis.

10.6.4 A pre-determined amount of the methanol extract is added to a 50ml volumetric flask, brought to volume with reagent water and inverted 3 times. The sample in the neck portion is discarded and the remainder of the sample is transferred into a 40ml VOA vial. Analysis may then proceed as previously described in section 10.4.

10.6.5 The soil from the third Encore TM device is removed and immediately placed into a 20mL vial. The sample weight is then directly uploaded into the preparation batch in TALs for GCMS. The soil is then spiked with the 1mL of surrogate standard. 9mL of Purge and Trap grade Methanol for Mass Spectroscopy is added to the vial and the cap is applied. The vial is then shaken for 2 minutes. The vials are then stored at >= -7degrees C in an incubator specifically for 5035 volatile samples.

10.6.6 If sample extracts are prepared in the field (e.g. Terracore kits) then both system monitoring compounds and internal standards are added by the auto-sampler prior to analysis.

10.6.7 Table 3 may be used to determine the volume of methanol extract required for a given dilution factor.

10.7 pH Determinations For Water Samples

10.7.1 After the sample aliquots are taken from the VOA vials, the pH of the sample is determined using wide range pH paper. A checkmark will be entered in the injection logbook if the sample pH is <2, however if the sample demonstrates a pH>2, the actual pH will be noted in the injection logbook.

11.0 Calculations / Data Reduction

11.1 Calculations For MS/MSD Samples

11.1.1 The calculations to determine concentrations are the same equations described for sample analysis of a given matrix.

11.1.2 The percent recovery of the matrix spiking compounds is determined using equation:

$$\text{Matrix Spike Recovery} = \frac{SSR - SR}{SA} \times 100$$

Where: SSR = Spiked sample result
SR = Sample results
SA = Spike added

11.1.3 The relative percent difference (RPD) of the recoveries of each compound between the matrix spike and matrix spike duplicate is determined using equation:

$$RPD = \frac{|MSR - MSDR|}{1/2\ (MSR + MSDR)} \times 100$$

Where: MSR = Matrix spike recovery
MSDR = Matrix spike duplicate recovery

11.2 Calculations For Initial Calibration

11.2.1 The relative response factor (RRF) for each target compound and each system monitoring compound is calculated using equation.

$$RRF = \frac{Ax}{Ais} \times \frac{Cis}{Cx}$$

Where,
Ax = Area of the characteristic ion (EICP) for the compound to be measured (see Table 4)
Ais = Area of the characteristic ion (EICP for the specific internal standard (see Table 4)
Cis = Concentration of the internal standard
Cx = Concentration of the compound to be measured

11.2.2 The relative response factor of the Xylenes requires the use of the area response and the concentration of the peak that represents the single isomer.

11.2.3 The relative response factor of 1,2-dichloroethene is calculated using the sum of the areas of both isomers and the sum of the concentrations.

11.2.4 The average response factor (RRF) is calculated for all compounds of interest.

11.2.5 The relative standard deviation (% RSD) is calculated over the working range of the curve for all compounds using equation:

$$\%RSD = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^{n}(\chi i - \bar{\chi})2}{n-1}}$$

Where,
Xi = each individual value used to calculate the mean
X = the mean of n values
n = the total number of values

11.3 Calculations For Continuing Calibration

11.3.1 The relative response factor (RRF) for all target compounds and system monitoring compounds is calculated using equation 11.2.1.

11.3.2 The percent difference between the initial calibration and the continuing calibration is determined for all target compounds and system monitoring compound using equation:

$$\%Difference = \frac{RRFc - RRFi}{RRFi} \times 100$$

Where,
RRFc = Relative response factor from continuing calibration standard
RRFi = Mean relative response factor from the most recent initial calibration meeting technical acceptance criteria

11.4 Percent Moisture Determinations

11.4.1 Immediately after weighing the sample for analysis, a 5-10g portion is weighed into a tarred weigh pan. The sample is then dried at 105^{0}C. The sample is allowed to cool. The final weight is recorded. Using the equation for % moisture, concentrations relative to the dry weight of the soil/sediment samples, may be determined.

$$\%moisture = \frac{\text{g of wet sample - g of dry sample}}{\text{g of wet sample}} \times 100$$

11.5 **Quantitation of volatile target compounds** is done using the internal standard method. The Internal Standard RRF of the continuing calibration is used in the quantitation calculation.

11.5.1 Water Samples: The following equation is used to calculate water samples:

$$\text{Concentration ug/L} = \frac{(Ax)\,(Is)\,(DF)}{(Ais)\,(RRF)\,(Vo)}$$

Where,

Ax = Area of the characteristic ion (EICP) for the compound to be measured (see Table 4)

Ais = Area of the characteristic ion (EICP) for the specific internal standard (see Table 4)

Is = Amount of internal standard added in nanograms (ng)

RRF= Relative response factor from the ambient temperature purge of the calibration standard.

Vo = Volume of water purged in milliliters (mL)

Df = Dilution factor. The dilution factor for analysis of water samples for volatiles by this method is defined as the ratio of the number of milliliters (mL) of water purged (i.e., Vo above) to the number of mL of the original water sample used for purging. For example, if 2.0 mL of sample is diluted to 5 mL with reagent water and purged, Df = 5 mL/2.0 mL = 2.5. If no dilution is performed, Df = 1.

11.5.2 Low Level Soil/Sediment Samples - The following equation is used for low level soil/sediment samples:

$$\text{Concentration ug/Kg (dry weight basis)} = \frac{(Ax)\,(Is)}{(Ais)\,(RRF)\,(Ws)\,(D)}$$

Where,

Ax, Is, Ais are as given for water.

RRF = Relative response factor form the heated purge of the calibration standard.

$D = \frac{100 - \%\ \text{moisture}}{100}$

Ws = Weight of sample added to the purge tube, in grams (g).

11.5.3 Medium Level Soil/Sediment Samples

The following equation is used for quantitation of medium level soil/sediment samples:

$$\text{Concentration ug/Kg (Dry weight basis)} = \frac{(Ax)\,(Is)\,(Vt)\,(1000)\,(Df)}{(Ais)\,(RRF)\,(Va)\,(Ws)\,(D)}$$

Where,
Ax, Is, Ais are as given for water.
RRF = Relative response factor from the ambient temperature purge of the calibration standard.
Vt = Total volume of the methanol extract in milliliters (mL).

NOTE: This volume is typically 10 mL, even though only 1 mL is transferred to the vial.

Va = Volume of the aliquot of the sample methanol extract (i.e., sample extract not including the methanol added to equal 100 uL) in micro liters (ul) added to reagent water for purging.
Ws = Weight of soil/sediment extracted, in grams (g).
D = $\frac{100 - \%\ \text{moisture}}{100}$
Df = Dilution factor. The dilution factor for analysis of soil/sediment samples for volatiles by the medium level method is defined as:

$$\frac{\text{ul most conc. extract used to make dilution + ul clean solvent}}{\text{ul most conc. extract used to make dilution}}$$

(The dilution factor is equal to 1.0 in all cases other than those requiring dilution of the sample methanol extract (Vt). The factor of 1,000 in the numerator converts the value of Vt from mL to ul.)

11.6 When quantitating the sample concentration of Xylenes (total), the areas of both the m & p Xylene peak and the o-Xylene peak are summed and the RRF determined using equation 11.2.1 are used. The concentration of each peak may be determined separately and then summed to determine the concentration of Xylene (total).

11.7 When quantitating the concentration of 1,2-Dichloroethene (total), the concentrations of the two isomers (cis and trans) are summed.

11.8 Secondary ion quantitation may be used if interferences (such as matrix effects) may cause a bias in quantitation.

11.9 If manual integration of any compound (including internal standards, system monitoring compounds, target or tentatively identified compounds) is required, the EICP of that compound will be provided. All manual integrations will be identified with an "m" and initialed and dated by the GC/MS analyst.

11.10 Tentatively Identified Compounds

11.10.1 An estimated concentration for tentatively identified compounds will be determined using the equations described above for a given matrix using the total area counts of both the tentatively identified compound and the nearest internal standard which is free of interferences.

11.10.2 The RRF used to determine all concentrations of tentatively identified compounds will be an assumed RRF of one (1). The Chrome data system is set to a Q value of 85% and any tentatively identified compound with a Q value less than 85% will be named unknown.

11.10.3 All tentatively identified compounds will be qualified as "J" (estimated) and "N" (presumptive evidence).

11.11 System Monitoring Compounds

11.11.1 The recovery of all system monitoring compounds in samples, blanks matrix spikes and matrix spike duplicates, is calculated using equation:

$$\% \text{ Recovery} = \frac{\text{Concentration (amount) found}}{\text{Concentration (amount) spiked}} \times 100$$

11.11.2 The recovery limits for each system monitoring compound are laboratory established on an annual basis. The recoveries must be within the criteria limits. If they fall outside criteria limits, the results must be evaluated and the sample reanalyzed, if necessary.

11.11.3 The relative retention time (RRT) of each system monitoring compound must be within the acceptance windows of ±0.06 RRT.

11.12 Internal Standards

11.12.1 The internal standards of all samples, blanks, matrix spikes and matrix spike duplicates must be monitored. The EICP area of each internal standard must be within the range of -50.0 percent to 200.0 percent of those in the continuing calibration.

11.12.2 The relative retention time (RRT) of each internal standard must be within 0.5 minutes (30 seconds) of those in the continuing calibration.

11.13 Verification of Calculated Result

11.13.1 The laboratory analyst/data entry analyst will print out and review sample worksheets and hand calculate the result for positive hits, internal standards and surrogates for comparison to the LIMS calculated result. Corrective action will result, if needed.

12.0 Method Performance

Each analyst prior to sample analysis will perform 4 replicate QC check standards as an Initial Demonstration of Capability. The average recovery and standard deviation are calculated in the LIMS system and kept with each analyst's training file.

12.1 Method Detection Limit Study (MDL)

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL is determined according to the laboratory's MDL procedure in the QA Manual. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method requirements require a greater frequency.

12.2 Demonstration of Capabilities

12.2.1 A one–time initial demonstration of performance for each individual method for both soils and water matrices must be generated.

12.2.2 This requires quadruplicate analysis of a mid–level check standard containing all of the standard analytes for the method using the same procedures used to analyze samples, including sample preparation.

12.2.3 Compare these results with the acceptance criteria given in the Method or to laboratory historical limits (if available).

12.2.4 Repeat the test for any analyte that does not meet the acceptance criteria. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

12.3 Training Requirements

12.3.1 The supervisor has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience.

12.3.2 The following analyst validation information is maintained for this method in the laboratory QA files.

12.3.3 The analyst must complete the laboratory safety orientation training that includes, but is not limited to, chemicals, PPE requirements, and electrical safety.

12.3.4 The analyst must read and understand this SOP.

12.3.5 The analyst must read and understand the Method used as reference for this SOP.

12.3.6 The analyst must complete a DOC or successfully analyze PT samples annually.

12.3.7 The analyst must complete the TestAmerica Quality Assurance Training.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to the Corporate Safety Manual. The following waste streams are produced when this method is carried out.

14.1 Waste Streams Produced by the Method

The following waste streams are produced when this method is carried out.

14.1.1 Spill Response: Any spills must be cleaned up immediately and handled correctly. Any wastes that have a pH < 7 must be disposed of in an "A" waste container. Any wastes having a pH > 7 must be disposed of in a "D" waste container.

14.1.2 Aqueous waste generated from analysis: Any wastes that have a pH < 7 must be disposed of in an "A" waste container. Any wastes having a pH > 7 must be disposed of in a "D" waste container.

14.1.3 Solvent waste generated from analysis: Solvent waste is stored in laboratory approved metal waste receptacle and labeled "C" waste. Waste receptacles are then taken to sample control where they are then properly disposed of.

14.1.4 Solid waste generated from analysis: Solid volatile analysis waste consists of soils and glass. The soil is wrapped in tin foil and placed in the solid waste receptacle. Soils used for dry weight measurements are also disposed of in this manner. Glass waste such as pipettes and vials are rinsed and disposed of in approved glass receptacles

14.1.5 Expired Standards: Expired and used standards are stored in a laboratory approved metal waste receptacle labeled "BV". Waste receptacles are then taken to sample control where they are then properly disposed of.

15.0 References / Cross-References

- Method 8260C, "Test Methods for Evaluating Solid Waste"; SW846, Fourth Edition, August 2006.

16.0 Method Modifications: NA

17.0 Attachments

Table 1. Compounds Determined by Method 8260C
Table 2. BFB Key Ions and Ion Abundance Criteria
Table 3. Volume of Medium Level Extracts for Dilution
Table 4. Characteristic Masses (m/z) for Purgeable Organic Compounds
Table 5. Poor Performing Compounds
Table 5a. Defined CCV Poor performing compounds
Table 6. Minimum Response Factors
Table 7.Job Summary Check List (Page 1 & 2)
Tables 8-16. Composition of Stock Standards
Table 17 TestAmerica Buffalo GCMS VOA Dilution Calculation

18.0 Revision History

Revision 01, dated -13 January, 2015

- Section 1.1.1: Removed reference to 25mL purge analysis – no longer perform.
- Section 2.2: Removed reference to 25mL purge analysis.
- Section 3.6 Change batch to 18 field samples.
- Section 9.4.1.4 Added the read back of the low level standard for linear fit analytes.
- Section 7.3.1.2: Changed the standards to incorporate the new corporate formulations.
- Section 7.3.1.3: Changed the standards to incorporate the new add corporate formulations.
- Section 7.3.2.1&2: Changed the second source standards to incorporate the new corporate formulations.
- Section 7.3.3: Removed 1,4-difluorobenzene and added Fluorobenzene – new corporate mixes.
- Section 7.3.4: Added Dibromofluoromethane – new corporate mixes.
- Section 7.3.5: Removed Stock Matrix Spike Solution – do not use.
- Section 7.4(old): Removed whole section as it is not needed (secondary IS and Surrogate dilution standards.
- Section 7.4.1.2: Removed the 54 component reference and changed to the 8260 Mega mix reference.
- Section 7.4.1.2: Change the number of stocks from four to five.
- Section 7.4.2: Removed the 17 compound spike references and removed the verification in standard.
- Section 7.4.2.2: Changed the 200uL to 1000uL of the 8260 Mega mixes; four mixes to five.
- Section 7.4.5: Removed the 25mL purge curve reference. Reduced curves to 6 point calibrations for both waters and soils.
- Section 7.4.5.1.1: Changed 5mL water initial curve to 6 points. Removed the surrogate multipoint references.
- Section 7.4.5.1.2: Removed the multipoint surrogate calibration.
- Section 7.4.5.2.1: Changed 5mL soil initial curve to 6 points. Removed the surrogate multipoint references.
- Section 7.4.5.2.2: Removed the multipoint surrogate calibration.
- Section 7.4.6: Removed the 25mL continuing calibration standards.
- Section 8.5.1: Removed the 8uL of 50 ng/uL or 4ul of 100 ng/ul matrix spike standard for 25mL and 22ul of 50ng/ul. Also removed the concentrations related to 25mL purge.
- Section 8.5.2: Removed 5ul of 50ng/ul standard.
- Section 9.2.1: Removed 10ug/L for 25mL analysis.

- Section 9.2.2: Removed 10ug/L for 25mL analysis.
- Section 9.2.5: Removed the 17 compound spike references and removed the when required from the full spike.
- Section 9.4.1.2: Added the alternate quant ion statement.
- Section 9.4.1.4.2: Added ICV allowed at 50% for poor performing compounds.
- Section 9.4.2.2: Added CCV failure corrective actions.
- Section 9.5.5.1: Removed the 17 compound spike reference as we use full spike.
- Section 10.1.3: Removed the chart for 25mL Purge analysis and * for optional 6th point.
- Section 10.2.1: Removed 25mL purge amount.
- Section 10.2.4.2: Removed 25mL purge reference.
- Section 10.4.1: Removed 25mL purge reference.
- Section 10.6.3: Added the correct procedure for medium level soil prep for method 5035.
- Section 11.10.2: Added the Chrome setting for the 85% Q value and naming convention.
- Table 1: Added compounds to additional analytes amenable to 8260 analysis.
- Table 3: Change volume of extract header.
- Table 4: Removed 1,4-difluorobenzene and added Fluorobenzene and the correct primary and secondary ions.
- Table 5: Removed add compounds as we do not spike with adds and added Bromoform, Isobutyl alcohol and 2-methyl-2-propanol.
- Table 5a: Defined CCV poor performers.
- Table 8: Replaced gas mix certification.
- Table 9: Changed the 54 compound mix to 8260 Mega Mix and put in new certification.
- Table 10: Changed the title of table and the certifications.
- Table 11: Changed the title of table and the certifications.
- Table 12: Changed the title of table and the certifications.
- Table 13: Changed the certifications.
- Table 15: Changed the certifications.
- Table 16: Changed the certifications.

Initial Version

Table 1: Compounds Determined by Method 8260C

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
Acetone	67-64-1	pp	c	c	nd	c	c
Acetonitrile	75-05-8	pp	c	nd	nd	nd	c
Acrolein	107-02-8	pp	c	c	nd	nd	c
Acrylonitrile	107-13-1	pp	c	c	nd	c	c
Allyl alcohol	107-18-6	ht	c	nd	nd	nd	c
Allyl chloride	107-05-1	c	nd	nd	nd	nd	c
Benzene	71-43-2	c	nd	c	c	c	c
Benzyl chloride	100-44-7	c	nd	nd	nd	nd	c
Bis(2-chloroethyl)sulfide	505-60-2	pp	nd	nd	nd	nd	c
Bromoacetone	598-31-2	pp	nd	nd	nd	nd	c
Bromochloromethane	74-97-5	c	nd	c	c	c	c
Bromodichloromethane	75-27-4	c	nd	c	c	c	c
4-Bromofluorobenzene (surr)	460-00-4	c	nd	c	c	c	c
Bromoform	75-25-2	c	nd	c	c	c	c
Bromomethane	74-83-9	c	nd	c	c	c	c
n-Butanol	71-36-3	ht	c	nd	nd	nd	c
2-Butanone (MEK)	78-93-3	pp	c	c	nd	nd	c
t-Butyl alcohol	75-65-0	pp	c	nd	nd	nd	c
Carbon disulfide	75-15-0	pp	nd	c	nd	c	c
Carbon tetrachloride	56-23-5	c	nd	c	c	c	c
Chloral hydrate	302-17-0	pp	nd	nd	nd	nd	c
Chlorobenzene	108-90-7	c	nd	c	c	c	c
Chlorobenzene-d5 (IS)		c	nd	c	c	c	c
Chlorodibromomethane	124-48-1	c	nd	c	nd	c	c
Chloroethane	75-00-3	c	nd	c	c	c	c
2-Chloroethanol	107-03-3	pp	nd	nd	nd	nd	c
2-Chloroethyl vinyl ether	110-75-8	c	nd	c	nd	nd	c

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
Chloroform	67-66-3	c	nd	c	c	c	c
Chloromethane	74-87-3	c	nd	c	c	c	c
Chloroprene	126-99-8	c	nd	nd	nd	nd	c
3-Chloropropionitrile	542-76-7	l	nd	nd	nd	nd	pc
Crotonaldehyde	4170-30-3	pp	c	nd	nd	nd	c
1,2-Dibromo-3-chloropropane	96-12-8	pp	nd	nd	c	nd	c
1,2-Dibromoethane	106-93-4	c	nd	nd	c	nd	c
Dibromomethane	74-95-3	c	nd	c	c	c	c
1,2-Dichlorobenzene	95-50-1	c	nd	nd	c	nd	c
1,3-Dichlorobenzene	541-73-1	c	nd	nd	c	nd	c
1,4-Dichlorobenzene	106-46-7	c	nd	nd	c	nd	c
1,4-Dichlorobenzene-d4 (IS)		c	nd	nd	c	nd	c
cis-1,4-Dichloro-2-butene	1476-11-5	c	nd	c	nd	nd	c
trans-1,4-Dichloro-2-butene	110-57-6	pp	nd	c	nd	nd	c
Dichlorodifluoromethane	75-71-8	c	nd	c	c	nd	c
1,1-Dichloroethane	75-34-3	c	nd	c	c	c	c
1,2-Dichloroethane	107-06-2	c	nd	c	c	c	c
1,2-Dichloroethane-d4 (surr)		c	nd	c	c	c	c
1,1-Dichloroethene	75-35-4	c	nd	c	c	c	c
trans-1,2-Dichloroethene	156-60-5	c	nd	c	c	c	c
1,2-Dichloropropane	78-87-5	c	nd	c	c	c	c
1,3-Dichloro-2-propanol	96-23-1	pp	nd	nd	nd	nd	c
cis-1,3-Dichloropropene	10061-01-5	c	nd	c	nd	c	c
trans-1,3-Dichloropropene	10061-02-6	c	nd	c	nd	c	c
1,2,3,4-Diepoxybutane	1464-53-5	c	nd	nd	nd	nd	c
Diethyl ether	60-29-7	c	nd	nd	nd	nd	c

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
1,4-Difluorobenzene (I.S.)	540-36-3	nd	nd	nd	nd	c	c
1,4-Dioxane	123-91-1	pp	c	c	nd	nd	c
Epichlorohydrin	106-89-8	l	nd	nd	nd	nd	c
Ethanol	64-17-5	l	c	c	nd	nd	c
Ethyl acetate	141-78-6	l	c	nd	nd	nd	c
Ethylbenzene	100-41-4	c	nd	c	c	c	c
Ethylene oxide	75-21-8	pp	c	nd	nd	nd	c
Ethyl methacrylate	97-63-2	c	nd	c	nd	nd	c
Fluorobenzene (IS)	462-06-6	c	nd	nd	nd	nd	nd
Hexachlorobutadiene	87-68-3	c	nd	nd	c	nd	c
Hexachloroethane	67-72-1	l	nd	nd	nd	nd	c
2-Hexanone	591-78-6	pp	nd	c	nd	nd	c
2-Hydroxypropionitrile	78-97-7	l	nd	nd	nd	nd	pc
Iodomethane	74-88-4	c	nd	c	nd	c	c
Isobutyl alcohol	78-83-1	pp	c	nd	nd	nd	c
Isopropylbenzene	98-82-8	c	nd	nd	c	nd	c
Malononitrile	109-77-3	pp	nd	nd	nd	nd	c
Methacrylonitrile	126-98-7	pp	l	nd	nd	nd	c
Methanol	67-56-1	l	c	nd	nd	nd	c
Methylene chloride	75-09-2	c	nd	c	c	c	c
Methyl methacrylate	80-62-6	c	nd	nd	nd	nd	c
4-Methyl-2-pentanone (MIBK)	108-10-1	pp	c	c	nd	nd	c
Naphthalene	91-20-3	c	nd	nd	c	nd	c
Nitrobenzene	98-95-3	c	nd	nd	nd	nd	c
2-Nitropropane	79-46-9	c	nd	nd	nd	nd	c
N-Nitroso-di-n-butylamine	924-16-3	pp	c	nd	nd	nd	c
Paraldehyde	123-63-7	pp	c	nd	nd	nd	c
Pentachloroethane	76-01-7	l	nd	nd	nd	nd	c

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
2-Pentanone	107-87-9	pp	c	nd	nd	nd	c
2-Picoline	109-06-8	pp	c	nd	nd	nd	c
1-Propanol	71-23-8	pp	c	nd	nd	nd	c
2-Propanol	67-63-0	pp	c	nd	nd	nd	c
Propargyl alcohol	107-19-7	pp	l	nd	nd	nd	c
B-Propiolactone	57-57-8	pp	nd	nd	nd	nd	c
Propionitrile (ethyl cyanide)	107-12-0	ht	c	nd	nd	nd	c
n-Propylamine	107-10-8	c	nd	nd	nd	nd	c
Pyridine	110-86-1	l	c	nd	nd	nd	c
Styrene	100-42-5	c	nd	c	c	c	c
1,1,1,2-Tetrachloroethane	630-20-6	c	nd	nd	c	c	c
1,1,2,2-Tetrachloroethane	79-34-5	c	nd	c	c	c	c
Tetrachloroethene	127-18-4	c	nd	c	c	c	c
Toluene	108-88-33	c	nd	c	c	c	c
Toluene-d8 (surr)	2037-26-5	c	nd	c	c	c	c
o-Toluene	95-53-4	pp	c	nd	nd	nd	c
1,2,4-Trichlorobenzene	120-82-1	c	nd	nd	c	nd	c
1,1,1-Trichloroethane	71-55-6	c	nd	c	c	c	c
1,1,2-Trichloroethane	79-00-5	c	nd	c	c	c	c
Trichloroethane	79-01-6	c	nd	c	c	c	c
Trichlorofluoromethane	75-69-4	c	nd	c	c	c	c
1,2,3-Trichloropropane	96-18-4	c	nd	c	c	c	c
Vinyl acetate	108-05-4	c	nd	c	nd	nd	c
Vinyl chloride	75-01-4	c	nd	c	c	c	c
Xylene (Total)	1330-20-7	c	nd	c	c	c	c

c= Adequate response by this technique
b= Chemical Abstract Services Registry Number
pp= Poor purging efficiency resulting in high EQLs
l= Inappropriate technique for this analyte
nd= Not determined
surr= Surrogate
IS= Internal Standard
ht= Method analyte only when purged at 80 C

pc= Poor chromatographic behavior

The following compounds are also amenable to analysis by Method 8260:

Bromombenzene
n-Butylbenzene
sec-Butlybenzene
tert-Butylbenzene
Chloroacetonitrile
1-Chlorobutane
1-Chlorohexane
2-Chlorotoluene
4-Chlorotoluene
Dibromofluoromethane
cis-1,2-Dichloroethene
Di-isopropyl ether
tert-amyl methyl ether
isooctane
2-methylnaphthalene
t-amyl alcohol
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
p-Isopropyltoluene
Methyl acrylate
Methyl-t-butyl ether
Pentafluorobenzene
n-Propylbenzene
1,2,3-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
tert-butyl ethyl ether
benzyl chloride
n-butyl acetate
ethanol

Table 2. BFB Key Ions and Ion Abundance Criteria

mz	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

*Alternate tuning criteria may be used, (e.g. CLP, Method 524.2, or manufacturers' instructions), provided that method performance is not adversely affected.

Table 3. Volume of Medium Level Extracts for Dilution (for a 5mL purge volume)

Dilution Factor	Volume of ML soil Extract
1	100ul
2	50ul
5	20ul
10	10ul
20	5ul
25	4ul
40	2.5ul
50	2ul
100	1ul
200	50ul of a 1/10 Dilution

Table 4. Characteristic Masses (m/z) for Purgeable Organic Compounds

Analyte	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

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Chloroform	83	85
Chloromethane	50 (49*)	52 (51*)
Chloroprene	53	88,90,51
3-Chloropropionitrile	54	49,89,91
3-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
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-Dichlorothane	63	65,83
1,2-Dichloroethane	62	98
1,1-Dichlorothene	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-Isopropyl toluene	119	134,91
Malonitrile	66	39,65,38
Methacrylonitrile	41	67,39,52,66
Methyl acrylate	55	85

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Methyl-t-butyl ether	73	57
Methylene chloride	84	86,49
Methyl ethyl ketone	72	43
Methyl iodide	142	127,141
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
B-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-d6	84	83
Bromobenzene-d5	82	162
Bromochloromethane-d2	51	131
Fluorobenzene	96	77
Chlorobenzene-d5	117	
1,4-Dichlorobenzene-d4	152	115,150
1,1,2-Trichloroethane-d3	100	
4-Bromofluorobenzene	95	174,176
Chloroform-d1	84	
Dibromofluoromethane	113	

Table 5. Poor Performing Compounds

Bromoform	Bromomethane
1,2-Dibromo-3-chloropropane (DBCP)	Carbon Disulfide
1,4-Dioxane	Chloroethane
2-Butanone (MEK)	Isobutyl Alcohol
2-Chloroethylvinyl ether	Dichlorodifluoromethane
2-Methyl-2-propanol	Iodomethane
4-Methyl-2-pentanone (MIBK)	Methyl Acetate
Acetone	trans-1,4-Dichloro-2-butene
Acrolein	

Table 5a. Defined CCV Poor Performing Compounds

Bromoform	Bromomethane
1,2-Dibromo-3-chloropropane (DBCP)	Chloroethane
1,4-Dioxane	Isobutyl Alcohol
2-Methyl-2-propanol	Dichlorodifluoromethane
Acetone	Methyl Acetate
Acrolein	trans-1,4-Dichloro-2-butene

Table 6. Minimum Relative Response Factors

RECOMMENDED MINIMUM RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION VERIFICATION

Volatile Compounds	Minimum Response Factor (RF)[a]	Typical Response Factor (RF)[b]
Dichlorodifluoromethane	0.100	0.327
Chloromethane	0.100	0.537
Vinyl chloride	0.100	0.451
Bromomethane	0.100	0.255
Chloroethane	0.100	0.254
Trichlorofluoromethane	0.100	0.426
1,1-Dichloroethene	0.100	0.313
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100	0.302
Acetone	0.100	0.151
Carbon disulfide	0.100	1.163
Methyl Acetate	0.100	0.302
Methylene chloride	0.100	0.380
trans-1,2-Dichloroethene	0.100	0.351
cis-1,2-Dichloroethene	0.100	0.376
Methyl tert-Butyl Ether	0.100	0.847
1,1-Dichloroethane	0.200	0.655
2-Butanone	0.100	0.216
Chloroform	0.200	0.557
1,1,1-Trichloroethane	0.100	0.442
Cyclohexane	0.100	0.579
Carbon tetrachloride	0.100	0.353
Benzene	0.500	1.368
1,2-Dichloroethane	0.100	0.443
Trichloroethene	0.200	0.338
Methylcyclohexane	0.100	0.501
1,2-Dichloropropane	0.100	0.382

Table 6. Minimum Relative Response Factors continued…

Volatile Compounds	Minimum Response Factor (RF)[a]	Typical Response Factor (RF)[b]
Bromodichloromethane	0.200	0.424
cis-1,3-Dichloropropene	0.200	0.537
trans-1,3-Dichloropropene	0.100	0.515
4-Methyl-2-pentanone	0.100	0.363
Toluene	0.400	1.577
1,1,2-Trichloroethane	0.100	0.518
Tetrachloroethene	0.200	0.606
2-Hexanone	0.100	0.536
Dibromochloromethane	0.100	0.652
1,2-Dibromoethane	0.100	0.634
Chlorobenzene	0.500	1.733
Ethylbenzene	0.100	2.827
meta-/para-Xylene	0.100	1.080
ortho-Xylene	0.300	1.073
Styrene	0.300	1.916
Bromoform	0.100	0.413
Isopropylbenzene	0.100	2.271
1,1,2,2-Tetrachloroethane	0.300	0.782
1,3-Dichlorobenzene	0.600	1.408
1,4-Dichlorobenzene	0.500	1.427
1,2-Dichlorobenzene	0.400	1.332
1,2-Dibromo-3-chloropropane	0.050	0.129
1,2,4-Trichlorobenzene	0.200	0.806

[a] The project-specific response factors obtained may be affected by the quantitation ion selected and when using possible alternate ions the actual response factors may be lower than those listed. In addition, lower than the recommended minimum response factors may be acceptable for those compounds that are not considered critical target analytes and the associated data may be used for screening purposes.

[b] Data provided by EPA Region III laboratory.

Table 7. Job Summary Check List

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

GCMS VOA Data Review Checklist
Rev. 1 October 24, 2012

GCMS VOA Work Order Summary

Work Order: _____ Method: _____

Work Order Due: _____

Sequence #1 Curve Batch# _____ Prep Batch# _____
Chrom WL _____ TALS Batch _____ Instrument _____ Date Created _____

Sequence #2 Curve Batch# _____ Prep Batch# _____
Chrom WL _____ TALS Batch _____ Instrument _____ Date Created _____

Sequence #3 Curve Batch# _____ Prep Batch# _____
Chrom WL _____ TALS Batch _____ Instrument _____ Date Created _____

Sequence #4 Curve Batch# _____ Prep Batch# _____
Chrom WL _____ TALS Batch _____ Instrument _____ Date Created _____

Sequence #5 Curve Batch# _____ Prep Batch# _____
Chrom WL _____ TALS Batch _____ Instrument _____ Date Created _____

Sequence #6 Curve Batch# _____ Prep Batch# _____
Chrom WL _____ TALS Batch _____ Instrument _____ Date Created _____

Analyte Comments: _____

Sample Comments: _____

First Level Review: Initials: _____ Date: _____

Second Level Review: Initials: _____ Date: _____

Check Second Level Review:
___ Quantitative Accuracy
___ Calibration
___ QC Samples
___ Method and/or Quapp Specific QC Criteria
___ Manual Integrations Reviewed

Table 8. Gas Mixture (8260 List 1/std 3 gases)

RESTEK

110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

www.restek.com

ACCREDITED ISO Guide 34 Accredited Reference Material Producer

ilac-MRA

ACCREDITED ISO/IEC 17025 Accredited Testing Laboratory

Certificate of Analysis

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 567645 **Lot No.:** A093341

Description : 8260 List 1 / Std #3 Gases

8260 List 1 / Std #3 Gases 2,000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2015 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Dichlorodifluoromethane (CFC-12) CAS # 75-71-8 Purity 99%	2,000.0 µg/mL	+/- 13.8716 +/- 25.2661 +/- 28.2336	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
2	Chloromethane (methyl chloride) CAS # 74-87-3 Purity 99%	1,999.8 µg/mL	+/- 13.9993 +/- 25.3348 +/- 28.2945	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
3	Vinyl chloride CAS # 75-01-4 Purity 99%	2,000.1 µg/mL	+/- 13.9625 +/- 25.3168 +/- 28.2792	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
4	1,3-Butadiene CAS # 106-99-0 Purity 99%	2,000.0 µg/mL	+/- 13.3773 +/- 24.9981 +/- 27.9940	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
5	Bromomethane (methyl bromide) CAS # 74-83-9 Purity 99%	2,000.1 µg/mL	+/- 14.2856 +/- 25.4963 +/- 28.4399	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
6	Chloroethane (ethyl chloride) CAS # 75-00-3 Purity 99%	2,000.0 µg/mL	+/- 13.2200 +/- 24.9143 +/- 27.9191	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
7	Dichlorofluoromethane (CFC-21) CAS # 75-43-4 Purity 99%	2,000.0 µg/mL	+/- 13.5174 +/- 25.0735 +/- 28.0614	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
8	Trichlorofluoromethane (CFC-11) CAS # 75-69-4 Purity 99%	1,999.9 µg/mL	+/- 13.1170 +/- 24.8590 +/- 27.8696	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
Solvent:	P&T Methanol CAS # 67-56-1 Purity 99%				

Table 9. 8260 Mega Mixture (8260 List 1/Std 1 mega mix)

RESTEK

110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

www.restek.com

Certificate of Analysis

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 567641 **Lot No.:** A093581

Description : 8260 List 1 / Std #1 MegaMix

8260 List 1 / Std #1 MegaMix 1000-50,000 µg/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2016 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	Diethyl ether (ethyl ether) CAS # 60-29-7 Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL	Gravimetric Unstressed Stressed
2	1,1,2-Trichlorotrifluoroethane (CFC-113) CAS # 76-13-1 Purity 97%	1,999.9 µg/mL	+/- 11.6279 µg/mL +/- 44.2519 µg/mL +/- 44.4323 µg/mL	Gravimetric Unstressed Stressed
3	1,1-dichloroethene CAS # 75-35-4 Purity 98%	2,000.0 µg/mL	+/- 11.6281 µg/mL +/- 44.2527 µg/mL +/- 44.4331 µg/mL	Gravimetric Unstressed Stressed
4	tert-Butanol (TBA) CAS # 75-65-0 Purity 99%	20,000.0 µg/mL	+/- 116.2756 µg/mL +/- 442.5291 µg/mL +/- 444.3332 µg/mL	Gravimetric Unstressed Stressed
5	Iodomethane (methyl iodide) CAS # 74-88-4 Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL	Gravimetric Unstressed Stressed
6	Allyl chloride (3-chloropropene) CAS # 107-05-1 Purity 98%	2,000.0 µg/mL	+/- 11.6281 µg/mL +/- 44.2527 µg/mL +/- 44.4331 µg/mL	Gravimetric Unstressed Stressed
7	Methyl acetate CAS # 79-20-9 Purity 99%	10,000.0 µg/mL	+/- 58.1378 µg/mL +/- 221.2646 µg/mL +/- 222.1666 µg/mL	Gravimetric Unstressed Stressed
8	Carbon disulfide CAS # 75-15-0 Purity 98%	2,000.0 µg/mL	+/- 11.6281 µg/mL +/- 44.2527 µg/mL +/- 44.4331 µg/mL	Gravimetric Unstressed Stressed
9	Methylene chloride (dichloromethane) CAS # 75-09-2 Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL	Gravimetric Unstressed Stressed

10	Acrylonitrile	20,000.0	µg/mL	+/-	116.2756	µg/mL	Gravimetric
	CAS # 107-13-1			+/-	442.5291	µg/mL	Unstressed
	Purity 99%			+/-	444.3332	µg/mL	Stressed
11	Methyl-tert-butyl ether (MTBE)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 1634-04-4			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
12	cis-1,2-Dichloroethene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 156-59-2			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
13	n-Hexane (C6)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 110-54-3			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
14	1,1-Dichloroethane	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 75-34-3			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
15	2,2-Dichloropropane	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 594-20-7			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
16	trans-1,2-Dichloroethene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 156-60-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
17	chloroform	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 67-66-3			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
18	Isobutanol (2-Methyl-1-propanol)	50,000.0	µg/mL	+/-	290.6891	µg/mL	Gravimetric
	CAS # 78-83-1			+/-	1,106.3228	µg/mL	Unstressed
	Purity 99%			+/-	1,110.8331	µg/mL	Stressed
19	Bromochloromethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 74-97-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
20	Tetrahydrofuran	4,000.0	µg/mL	+/-	23.2563	µg/mL	Gravimetric
	CAS # 109-99-9			+/-	88.5061	µg/mL	Unstressed
	Purity 99%			+/-	88.8670	µg/mL	Stressed
21	1,1,1-trichloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 71-55-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
22	Cyclohexane	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 110-82-7			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
23	1,1-Dichloropropene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 563-58-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
24	carbon tetrachloride	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 56-23-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
25	n-Heptane (C7)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 142-82-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
26	Benzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 71-43-2			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
27	1,2-Dichloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 107-06-2			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
28	Trichloroethene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 79-01-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed

29	Methylcyclohexane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-87-2			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
30	1,2-Dichloropropane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 78-87-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
31	1,4-Dioxane	40,000.0	µg/mL	+/-	232.5513	µg/mL	Gravimetric
	CAS # 123-91-1			+/-	885.0582	µg/mL	Unstressed
	Purity 99%			+/-	888.6665	µg/mL	Stressed
32	Dibromomethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 74-95-3			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
33	bromodichloromethane	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 75-27-4			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
34	cis-1,3-Dichloropropene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 10061-01-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
35	Toluene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-88-3			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
36	Ethyl methacrylate	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 97-63-2			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
37	trans-1,3-Dichloropropene	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 10061-02-6			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
38	1,1,2-Trichloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 79-00-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
39	1,3-Dichloropropane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 142-28-9			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
40	Tetrachloroethene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 127-18-4			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
41	dibromochloromethane	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 124-48-1			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
42	1,2-Dibromoethane (EDB)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 106-93-4			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
43	Chlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-90-7			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
44	1,1,1,2-Tetrachloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 630-20-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
45	m-Xylene	1,000.0	µg/mL	+/-	5.8141	µg/mL	Gravimetric
	CAS # 108-38-3			+/-	22.1265	µg/mL	Unstressed
	Purity 99%			+/-	22.2167	µg/mL	Stressed
46	p-Xylene	1,000.0	µg/mL	+/-	5.8141	µg/mL	Gravimetric
	CAS # 106-42-3			+/-	22.1265	µg/mL	Unstressed
	Purity 99%			+/-	22.2167	µg/mL	Stressed
47	o-Xylene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 95-47-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed

48	Ethylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 100-41-4			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
49	Styrene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 100-42-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
50	Isopropylbenzene (cumene)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 98-82-8			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
51	bromoform	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 75-25-2			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
52	1,1,2,2-Tetrachloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 79-34-5			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
53	1,2,3-Trichloropropane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 96-18-4			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
54	trans-1,4-dichloro-2-butene	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 110-57-6			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
55	n-Propylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 103-65-1			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
56	Bromobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-86-1			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
57	1,3,5-Trimethylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-67-8			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
58	2-Chlorotoluene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 95-49-8			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
59	4-Chlorotoluene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 106-43-4			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
60	tert-Butylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 98-06-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
61	1,2,4-Trimethylbenzene	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 95-63-6			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
62	sec-Butylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 135-98-8			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
63	4-Isopropyltoluene (p-Cymene)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 99-87-6			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
64	1,3-Dichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 541-73-1			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
65	1,4-Dichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 106-46-7			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
66	n-Butylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 104-51-8			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed

Table 10. 8260 Mega Mix (List 1/Standard 2,4 5 6)

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ACCREDITED ISO Guide 34 Accredited Reference Material Producer California #3022.01

ilac-MRA

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Certificate of Analysis

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 567642 **Lot No.:** A093365

Description : 8260 List 1 / Std #2 Ketones

8260 List 1 / Std #2 Ketones 10,000 ug/ml, P&T Methanol/Water (90:10), 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2016 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Acetone CAS # 67-64-1 Purity 99%	10,000.0 µg/mL	+/- 58.1378 µg/mL +/- 798.6896 µg/mL +/- 799.0807 µg/mL		Gravimetric Unstressed Stressed
2	2-Butanone (MEK) CAS # 78-93-3 Purity 99%	10,000.0 µg/mL	+/- 58.1378 µg/mL +/- 798.6896 µg/mL +/- 799.0807 µg/mL		Gravimetric Unstressed Stressed
3	4-Methyl-2-pentanone (MIBK) CAS # 108-10-1 Purity 99%	10,000.0 µg/mL	+/- 58.1378 µg/mL +/- 798.6896 µg/mL +/- 799.0807 µg/mL		Gravimetric Unstressed Stressed
4	2-Hexanone CAS # 591-78-6 Purity 99%	10,000.0 µg/mL	+/- 58.1378 µg/mL +/- 798.6896 µg/mL +/- 799.0807 µg/mL		Gravimetric Unstressed Stressed
Solvent:	P&T Methanol/Water (90:10) CAS # 67-56-1/7732-18-5 Purity 99%				

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Catalog No. : 567643 **Lot No.:** A093368

Description : 8260 List 1 / Std #4 2-Chloroethylvinyl Ether

8260 List 1 / Std #4 2-Chloroethylvinyl Ether 2,000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2016 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	2-Chloroethyl vinyl ether	2,000.0 µg/mL	+/- 11.6282	µg/mL	Gravimetric
	CAS # 110-75-8		+/- 44.2531	µg/mL	Unstressed
	Purity 99%		+/- 44.4335	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

Tech Tips:

Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

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Catalog No. : 568720 **Lot No.:** A0100019

Description : 8260 List 1/Std #5 Acrolein High

8260 List 1/Std #5 Acrolein High 20,000 µg/ml, Water, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : April 30, 2014 **Storage:** 10°C or colder

CERTIFIED VALUES

Elution Order	Compound		Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Acrolein		20,000.7 µg/mL	+/- 117.1083	µg/mL	Gravimetric
	CAS # 107-02-8	(Lot 130830JLM)		+/- 641.2843	µg/mL	Unstressed
	Purity 99%			+/- 745.4228	µg/mL	Stressed

Solvent: Water
CAS # 7732-18-5
Purity 99%

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This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 567646 **Lot No.:** A099480

Description : 8260 List 1 / Std #6 Vinyl Acetate

8260 List 1 / Std #6 Vinyl Acetate 4000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : May 31, 2014 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Vinyl acetate	3,994.0 µg/mL	+/- 23.4390	µg/mL	Gravimetric
	CAS # 108-05-4 (Lot 131011JLM)		+/- 318.1798	µg/mL	Unstressed
	Purity 99%		+/- 318.3564	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

Tech Tips:
Vinyl acetate is a volatile organic ester included in the target lists of several US EPA and other methods. Under acidic conditions, esters react with alcohols to form new esters (transesterification). Methanol-based mixes containing halogenated compounds are slightly acidic, so it is important to minimize exposure of vinyl acetate to mixes of halogenated compounds in methanol. For this reason, we offer vinyl acetate in individual solution, and suggest that it be introduced into the working level calibration solution immediately before use. This will minimize problems and ensure more consistent results.

Table 11. Second Source 8260 Mega Mix

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This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 567641.sec **Lot No.:** A093733

Description : 8260 List 1 / Std #1 MegaMix

8260 List 1 / Std #1 MegaMix 1,000-50,000 µg/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2016 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Diethyl ether (ethyl ether) CAS # 60-29-7.SEC Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL		Gravimetric Unstressed Stressed
2	1,1,2-Trichlorotrifluoroethane (CFC-113) CAS # 76-13-1.SEC Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL		Gravimetric Unstressed Stressed
3	1,1-Dichloroethene CAS # 75-35-4.SEC Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL		Gravimetric Unstressed Stressed
4	tert-Butanol (TBA) CAS # 75-65-0.SEC Purity 99%	20,000.0 µg/mL	+/- 116.2756 µg/mL +/- 442.5291 µg/mL +/- 444.3332 µg/mL		Gravimetric Unstressed Stressed
5	Iodomethane (methyl iodide) CAS # 74-88-4.SEC Purity 97%	2,000.0 µg/mL	+/- 11.6284 µg/mL +/- 44.2540 µg/mL +/- 44.4344 µg/mL		Gravimetric Unstressed Stressed
6	Allyl chloride (3-chloropropene) CAS # 107-05-1.SEC Purity 98%	2,000.0 µg/mL	+/- 11.6281 µg/mL +/- 44.2527 µg/mL +/- 44.4331 µg/mL		Gravimetric Unstressed Stressed
7	Methyl acetate CAS # 79-20-9.SEC Purity 99%	10,000.0 µg/mL	+/- 58.1378 µg/mL +/- 221.2646 µg/mL +/- 222.1666 µg/mL		Gravimetric Unstressed Stressed
8	Carbon disulfide CAS # 75-15-0.SEC Purity 98%	2,000.0 µg/mL	+/- 11.6281 µg/mL +/- 44.2527 µg/mL +/- 44.4331 µg/mL		Gravimetric Unstressed Stressed
9	Methylene chloride (dichloromethane) CAS # 75-09-2.SEC Purity 99%	2,000.0 µg/mL	+/- 11.6282 µg/mL +/- 44.2531 µg/mL +/- 44.4335 µg/mL		Gravimetric Unstressed Stressed

10	Acrylonitrile	20,000.0	µg/mL	+/-	116.2756	µg/mL	Gravimetric
	CAS # 107-13-1.SEC			+/-	442.5291	µg/mL	Unstressed
	Purity 99%			+/-	444.3332	µg/mL	Stressed
11	Methyl-tert-butyl ether (MTBE)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 1634-04-4.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
12	cis-1,2-Dichloroethene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 156-59-2.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
13	n-Hexane (C6)	2,000.1	µg/mL	+/-	11.6286	µg/mL	Gravimetric
	CAS # 110-54-3.SEC			+/-	44.2549	µg/mL	Unstressed
	Purity 98%			+/-	44.4353	µg/mL	Stressed
14	1,1-Dichloroethane	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 75-34-3.SEC			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
15	2,2-Dichloropropane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 594-20-7.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
16	trans-1,2-Dichloroethene	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 156-60-5.SEC			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
17	Chloroform	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 67-66-3.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
18	Isobutanol (2-Methyl-1-propanol)	50,000.0	µg/mL	+/-	290.6891	µg/mL	Gravimetric
	CAS # 78-83-1.SEC			+/-	1,106.3228	µg/mL	Unstressed
	Purity 99%			+/-	1,110.8331	µg/mL	Stressed
19	Bromochloromethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 74-97-5.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
20	Tetrahydrofuran	4,000.0	µg/mL	+/-	23.2563	µg/mL	Gravimetric
	CAS # 109-99-9.SEC			+/-	88.5061	µg/mL	Unstressed
	Purity 99%			+/-	88.8670	µg/mL	Stressed
21	1,1,1-Trichloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 71-55-6.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
22	Cyclohexane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 110-82-7.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
23	1,1-Dichloropropene	2,010.5	µg/mL	+/-	11.6890	µg/mL	Gravimetric
	CAS # 563-58-6.SEC			+/-	44.4847	µg/mL	Unstressed
	Purity 98%			+/-	44.6661	µg/mL	Stressed
24	Carbon tetrachloride	2,000.1	µg/mL	+/-	11.6286	µg/mL	Gravimetric
	CAS # 56-23-5.SEC			+/-	44.2549	µg/mL	Unstressed
	Purity 98%			+/-	44.4353	µg/mL	Stressed
25	n-Heptane (C7)	2,000.1	µg/mL	+/-	11.6288	µg/mL	Gravimetric
	CAS # 142-82-5.SEC			+/-	44.2553	µg/mL	Unstressed
	Purity 99%			+/-	44.4357	µg/mL	Stressed
26	Benzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 71-43-2.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
27	1,2-Dichloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 107-06-2.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
28	Trichloroethene	2,000.1	µg/mL	+/-	11.6286	µg/mL	Gravimetric
	CAS # 79-01-6.SEC			+/-	44.2549	µg/mL	Unstressed
	Purity 98%			+/-	44.4353	µg/mL	Stressed

29	Methylcyclohexane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-87-2.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
30	1,2-Dichloropropane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 78-87-5.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
31	1,4-Dioxane	40,000.0	µg/mL	+/-	232.5513	µg/mL	Gravimetric
	CAS # 123-91-1.SEC			+/-	885.0582	µg/mL	Unstressed
	Purity 99%			+/-	888.6665	µg/mL	Stressed
32	Dibromomethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 74-95-3.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
33	Bromodichloromethane	2,000.1	µg/mL	+/-	11.6290	µg/mL	Gravimetric
	CAS # 75-27-4.SEC			+/-	44.2562	µg/mL	Unstressed
	Purity 97%			+/-	44.4366	µg/mL	Stressed
34	cis-1,3-Dichloropropene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 10061-01-5.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
35	Toluene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-88-3.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
36	Ethyl methacrylate	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 97-63-2.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
37	trans-1,3-Dichloropropene	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 10061-02-6.SEC			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
38	1,1,2-Trichloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 79-00-5.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
39	1,3-Dichloropropane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 142-28-9.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
40	Tetrachloroethene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 127-18-4.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
41	Dibromochloromethane	2,000.1	µg/mL	+/-	11.6290	µg/mL	Gravimetric
	CAS # 124-48-1.SEC			+/-	44.2562	µg/mL	Unstressed
	Purity 97%			+/-	44.4366	µg/mL	Stressed
42	1,2-Dibromoethane (EDB)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 106-93-4.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
43	Chlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-90-7.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
44	1,1,1,2-Tetrachloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 630-20-6.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
45	m-Xylene	1,000.0	µg/mL	+/-	5.8141	µg/mL	Gravimetric
	CAS # 108-38-3.SEC			+/-	22.1265	µg/mL	Unstressed
	Purity 99%			+/-	22.2167	µg/mL	Stressed
46	p-Xylene	1,000.0	µg/mL	+/-	5.8141	µg/mL	Gravimetric
	CAS # 106-42-3.SEC			+/-	22.1265	µg/mL	Unstressed
	Purity 99%			+/-	22.2167	µg/mL	Stressed
47	o-Xylene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 95-47-6.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed

48	Ethylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 100-41-4.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
49	Styrene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 100-42-5.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
50	Isopropylbenzene (cumene)	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 98-82-8.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
51	Bromoform	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 75-25-2.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
52	1,1,2,2-Tetrachloroethane	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 79-34-5.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
53	1,2,3-Trichloropropane	2,000.0	µg/mL	+/-	11.6281	µg/mL	Gravimetric
	CAS # 96-18-4.SEC			+/-	44.2527	µg/mL	Unstressed
	Purity 98%			+/-	44.4331	µg/mL	Stressed
54	trans-1,4-Dichloro-2-butene	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 110-57-6.SEC			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
55	n-Propylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 103-65-1.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
56	Bromobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-86-1.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
57	1,3,5-Trimethylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 108-67-8.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
58	2-Chlorotoluene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 95-49-8.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
59	4-Chlorotoluene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 106-43-4.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
60	tert-Butylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 98-06-6.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
61	1,2,4-Trimethylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 95-63-6.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
62	sec-Butylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 135-98-8.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
63	4-Isopropyltoluene (p-cymene)	2,000.1	µg/mL	+/-	11.6285	µg/mL	Gravimetric
	CAS # 99-87-6.SEC			+/-	44.2545	µg/mL	Unstressed
	Purity 96%			+/-	44.4349	µg/mL	Stressed
64	1,3-Dichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 541-73-1.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
65	1,4-Dichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 106-46-7.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
66	n-Butylbenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 104-51-8.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed

67	1,2-Dichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 95-50-1.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
68	1,2-Dibromo-3-chloropropane	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 96-12-8.SEC			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
69	1,2,4-Trichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 120-82-1.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
70	Hexachlorobutadiene	2,000.0	µg/mL	+/-	11.6284	µg/mL	Gravimetric
	CAS # 87-68-3.SEC			+/-	44.2540	µg/mL	Unstressed
	Purity 97%			+/-	44.4344	µg/mL	Stressed
71	Naphthalene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 91-20-3.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed
72	1,2,3-Trichlorobenzene	2,000.0	µg/mL	+/-	11.6282	µg/mL	Gravimetric
	CAS # 87-61-6.SEC			+/-	44.2531	µg/mL	Unstressed
	Purity 99%			+/-	44.4335	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

Column:
60m x .25mm x 1.4um
Rtx-502.2 (cat.#10915)

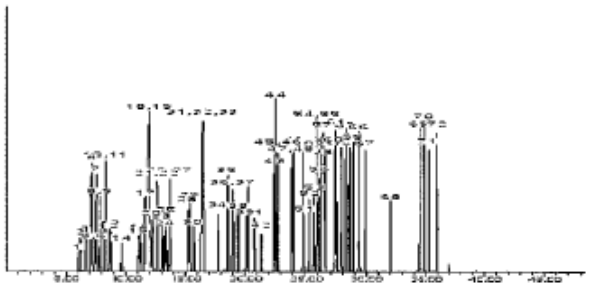
Carrier Gas:
helium-constant pressure 30 psi

Temp. Program:
40°C (hold 6 min.) to 240°C
@ 6°C/min. (hold 10 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
MSD



Jennifer L. Polino - QC Analyst Date Passed: 01-Mar-2013 Balance: 1127510105

Manufactured under Restek's ISO 9001:2008
Registered Quality System
Certificate #FM 80397

Table12. Second Source 8260 Mega Mix

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Catalog No. : 567645.sec **Lot No.:** A093618

Description : 8260 List 1 / Std #3 Gases

8260 List 1 / Std #3 Gases 2,000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2015 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Dichlorodifluoromethane (CFC-12) CAS # 75-71-8.SEC Purity 99%	2,001.8 µg/mL	+/- 11.3948 +/- 24.0125 +/- 27.1228	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
2	Chloromethane (methyl chloride) CAS # 74-87-3.SEC Purity 99%	2,000.6 µg/mL	+/- 11.1434 +/- 23.8835 +/- 27.0052	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
3	Vinyl chloride CAS # 75-01-4.SEC Purity 99%	1,996.5 µg/mL	+/- 13.5847 +/- 25.0789 +/- 28.0563	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
4	1,3-Butadiene CAS # 106-99-0.SEC Purity 99%	2,003.5 µg/mL	+/- 10.3715 +/- 23.5601 +/- 26.7280	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
5	Bromomethane (methyl bromide) CAS # 74-83-9.SEC Purity 99%	2,001.5 µg/mL	+/- 12.1569 +/- 24.3811 +/- 27.4489	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
6	Chloroethane (ethyl chloride) CAS # 75-00-3.SEC Purity 99%	1,997.2 µg/mL	+/- 13.6408 +/- 25.1155 +/- 28.0910	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
7	Dichlorofluoromethane (CFC-21) CAS # 75-43-4.SEC Purity 99%	2,004.9 µg/mL	+/- 12.2390 +/- 24.4529 +/- 27.5224	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
8	Trichlorofluoromethane (CFC-11) CAS # 75-69-4.SEC Purity 99%	2,001.9 µg/mL	+/- 16.1788 +/- 26.6190 +/- 29.4557	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
Solvent:	P&T Methanol CAS # 67-56-1 Purity 99%				

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Catalog No. : 567643.sec **Lot No.:** A093471

Description : 8260 List 1 / Std #4 2-Chloroethylvinyl Ether

8260 List 1 / Std #4 2-Chloroethylvinyl Ether 2,000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2016 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	2-Chloroethyl vinyl ether	2,000.0 µg/mL	+/- 11.6550	µg/mL	Gravimetric
	CAS # 110-75-8.SEC		+/- 44.2601	µg/mL	Unstressed
	Purity 99%		+/- 44.4405	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

Tech Tips:

Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

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Catalog No. : 567644.sec **Lot No.:** A098699

Description : 8260 List 1 / Std # 5 Acrolein

8260 List 1 / Std # 5 Acrolein 5,000 ug/ml, Water, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 28, 2014 **Storage:** 10°C or colder

CERTIFIED VALUES

Elution Order	Compound		Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Acrolein		5,006.2 µg/mL	+/- 29.3790	µg/mL	Gravimetric
	CAS # 107-02-8.SEC	(Lot 1506200)		+/- 131.3997	µg/mL	Unstressed
	Purity 97%			+/- 165.1986	µg/mL	Stressed

Solvent: Water
CAS # 7732-18-5
Purity 99%

SS AcroleinMix_00003 thru 00006

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Catalog No. : 567646.SEC **Lot No.:** A098982

Description : 8260 List 1 / Std #6 Vinyl Acetate

8260 List 1 / Std #6 Vinyl Acetate 4000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 28, 2014 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Vinyl acetate	4,003.0 µg/mL	+/- 23.4918	µg/mL	Gravimetric
	CAS # 108-05-4.SEC (Lot GPTIF)		+/- 318.8968	µg/mL	Unstressed
	Purity 99%		+/- 319.0538	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

Tech Tips:

Vinyl acetate is a volatile organic ester included in the target lists of several US EPA and other methods. Under acidic conditions, esters react with alcohols to form new esters (transesterification). Methanol-based mixes containing halogenated compounds are slightly acidic, so it is important to minimize exposure of vinyl acetate to mixes of halogenated compounds in methanol. For this reason, we offer vinyl acetate in individual solution, and suggest that it be introduced into the working level calibration solution immediately before use. This will minimize problems and ensure more consistent results.

Table 13. 8260 Add Mixture

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Catalog No. : 568722 **Lot No.:** A0100262

Description : 8260 List 2/ Std #1 Additions (2014)

8260 List 2/ Std #1 Additions (2014) 2,000-50,000 µg/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : June 30, 2015 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	2-Propanol (isopropanol) CAS # 67-63-0 (Lot SHBC5752V) Purity 99%	20,007.0 µg/mL	+/- 117.1454 µg/mL +/- 1,064.8186 µg/mL +/- 1,065.9927 µg/mL	Gravimetric Unstressed Stressed
2	Chloroprene (2-chloro-1,3-butadiene) CAS # 126-99-8 (Lot 130611JLM) Purity 99%	2,000.0 µg/mL	+/- 32.2441 µg/mL +/- 110.6029 µg/mL +/- 110.7159 µg/mL	Gravimetric Unstressed Stressed
3	Ethyl acetate CAS # 141-78-6 (Lot SHBD3394V) Purity 99%	4,002.0 µg/mL	+/- 23.4860 µg/mL +/- 213.0015 µg/mL +/- 213.2364 µg/mL	Gravimetric Unstressed Stressed
4	Methacrylonitrile CAS # 126-98-7 (Lot 2194000) Purity 99%	20,000.5 µg/mL	+/- 117.1073 µg/mL +/- 1,064.4727 µg/mL +/- 1,065.6464 µg/mL	Gravimetric Unstressed Stressed
5	2,2,4-Trimethylpentane (isooctane) CAS # 540-84-1 (Lot SHBB2470V) Purity 99%	2,004.5 µg/mL	+/- 11.7635 µg/mL +/- 106.6871 µg/mL +/- 106.8047 µg/mL	Gravimetric Unstressed Stressed
6	1-Butanol CAS # 71-36-3 (Lot SHBC1840V) Purity 99%	50,001.0 µg/mL	+/- 292.7518 µg/mL +/- 2,661.1667 µg/mL +/- 2,664.1010 µg/mL	Gravimetric Unstressed Stressed
7	1,4-Difluorobenzene CAS # 540-36-3 (Lot 13105AO) Purity 99%	2,006.5 µg/mL	+/- 11.7753 µg/mL +/- 106.7935 µg/mL +/- 106.9112 µg/mL	Gravimetric Unstressed Stressed
8	Ethyl acrylate CAS # 140-88-5 (Lot 10129902) Purity 99%	2,005.5 µg/mL	+/- 11.7694 µg/mL +/- 106.7403 µg/mL +/- 106.8580 µg/mL	Gravimetric Unstressed Stressed

9	Methyl methacrylate CAS # 80-62-6 Purity 99%	(Lot MKBK0839V)	4,003.0 µg/mL	+/- 23.4918 +/- 213.0548 +/- 213.2897	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
10	2-Nitropropane CAS # 79-46-9 Purity 97%	(Lot BCBJ4343V)	4,006.6 µg/mL	+/- 23.5129 +/- 213.2456 +/- 213.4807	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
11	Butyl acetate CAS # 123-86-4 Purity 99%	(Lot SHBC9340V)	2,001.0 µg/mL	+/- 11.7430 +/- 106.5008 +/- 106.6182	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
12	1-Chlorohexane CAS # 544-10-5 Purity 99%	(Lot 05107LK)	2,007.5 µg/mL	+/- 11.7811 +/- 106.8467 +/- 106.9645	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
13	1,2,3-Trimethylbenzene CAS # 526-73-8 Purity 97%	(Lot 8776.05-10)	2,004.0 µg/mL	+/- 11.7607 +/- 106.6615 +/- 106.7791	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
14	Benzyl chloride CAS # 100-44-7 Purity 99%	(Lot 20396EK)	2,009.0 µg/mL	+/- 11.7899 +/- 106.9266 +/- 107.0445	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
15	1,3,5-Trichlorobenzene CAS # 108-70-3 Purity 99%	(Lot 11319AS)	2,000.0 µg/mL	+/- 11.7371 +/- 106.4475 +/- 106.5649	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
Solvent:	P&T Methanol CAS # 67-56-1 Purity 99%					

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Catalog No. : 567719 **Lot No.:** A093359

Description : 8260 List 2 / Std #2

8260 List 2 / Std #2 2,000 ug/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2015 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Pentachloroethane CAS # 76-01-7 Purity 99%	2,000.0 µg/mL	+/- 11.6550 +/- 24.1205 +/- 27.2132	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
2	2-Methylnaphthalene CAS # 91-57-6 Purity 96%	1,999.9 µg/mL	+/- 11.6546 +/- 24.1196 +/- 27.2121	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

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Catalog No. : 567648 **Lot No.:** A093361

Description : 8260 List 2 / Std #3 Cyclohexanone

8260 List 2 / Std #3 Cyclohexanone 20,000 ug/ml, Water, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : February 2016 **Storage:** 10°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Cyclohexanone	20,000.0 µg/mL	+/- 116.2756	µg/mL	Gravimetric
	CAS # 108-94-1		+/- 1,597.3791	µg/mL	Unstressed
	Purity 99%		+/- 1,598.1615	µg/mL	Stressed

Solvent: Water
CAS # 7732-18-5
Purity 99%

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Catalog No. : 568723 **Lot No.:** A099930

Description : 8260 List 3/ Std#1 Polar Additions

8260 List 3/ Std#1 Polar Additions 2,000-100,000 µg/ml, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : December 31, 2015 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	Ethanol **CAS #** 64-17-5 (Lot SHBC8676V) **Purity** 99%	100,255.6 µg/mL	+/- 586.9883 µg/mL +/- 3,493.5733 µg/mL +/- 3,613.2792 µg/mL	Gravimetric Unstressed Stressed
2	Acetonitrile **CAS #** 75-05-8 (Lot SHBB3177V) **Purity** 98%	20,015.9 µg/mL	+/- 117.1976 µg/mL +/- 697.4888 µg/mL +/- 721.3879 µg/mL	Gravimetric Unstressed Stressed
3	Diisopropyl ether (DIPE) **CAS #** 108-20-3 (Lot SHBB6268V) **Purity** 99%	2,001.6 µg/mL	+/- 11.7465 µg/mL +/- 69.7537 µg/mL +/- 72.1435 µg/mL	Gravimetric Unstressed Stressed
4	Ethyl-tert-butyl ether (ETBE) **CAS #** 637-92-3 (Lot MKBP5984V) **Purity** 99%	2,008.4 µg/mL	+/- 11.7864 µg/mL +/- 69.9907 µg/mL +/- 72.3885 µg/mL	Gravimetric Unstressed Stressed
5	Propionitrile **CAS #** 107-12-0 (Lot BCBK0700V) **Purity** 99%	20,039.6 µg/mL	+/- 117.3363 µg/mL +/- 698.3142 µg/mL +/- 722.2416 µg/mL	Gravimetric Unstressed Stressed
6	tert-Amyl alcohol **CAS #** 75-85-4 (Lot STBB1898V) **Purity** 99%	20,035.2 µg/mL	+/- 117.3105 µg/mL +/- 698.1609 µg/mL +/- 722.0831 µg/mL	Gravimetric Unstressed Stressed
7	tert-Amyl methyl ether (TAME) **CAS #** 994-05-8 (Lot OS1028/4V) **Purity** 99%	2,005.6 µg/mL	+/- 11.7700 µg/mL +/- 69.8931 µg/mL +/- 72.2876 µg/mL	Gravimetric Unstressed Stressed

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Catalog No. : 568111 **Lot No.:** A095258

Description : Buffalo Add 2 Mix A

Buffalo Add 2 Mix A 5,000 µg/ml, P&T Methanol, 1 ml/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : May 31, 2014 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Propylene oxide	5,000.0 µg/mL	+/- 29.3426	µg/mL	Gravimetric
	CAS # 75-56-9 (Lot 85396HMV)		+/- 110.7037	µg/mL	Unstressed
	Purity 98%		+/- 111.1544	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

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Catalog No.: 568112 **Lot No.:** A095252

Description: Buffalo Add 2 Mix B

Buffalo Add 2 Mix B, 1,000 - 20,000 µg/mL, P&T Methanol, 1 mL/ampul

Container Size: 2 mL **Pkg Amt:** > 1 mL

Expiration Date: November 30, 2014 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound		Grav. Conc. (weight/volume)		Expanded Uncertainty (95% C.L.; K=2)		
1	Chlorodifluoromethane (CFC-22) CAS # 75-45-6 Purity 99%	(Lot Q162-44)	1,997.9	µg/mL	+/- 32.4219 +/- 53.5775 +/- 53.7263	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
2	Acetaldehyde dimethyl acetal CAS # 534-15-6 Purity 99%	(Lot 01604PC)	5,000.0	µg/mL	+/- 29.3428 +/- 110.7046 +/- 111.1553	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
3	tert-Amyl alcohol CAS # 75-85-4 Purity 99%	(Lot STBB1898V)	20,001.0	µg/mL	+/- 117.1103 +/- 442.7697 +/- 444.5731	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
4	3-Chlorobenzotrifluoride CAS # 98-15-7 Purity 99%	(Lot 21324DO)	1,003.0	µg/mL	+/- 5.9575 +/- 22.2264 +/- 22.3167	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
5	4-Chlorobenzotrifluoride CAS # 98-56-6 Purity 99%	(Lot 08507BO)	1,003.0	µg/mL	+/- 5.9575 +/- 22.2264 +/- 22.3167	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
6	2-Chlorobenzotrifluoride CAS # 88-16-4 Purity 99%	(Lot I0316DQ)	1,003.0	µg/mL	+/- 5.9575 +/- 22.2264 +/- 22.3167	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
7	3-Chlorotoluene CAS # 108-41-8 Purity 99%	(Lot I3528LX)	1,003.0	µg/mL	+/- 5.9575 +/- 22.2264 +/- 22.3167	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
8	Dicyclopentadiene CAS # 77-73-6 Purity 98%	(Lot 1421BB)	999.6	µg/mL	+/- 5.9373 +/- 22.1510 +/- 22.2410	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed

Table 14. BFB Standard

MVSC 3 1-710

RESTEK

CERTIFICATE OF ANALYSIS

FOR LABORATORY USE ONLY - READ MSDS PRIOR TO USE

110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800) 356-1688
Fax: (814) 353-1309

Catalog No.: 30067 Lot No.: A038650
Description: 4-Bromofluorobenzene Standard
Expiration Date[1]: January 2010 Storage: Freezer

Elution Order	Compound	CAS#	Percent Purity[2]	Concentration[3]	Percent Uncertainty[4]
1	1-Bromo-4-fluorobenzene (BFB)	460-00-4	99%	2500 ug/mL	+/- 0.1
	Solvent: P&T Methanol	67-56-1	99%		

Column:
105m x .53mm x 3.0um
Rtx-502.2 (cat.#10910)

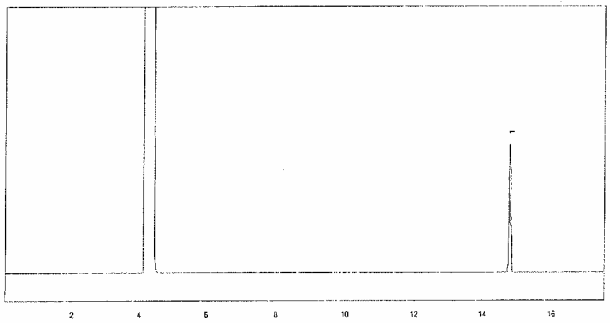
Carrier Gas:
hydrogen @ 40 cm/sec

Temp. Program:
50°C to 240°C @ 10°C/min.

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



Manufactured By: MEW
John Lidgett - QA Analyst

1 Expiration date of the unopened ampul stored at recommended temperature.
2 Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
3 Based upon gravimetric preperation with balance calibration verified using NIST traceable weights (7 mass levels).
4 Percent Uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

ISO 9001 REGISTERED
Manufactured Under Restek's ISO 9001 Registered Quality System
Certificate #FM80397

Page 1 1

Table 15. Internal Standard Mixture

RESTEK CERTIFIED REFERENCE MATERIAL

110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309
www.restek.com

Certificate of Analysis

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30241 **Lot No.:** A099180

Description : 8260A Internal Standard Mix

8260A Internal Standard Mix 2,500µg/mL, P&T Methanol, 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

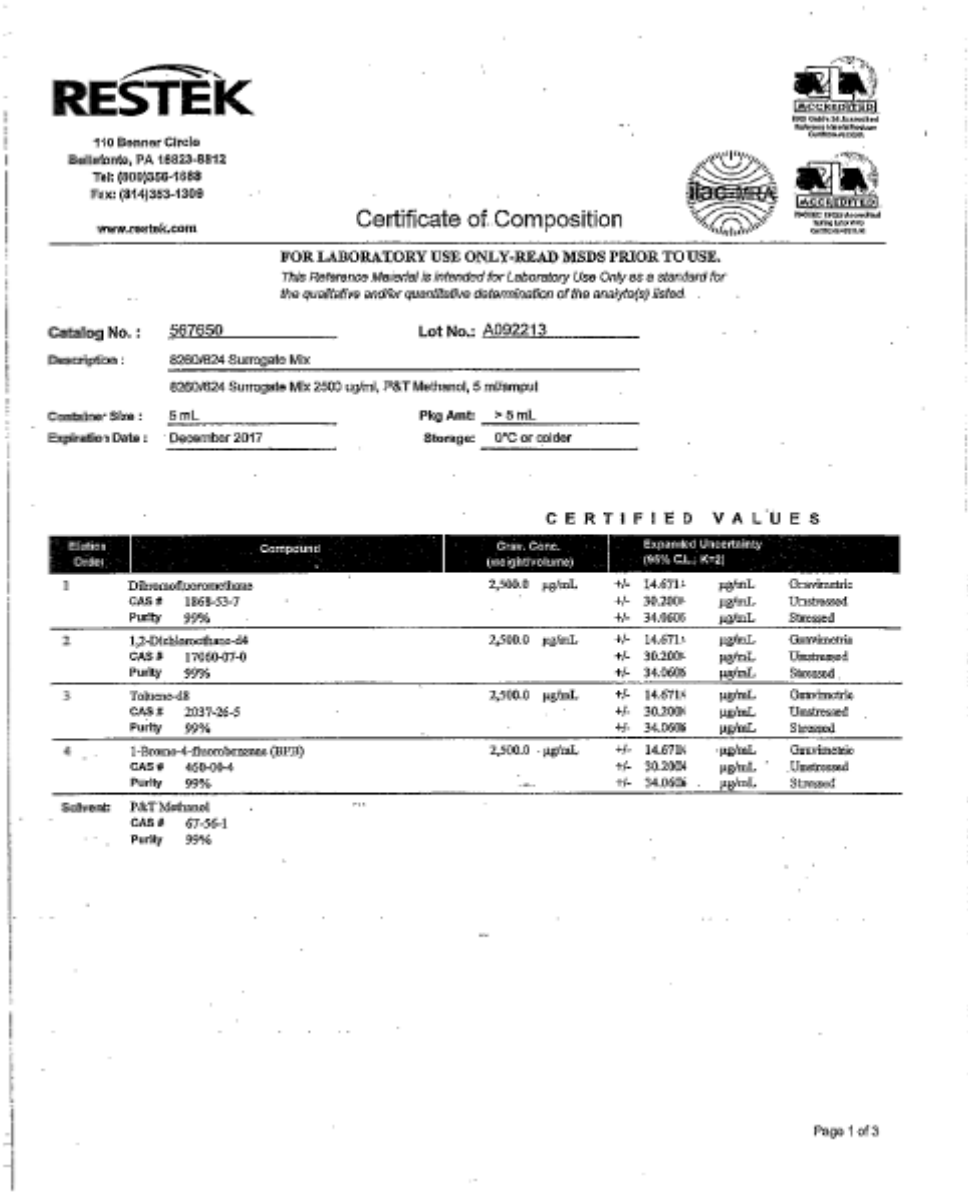
Expiration Date : November 30, 2018 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	Fluorobenzene CAS # 462-06-6 (Lot 1380033) Purity 99%	2,501.9 µg/mL.	+/- 14.5468 µg/mL. +/- 26.5547 µg/mL. +/- 30.8805 µg/mL.	Gravimetric Unstressed Stressed
2	Chlorobenzene-d5 CAS # 3114-55-4 (Lot PR-22736) Purity 99%	2,500.2 µg/mL.	+/- 14.5368 µg/mL. +/- 26.5365 µg/mL. +/- 30.8595 µg/mL.	Gravimetric Unstressed Stressed
3	1,4-Dichlorobenzene-d4 CAS # 3855-82-1 (Lot PR-18488) Purity 99%	2,501.9 µg/mL.	+/- 14.5468 µg/mL. +/- 26.5547 µg/mL. +/- 30.8805 µg/mL.	Gravimetric Unstressed Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

Table 16. Surrogate Mixture



RESTEK

110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309
www.restek.com

Certificate of Composition

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 567650 **Lot No.:** A092213

Description : 8260/624 Surrogate Mix

8260/624 Surrogate Mix 2500 ug/mL, P&T Methanol, 5 mL/ampul

Container Size : 5 mL **Pkg Amt:** > 5 mL

Expiration Date : December 2017 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Gravimetric Conc. (weight/volume)	Expanded Uncertainty (95% C.L., K=2)		
1	Dibromofluoromethane CAS # 1868-53-7 Purity 99%	2,500.0 µg/mL	+/- 14.671 +/- 30.280 +/- 34.060	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
2	1,2-Dichloroethane-d4 CAS # 17060-07-0 Purity 99%	2,500.0 µg/mL	+/- 14.671 +/- 30.200 +/- 34.060	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
3	Toluene-d8 CAS # 2037-26-5 Purity 99%	2,500.0 µg/mL	+/- 14.671 +/- 30.200 +/- 34.060	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
4	1-Bromo-4-fluorobenzene (BFB) CAS # 460-00-4 Purity 99%	2,500.0 µg/mL	+/- 14.671 +/- 30.202 +/- 34.060	µg/mL µg/mL µg/mL	Gravimetric Unstressed Stressed
Solvent:	P&T Methanol CAS # 67-56-1 Purity 99%				

Page 1 of 3

TestAmerica Buffalo GCMS VOA Dilution Calculation

Table 17:

5mL and 25mL Water	2	(25mL/50mL)/5mL P&T
	4	(12.5mL/50mL)/5mL P&T
	5	(10mL/50mL)/5mL P&T
	8	(6.25mL/50mL)/5mL P&T
	10	(5mL/50mL)/5mL P&T
	20	(2.5mL/50mL)/5mL P&T
	25	(2mL/50mL)/5mL P&T
	40	(1.25mL/50mL)/5mL P&T
	50	(1mL/50mL)/5mL P&T
	80	(625uL/50mL)/5mL P&T
	100	(500uL/50mL)/5mL P&T
	125	(400uL/50mL)/5mL P&T
	200	(250uL/50mL)/5mL P&T
	400	(125uL/50mL)/5mL P&T
	500	(100uL/50mL)/5mL P&T
	800	(62.5uL/50mL)/5mL P&T
	1,000	(50uL/50mL)/5mL P&T
	2,000	(25uL/50mL)/5mL P&T
	4,000	(12.5uL/50mL)/5mL P&T
	5,000	(10uL/50mL)/5mL P&T
	8,000	(6.25uL/50mL)/5mL P&T

NOTE**: 1. Primary dilutions are contained within the innermost parentheses. Any dilutions above 8000x are serial dilutions. The 50mL volumes are transferred into a 40mL Voa vial and contain zero headspace.**
2. If the analyst does not see the dilution listed on the work instruction; the dilution performed must be indicated on the raw data, including the dilution factor, in the "sample Info": filed of the quantitation report.

Title: Analysis of PCBs
SW846 8082 / 40CFR 608

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

3/31/14	3/31/14
Gary Rudz Date Department Manager	Kenneth E. Kasperek Date Technical Director
3/31/14	3/31/14
Brad Prinzi Date Quality Assurance Manager	Christopher Spencer Date Laboratory Director

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1.0 Scope and Application

This method is used to quantify polychlorinated biphenyls (PCBs) as Aroclors in extracts from aqueous, soil, sludge or oil matrices by direct injection techniques into a capillary column equipped gas chromatograph. An electron capture detector (ECD) is employed for identification and quantification. This method is restricted to use by or under the supervision of analysts experienced in the use of a gas chromatograph and the integration of gas chromatograms.

1.1 Analytes, Matrix(s), and Reporting Limits

This method is used to determine volatile organic compounds in a variety of matrices: water, soil, sediment, sludge, wipe, and waste drum samples.

Compound	CAS No.
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5
Aroclor 1262	37324-23-5
Aroclor 1268	11100-14-4

The routine reporting limits are:

0.5 ug/L for water samples	1 Liter	FV=10 ml	8082
0.5 ug/L for water samples	200 mLs	FV= 2 ml	8082
0.06 ug/L for low level water samples	1 Liter	FV= 2 ml	608/8082LL
1 ppM for routine soil samples	2 grams	FV=10 ml	8082
16.7 ug/Kg for soil samples (100% Dry)	30 grams	FV=10 ml	8082
2.5 mg/Kg for oil/waste samples	0.2 grams	FV=10 ml	8082
1.0 mg/Kg for oil/waste samples	0.5 grams	FV=10 ml	8082
1 ug/wipe for wipe sample	1 Wipe	FV=40 ml	8082

2.0 Summary of Method

2.1. Wastewater samples: approximately 1 liter of sample is extracted with Methylene chloride using a separatory funnel 3510C (SOP ASP-BF-OP-003) Soil samples are extracted using approximately 2g of soil/solid sample using sonication 3550C (SOP No. ASP-BF-OP-016) The extract is then exchanged to hexane and concentrated to 10 ml or less. The final extract is then separated by gas chromatography and detected by an electron capture detector.

2.2. Florisil & Silica Gel column cleanup procedures and sulfur removal procedures may be utilized to mitigate any interferences that may be encountered during analysis. Alternate cleanups may be employed per the analysts' discretion or by

client request, for example TBA cleanup. Although these procedures may eliminate several interferences, contamination of the sample may come from a variety of sources, including solvents, reagents, glassware and any of the hardware used in sample processing. For this reason, reagent and solvent blanks should be analyzed to insure their purity.

3.0 Definitions

3.1. Definitions of terms used in this SOP may be found in the glossary of the Laboratory Quality Manual.

3.1.1. **PCB (Polychlorinated Biphenyl)**

The general term used to describe a mixture of congeners, generated via the manufacturing process

3.1.2. **Aroclor**

Another reference to the PCB type, given as a known mixture rather than group of congeners

3.1.3. **Ar-**

An abbreviated version of Aroclor, used as Ar1242 (Aroclor 1242).

3.1.4. **Congener**

Any of the specific individual “Parts” of a PCB, designated by the number of chorines and the various isomers of each.

4.0 Interferences

4.1. Method interferences can be minimized by proper glassware cleaning methods, instrument maintenance, and the use of high purity reagents and solvents.

4.2. Sulfuric acid 3665A (ASP-BF-OP-010) is part of the extraction procedure for all PCB samples.

4.3. Copper cleanup Method 3660B (AGE-BF-GE-005), Silica Gel Cleanup 3630C (ASP-BF-OP-008), and Florisil Cartridge Cleanup 3620C (ASP-BF-OP-007) may be also used on samples when specified by project or historical results warrant further cleanup.

5.0 Safety

5.1. Employees must abide by the policies and procedures in the Corporate Safety Manual and this document.

5.2. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.3. Specific Safety Concerns or Requirements

5.4. The gas chromatograph contains zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to near room temperature prior to working on them.

5.5. There are areas of high voltage in the gas chromatograph. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.6. Primary Materials Used

5.6.1. The following is a list of the materials used in this method, which have a serious or significant hazard rating. Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table. A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material	Hazards	Exposure Limit (1)	Signs and symptoms of exposure
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Hexane	Flammable	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Sulfuric Acid	Carcinogen Irritant Dehydrator Poison Oxidizer	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

The health and safety hazards of many of the chemicals used in this procedure have not been fully defined. Additional health and safety information can be obtained from the Material Safety Data Sheets (MSDS) maintained in the laboratory

Aroclors have been classified as a potential carcinogen. Concentrated solutions of Aroclors must be handled with extreme care to avoid excess exposure.

6.0 Equipment and Supplies

Gas chromatograph suitable for on-column injection and all required materials, i.e., syringes, columns, gases, detector and a data processing system capable of measuring peak areas and heights.

Capillary columns
ZB-35 30m 0.53mm w/0.5um film or Equivalent
ZB-5 30m 0.53mm w/1.0um film or Equivalent
Electron Capture Detector
PE Nelson Totalchrom data system (Version 6.2.1 or Later)
Carrier Gas Hydrogen
Make Up Gas - Argon/Methane or Nitrogen
Syringes – 10ul Teflon tipped for Injection

6.1. Instrumentation *

Hewlett Packard 5890 gas chromatograph w/dual ECD detectors
Hewlett Packard 6890 gas chromatograph w/dual uECD detectors or Equivalent
Hewlett Packard 7673 Auto Samplers
Hewlett Packard 7683B Auto Samplers
Hewlett Packard 3396A Integrators
PE Nelson Totalchrom 6.2.1 data system
PE Nelson 900 Series A/D Boxes
PE Nelson 600 Series Link Controller Boxes
(or Equivalent)*

6.2. Supplies

Carrier Gas Hydrogen
Make Up Gas - Argon/Methane or Nitrogen
Syringes – various
1.8 Crimp-top Vials, Amber & Clear
5 ¾" Disposable Pipettes& Bulbs
Vila Inserts - 250ul Spring
Inlet Liners - Packed Purge w/Pesticide Grade Glass Wool
Inlet Liners – Capillary Drilled Uniler
2-4 um Extract Filters (PTFE)

7.0 Reagents and Standards

7.1. Reagents or pesticide grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of determination.

7.2. Standards are stored in the GC Standard Incubator at 4±2°C in Teflon-sealed amber containers in the dark, unless the manufacturer's storage recommendations differ. These cases will give rise to alternate storage conditions based upon need and availability.

7.3. All stock standard solutions are replaced before the expiration date. All other standard dilutions or working standards are discarded after six month (or at the stock standard expiration date, whichever comes first) or sooner if routine QC indicates a problem. Certified PCB Mixes (Aroclors 1016/1260, 1221, 1232, 1242, 1248, 1254, 1262 & 1268)

7.4. Second Source PCB Mixes for all Aroclors (Different Manu. or Lot #) to verify constant response of newly prepared calibration curve or single point standards.

7.5. Acetone (pesticide grade)

7.6. Hexane (pesticide grade)

8.0 Sample Collection, Preservation, Shipment and Storage

8.1. Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

8.2. Aqueous samples are to be collected in a 1-liter amber glass jar and stored at 4±2°C. Organic preparation is to be performed within 7 days of collection.

8.3. Aqueous Samples (8082) are to be collected in a 1-liter amber glass jar and stored at 4±2°C. Organic preparation is to be performed within 7 days of collection.

8.4. Aqueous Samples (608) are to be collected in a 1-liter amber glass jar and stored at 4±2°C. Organic preparation is to be performed within 1 year of collection.

8.5. Soil (solid) samples are to be collected in a 4 oz jar and stored at 4±2°C. Organic preparation is to be performed within 14 days of collection.

8.6. Wipe and Oil samples are to be collected in a 4 oz jar and stored at 4±2°C. Organic preparation is to be performed within 28 days of collection.

8.7. Analysis of all extracts is to be performed within 40 days of preparation.

8.8. Holding times specified in project specific quality assurance plans may supersede the above listed method criteria.

8.9. Extracts are stored in an Incubator under refrigeration at 4±2°C.

8.10. For CLP, AFCEE, and USACE samples, the extracts are maintained in secure storage incubator SC# 4

9.0 Quality Control

9.1. Sample QC - The following quality control samples are prepared with each batch of samples.

9.1.1. A method blank must be prepared and analyzed with each batch (maximum 20 samples). The acceptance criterion is that the method blank must contain a concentration less than the reporting limit for all target analytes. If the blank fails this criterion, the entire prep batch must be re-extracted and analyzed.

9.1.2. For USACE, the method blank must contain concentrations < ½ the reporting limit.

9.1.3. Analysis of at least one matrix spike and one matrix spike duplicate per batch. Sample spike and duplicate recoveries should fall within the laboratory Quality Control limits that are updated annually based upon historical data. If the recoveries are not achieved, the data is still valid as long as the LCS is acceptable. The routine matrix spiking solution is an Aroclor 1016/1260 mixture prepared at 5.0ng/ul. During preparation, 1000ul of this solution is added to all quality control samples (LCS/MS/MSD). The resulting expected concentration for both aqueous and soil sample is 0.50ng/ul in the 10ml extract. This translates to final sample concentrations of: 5.0 ug/L for a 1-Liter Aqueous samples, and 166.7ug/Kg for 30.0grams of Soil sample at 100% dry.

9.1.4. Limited sample volume can allow for the analysis of a matrix spike blank duplicate instead of a MS and MSD pair.

9.1.5. A laboratory control sample (LCS) must be prepared and analyzed with each batch. A laboratory control sample duplicate (LCSD)) should be prepared if insufficient volume exist for a sample spike duplicate. Spike recoveries should fall within the laboratory Quality Control limits that are updated annually based upon historical data.

9.2. Instrument QC

9.2.1. Initial Calibration Curve and Verification (ICC & ICV)

9.2.1.1. An Initial Calibration Curve (ICC) must be run for the Aroclor mix 1016/1260. Other Aroclors specified by project may be required if utilizing non-linear calibration models.

9.2.1.2. The curve will consist of a minimum of five concentration points ranging from 0.025ng/uL–2.0ng/uL. The concentration points will be prepared by diluting a certified Aroclor standard. Lower Levels may be prepared at the time of calibration by diluting existing higher levels. The following table summarizes the concentration levels used and the associated reporting levels for water, soil, wipe, & oil samples.

9.2.1.3. An Initial Calibration Curve must be run for the surrogate compounds Decachlorobiphenyl and Tetrachloro-meta-xylene, which is to be contained in the Ar1016/1260 calibration standards.

9.2.1.4. The ICC for the surrogates will require a minimum of five (5) concentration points. The concentrations will be made by serial dilutions of a certified standard. These levels are included within the Ar1660 calibration standards, recommended levels are: 0.005ng, 0.010ng, 0.020ng, 0.030ng, 0.040ng, and 0.05ng.

9.2.1.5. A single point calibration must be run for all other Aroclors. The Aroclor concentration should be near the midrange concentration of the 1016/1260 curve (~0.5ng/ul on column).

Calibration Standard Conc.	**RL 8082 Water** (1L fv=10 ml)	**RL 608 Water** (1L fv=2 ml)	**RL 8082 Soil** (30g/100% dry)	**RL 8082 Wipes** (FV=40.0ml)	**RL 8082 Oils** (0.1g fv=10ml)
0.025 ng/ul	**	**0.06 ug/L** *	**	**1.0 ug/Wipe**	**2.5 mg/Kg**
0.05 ng/uL	**0.50 ug/L**	0.10 ug/L	**16.67 ug/kg**	2.0 ug/Wipe	5.0 mg/Kg
0.10 ng/uL	1.0 ug/L	0.20 ug/L	33.3. ug/kg	4.0 ug/Wipe	10 mg/Kg
0.25 ng/uL	2.5 ug/L	0.5 ug/L	83.3 ug/kg	10.0 ug/Wipe	25 mg/Kg
0.50 ng/uL	5.0 ug/L	1.0 ug/L	166 ug/kg	20.0 ug/Wipe	50 mg/Kg
1.0 ng/uL	10.0 ug/L	2.0 ug/L	333 ug/kg	40.0 ug/Wipe	100 mg/Kg
2.0 ng/uL	20.0 ug/L	4.0 ug/L	883 ug/kg	80.0 ug/Wipe	250 mg/Kg

*- Adjusted reflecting MDLV data
** - Not Supported with MDL Studies

9.2.2. Continuing Calibration Verification (CCV)

9.2.2.1. A Continuing Calibration Verifications (CCV) must bracket every 10 samples. Aroclor1660 is used to represent all Aroclors for this purpose.

9.2.3. Instrument Blank (IBLK)

9.2.3.1. An Instrument Blank (IBLK) is analyzed immediately after the Continuing Calibration Verification (CCV) to verify the absence of any potential carry-over or contamination.

9.2.4. Calibration Acceptance Summary

9.2.4.1. Retention Time Windows

9.2.4.1.1. The Initial RTWindow Study is calculated using 3X the Standard Deviation (in minutes) of 3 injections of the Ar1660 Midpoint Standard (0.5ng) over a 72-hour period.

9.2.4.1.2. With the use of EPC (Electronic Pressure Control), the values given from this study will most likely be impractically small or 0.00. Any peak with a 3X Standard deviation of <0.05ng minutes defaults to 0.05 min (3.0 sec) at minimum. It should be noted that the primary means of identification are based upon pattern recognition.
* Matrix effects may shift actual retention times, but the primary pattern may remain intact.

9.2.4.1.3. The Chrom calibration retention time windows may be adjusted slightly (tighter or wider) to better reflect peak width values, to allow for consistent situational identification and quantification. When RT drift due to maintenance or minor changes conditions occurs, these windows should be centered and updated for each Aroclor simultaneously, based upon a full set of all Aroclor standards, to allow these values for each component to reflect the current chromatographic conditions.

9.2.4.2. Calibration Model

9.2.4.2.1. The Percent Relative Standard Deviation for Aroclor1016 and Aroclor1260 must be $\leq$20% for the ICC to be acceptable, and to use single point standards for the remaining Aroclors

9.2.4.2.2. 1st Order Calibrations do not prove linearity through zero, and therefore does not allow for the use of single point standards to be used to quantify any other Aroclors of interest.

9.2.4.2.3. If a quadratic regression fit is required to obtain acceptable data, 6 or more calibration points must be employed. If a 2nd Order Curve Calibration for Ar1660 is used, single points for the remaining Aroclors cannot be used to calculate sample positives. If Aroclor positives are found, then the calibration requirements for full curves are then applied to any such Aroclor.

9.2.4.2.4. If RSD $\leq$20% for each Aroclor (1016 & 1260), then linearity of the detector can be assumed for all other Aroclors over the same analytical range. The congener range for Aroclor 1016 reflects the ranges for Aroclors 1221, 1232, 1242, & 1248. The congener range for Aroclor 1260 reflects the ranges for Aroclors 1254, 1262, & 1268.

9.2.4.2.5. The RSD for some of the individual peaks of each Aroclor 1016 & 1260 can be >20% and <30%, as long as the Total Aroclor RSD for each is <20%.

9.2.4.2.6. For each Aroclor, three to five major chromatographic peaks are chosen that represent the key to the patterns present in each particular Aroclor for quantification. Four – five peaks will be used in calibration to allow for the potential loss of peaks due to interferences. This is important due to the assessment of degraded patterns when determining identification and quantification needs in difficult matrices.

9.2.4.2.7. ***Is has been found that "Unique" Peaks for each Aroclor do not always exist, the fact is that many mixes containing all the congeners for another Aroclor.***

9.2.4.2.8. Due to this, the following combinations of Aroclors cannot be identified simultaneously in a given sample:

9.2.4.2.9. Aroclors: 1016, 1232, & 1242 will not have unique peaks that meet all criteria when compared to one another.

9.2.4.2.10. Aroclors: 1221 & 1232 will not have unique peaks that meet all criteria when compared to one another.

9.2.4.2.11. Aroclors: 1242 & 1248 will not have unique peaks that meet all criteria when compared to one another.

9.2.4.2.12. Aroclors: 1260 & 1262 will not have unique peaks that meet all criteria when compared to one another.

9.2.4.2.13. The remaining Aroclors; 1248, 1254, & 1268 can be identified in combination, and along with any one of the other of the single Aroclors listed above.

9.2.4.2.14. It is important to note that the identification of multiple Aroclors in any given sample can be difficult and requires a vast working knowledge of the distinct parts of each pattern. It is paramount that the majority of the biphenyls present, are to try to be explained using the most representative pattern match, along with the best quantitation of peaks present. The outside factors such as weathering, dechlorination, matrix, and overlap must also be considered when identifying potential Aroclors in complex sample patterns.

9.2.4.2.15. The Percent Relative Standard Deviation for each surrogate must be $\leq$20%, or have a Correlation Coefficient "R" $\geq$0.995 (R squared $\geq$0.990) for the ICC to be acceptable. The curve

may be determined linear if a minimum of 5 points are used, and quadratic if a minimum of 6 points are used.

10.0 Procedure

10.1. Set up the Hewlett Packard Gas Chromatograph as a single injection split into dual column/detector analysis for each instrument.

10.1.1. Split injection instruments shall have different columns as to maximize the ability to confirm Aroclors present in the extracts in the most efficient manner.

10.1.2. An acceptable ICC curve is run for Ar1660 and surrogates, and single point calibrations are then run for all remaining Aroclors. Both sides of a split injection instrument must be calibrated with the identical injections.

10.1.3. The Packard Gas Chromatograph will require priming prior to use if allowed to sit idle for more than 24 hours.

10.1.3.1. Priming consists of analyzing several recently injected standards and/or hexane blanks to allow the oven and other high temperature zones to equilibrate.

10.1.4. An ICV/CCV will consist of a concentration point at or near the midrange of the curve, (generally 0.5ng on column). The concentration point will be prepared through serial dilutions of a certified Aroclor standard.

10.1.4.1. The response factor of the ICV must be ±15% D for Aroclors 1016 & 1260. The ICVs and CCVs may >15% biased high to confirm non-detects. ICVs and CCVs that are biased >15% low will require a sample and system evaluation to determine if the effects are temporary or lasting.

10.1.4.2. In the temporary case, the instrument should be baked out and allowed to come to equilibrium to check compliance.

10.1.4.3. If the symptoms still persist, routine maintenance of liner, septa, syringe, rinse vial, guard column or other replacement may be required prior to checking compliance.

10.1.4.4. If the system still in non-compliant, check the instrument for stability by analyzing several test runs, prior to analyzing a new calibration curve. Detector Maintenance, changing the Column, or changing the detector settings will require recalibration of the system.

10.1.4.5. Sample analysis which continually produces reduced response upon re-analysis can be dealt with in several ways

10.1.4.5.1. The extracts should be check for possible further cleanup and/or dilution to minimize these effects.

10.1.4.5.2. The samples may be diluted for color, due to the presence of metallic or non-carbon compounds which do not respond to electron capture detector,

and have severely adverse effects upon the equipment.

10.1.4.5.3. The insertion of hexane blanks after some samples may allow the instrument to recover. This step should not be done as routine without historical or screening data to support it, otherwise all analysis within bracketing CCVs need to be analyzed in a similar manner.

10.1.4.6. Sample analysis which continually produces reduced response, historically/site based, or have known matrix effects which are unaffected by any cleanup methodology may lead to:

10.1.4.6.1. Dilutions due to these facts, not based upon matrix, positives, color, or any other visual data.

10.1.4.6.2. Review of Report Level requirements and submittal of data as analyzed, with comment that the data is to be considered bias low

10.1.4.6.3. Client notification, if unaware of these potential effects upon the data from this project or site. Decisions then going forward should always consider client feedback for future analysis and actions.

10.1.5. The retention time window determined as in 9.2.4.1.1 for each peak must be adjusted using the CCV on a daily basis to account for any shifts in the instrument's operating conditions.

10.1.5.1. The 1016/1260 mix contains all of the unique components (or congeners) of each individual Aroclor and if the CCV is acceptable for this, it can be understood that the CCV is acceptable for all Aroclors.

10.1.6. Continuing Calibration Verifications (CCVs) for Ar1016/1260 must bracket every 10 samples. Other Aroclors may be analyzed along with this CCV midpoint standard to confirm full pattern recognition when needed. These additional standards are not subject to quantifiable verification.

10.1.6.1. The total response factor for each Aroclor in the CCV must be less than or equal to ±15% D. (Individual peaks may be 15% > 25%, as long as the total Aroclor amount or average is </= 15%.) All data is acceptable as long as it is bracketed by an acceptable ICV and CCV, or CCV and CCV.

10.1.7. Each sample is injected into the gas chromatograph and its acceptable data is evaluated for Aroclor patterns and surrogate recovery. Spike recovery is also evaluated in spiked samples.

10.2. Sample Preparation

10.2.1. The most commonly used extraction procedures are SW-846 Methods 3510A (waters SOP # BF-OP-003) and 3550B (soils SOP # BF-OP-005).

10.2.2. Prior to sample analysis, the extracts should be screened on a GC with an ECD setup, to better judge any potential dilutions, cleanups, or high level contamination dangers. This one-time analysis will be based loosely upon the response seen from a midrange standard analyzed in the same manner.

10.3. Sample Analysis

10.3.1. MB: A laboratory method blank must be analyzed with every set of 20 samples at a minimum of 1 per batch. Acceptance criteria are less than the report limit. If the acceptance criteria are met, the QC sample indicates no contamination due to the preparation procedure and is considered acceptable. If analyte is measured above the reporting limit, reanalyze. If reanalysis is acceptable, continue. If reanalysis again indicates contamination the sample results are not useable for drinking water samples. Results for other sample matrices may be used if they are greater than 10 times the blank contamination. For USACE, the method blank must not contain compounds at levels > ½ the report level.

10.3.2. Blank contamination and recoveries outside this range may lead to: Re-extraction if within holding time and volume available, noting recoveries in case narrative, or flagging values as estimated. The spike results, sample matrix, and reported positives in the prep batch are also to be considered. The Project Manager will be notified with a job exception, and acceptability may be determined by citing historical, sample, and method results on a case by case basis.

10.3.3. LCS: (lab control sample) must be analyzed with every batch of 20 samples or a minimum of 1 per day. The routine matrix spiking solution is an Aroclor 1016/1260 mixture prepared at 5.0ng/ul. During preparation, 1000ul of this solution is added to all quality control samples (LCS/LCSD/MS/MSD). The resulting expected concentration for both aqueous and soil sample is 0.50ng/ul in the 10ml extract. This translates to final sample concentrations of: 5.0 ug/L for a 1-Liter Aqueous samples, and 166.7ug/Kg for 30.0grams of Soil sample at 100% dry. Statistical in-house acceptance limits are updated annually and are maintained in the laboratory LIMS system. If the required recovery limits are met, the QC sample indicates control of the preparation procedure and is considered acceptable. If the recovery limits are not met, reanalyze. If reanalysis yields acceptable recovery, continue. If the recovery limits are again not met the batch results are not useable unless the control sample recovery is high and the sample concentrations are below the reportable limit.

10.3.4. MS: A matrix spike sample must be set for one in every batch of 20 samples if sufficient sample volume exists. Statistical in-house acceptance limits are updated annually and are maintained in the laboratory LIMS system. If the acceptance criteria are met, no adverse matrix effects are indicated. If acceptance criteria are not met, continue and this result will be noted in the case narrative in reference to a compliant LCS.. To minimize bias, samples for matrix spike analysis shall be chosen at random. All

analytes in the spike solution shall be measured unless they are not of interest in the spiked sample.

10.3.5. MSD: Along with every matrix spike sample, a duplicate MS must also be set if volume exists. This sample is the matrix spike duplicate (MSD). Minimum acceptance criteria are <50% RPD. If the acceptance criteria are met, continue. If the acceptance criteria are not met, continue and this result will be noted in the case narrative in reference to a compliant LCS.

10.3.6. When QC results, unknown positives, or sample matrix present the analyst with questionable data, the spike results, sample matrix, and reported positives in the prep batch are all to be considered. Acceptability may be determined by citing historical, sample, and method results on a case by case basis. The project manager shall be notified of any method anomalies, and can then contact the client as to specific instructions on the usability of the data and any further actions

10.4. Example Analysis Queue

Instrument Counter	Number of Runs	ID	Comments
1-2	*2*	*Priming Runs*	*Weekly Startup*
3-12	*9*	*All Individual Aroclors*	*CCV(66), RT & Pattern Check*
13	*1*	*ICM3*	*Instrument Blank*
14-23	*10*	*Samples*	
24-25	*2*	*ICM66 & ICM3*	*CCV & Inst Blank – Every 10 Injections*
26-35	*10*	*Samples*	
36-37	*2*	*ICM66 & ICM3*	*CCV & Inst Blank – Every 10 Injections*
1-2	*2*	*Priming Runs*	*Daily Startup*
3-4	*2*	*ICM66 & ICM3*	*CCV & Inst Blank*
5-14	*10*	*Samples*	
15-16	*2*	*ICM66 & ICM3*	*CCV & Inst Blank – Every 10 Injections*
17-26	*10*	*Samples*	
27-28	*2*	*ICM66 & ICM3*	*CCV & Inst Blank – Every 10 Injections*

11.0 Calculations / Data Reduction

11.1. Include all formulas used to calculate/interpret data. Other documents may be referenced. The QA Manual may contain many of the more frequently used formulas. Include any guidance to be used when interpreting the data. You may include examples in the Attachment section.

11.2. *Examples:*

Accuracy

$$\text{CCV / CCV, LCS \% Recovery} = \frac{\text{observed concentration}}{\text{known concentration}} \times 100$$

$$\text{MS \% Recovery} = \frac{\text{(spiked sample) - (unspiked sample)}}{\text{spiked concentration}} \times 100$$

Precision (RPD)

$$\text{Matrix Duplicate (MD)} = \frac{|\text{orig. sample value - dup. sample value}|}{[(\text{orig. sample value + dup. sample value})/2]} \times 100$$

Concentration = mg/kg or L $= \frac{C \times V \times D}{W}$

Where:

C = sample concentration in extract (ppm)
V = Volume of extract (mL)
D = Dilution Factor
W = Weight/Volume of sample aliquot extracted (grams or mLs)

NOTE: All dry weight corrections are made in TALs before the final report is prepared.

Calculating the ng amount of Aroclor in each peak.

$$\frac{\text{Area of the peak (a)}}{\text{Calibration factor of peak (a)}} = \text{ng amount of peak (a)}$$

(or the ng amount from the curve equation If linear calibration)

Calculating the ng amount of Aroclor in the sample

$$\frac{\text{Peak(n)ng + peak(n+1)ng + peak(n+2)ng +}}{\text{Total Peaks}} = \text{ng amount of sample}$$

Converting ng amount to ug/Kg, ug/L and ug/wipe

$$\text{ug/Kg} = \frac{\text{(ng) x (final volume in ml) x (dilution factor)}}{1000} \times \frac{}{\text{(injection vol. in ul) x (sample wt.) x (\% Dry)}}$$

For Oils % dry = 100

$$\text{ug/L} = \frac{\text{(ng) x (final volume in ml) x (dilution factor)}}{\text{(injection volume in ul) x (sample volume in L)}}$$

$$\text{ug/wipe} = \frac{\text{(ng) x (final volume in ml) x (dilution factor)}}{\text{(injection vol. in ul) x (sample wt.) x (\% Dry)}}$$

For wipes, sample weight = 1, % Dry = 100

12.0 Method Performance

12.1.1. Method Detection Limit Study (MDL)

12.1.1.1. MDL studies are performed annually on a matrix and instrument type basis

12.1.1.2. The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL is determined according to the laboratory's MDL procedure in the QA Manual. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method requirements require a greater frequency.

12.1.1.3. MDL studies are to be preformed using Aroclor1016/1260 as the representative mixture for each applicable matrix, and then for the range of biphenyls found in all of the remaining reported Aroclors. The MDLs generated for Aroclor 1016 will be reflective for the ranges for Aroclors 1221, 1232, 1242, & 1248. The MDLs generated for Aroclor 1260 will be reflective for the ranges for Aroclors 1254, 1262, & 1268.

12.1.1.4. MDLVs (Verifications) will be analyzed for all Aroclors, for every matrix, on all Instruments, to verify the recovery and allowable reporting of the applied MDLs above to each representative Aroclor. These should be spiked at no greater than the RL equivalent concentration on-column, and should show a positive ng value on the analysis report for all Aroclors.

12.1.2. Demonstration of Capabilities

12.1.2.1. An initial demonstration of capability (IDOC) is performed for either aqueous or soil matrices per analyst and compared to the method criteria. The concentration used is either equal to a CCV or a LCS/LCS.

12.1.2.2. The analyst will run, analyze, and report 4 standards or spikes. Reporting the expected concentrations of each in a summary report. This is usually entered into a LIMs data system for reporting, and a final copy is submitted to the QA department for record keeping

12.1.2.3. A continuing demonstration of capability (DOC) will be performed on an annual basis for each analyst, for each operational method they run and analyze.

12.1.3. Training Requirements

12.1.3.1. The QA Manual or a Training SOP may be referenced for training requirements. If applicable, state required concentration of samples prepared for Precision and Accuracy study or alternate training procedure.

13.0 Pollution Control

13.1. It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability)

13.2. Waste streams produced by this method
13.2.1. Acidic waste generated in the lab.
13.2.2. Solvent waste generated by the extraction
13.2.3. Expired primary and working PCB standards
13.2.4. Vials containing sample extracts
13.2.5. Solid Wastes

14.0 Waste Management

14.1. If the published method does not include this section, a statement similar to the following may be inserted:

14.2. All waste will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.3. All solvent waste generated by the extraction is to be disposed of in a labeled "C" waste container.

14.4. All acidified aqueous waste is to be disposed of into a labeled "A" waste container

14.5. All Solid Wastes are to be disposed of in to the labeled "BE" waste containers.

15.0 References/Cross- References

15.1. Method 8082 U.S. Environmental Protection Agency, Office of Solid Waste and Energy Response, "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," 3rd edition, SW-486, update III, Dec. 1996.

16.0 Method Modifications: N/A

17.0 Attachments

Attachment A: Job Summary Sheet and Data Review Checklist

18.0 Revision History

- Revision 0, dated March 31, 2008
  - Integration for TestAmerica and STL operations.

- Revision 1, dated March 18, 2010
  - Replaced WO summary example with current document.
  - Removed all LIMs references from Aims to Element.

- Revision 2, dated March 29, 2012
  - Changed QA Manager, signature added.
  - Updated all LIMs references from Element to TALs.
  - Replaced all MSB references with LCS.
  - Section 9.2.4.2 updated calibration model to reflect Average Cal Factor needed to use single point ICALs for Aroclors.
  - Clarified ICV and CCV references pertaining to TALs.

- Revision 3, dated March 31, 2014
  - Updated QA Manager
  - Revised section 1.1 to include 1ppm Waste extraction.
  - Updated Method and SOP references in sections 2.1 & 4.3

Attachment A: Job Summary Sheet and Data Review Checklist

BF-GE-DRC-002
GE/GV Review Checklist
Rev. 2 2/13/2014

Method		Samples	Water Soil Wipe Waste	Job #

Prep Batch	WorkList	TALS Batch	Cleanups	
			Cu++	Y / N
			Silica	Y / N
			Filter	Y / N
			Florisil	Y / N

Chrom			1st TALS	2nd TALS
Instrument No.		Instrument No.		
Reporting channel A / B / Both		Reporting channel A / B / Both		
Open CCV All in High Other		Open CCV All in High Other		
Middle CCV All in High Other		Middle CCV All in High Other		
Closing CCV All in High Other		Closing CCV All in High Other		
Pesticide Degredation <20% Y / N				
Blanks clean? Y / <RL / <MDL / >RL				
Recoveries in limits LCS/ LCSD? (Chrom LCS Reports) Y / N				
Surrogates in for QC? Y / N				
Recoveries in limits MS/MSD? (Chrom MS/MSD Report)				
Surrogates in for MS/MSD Y / N RPD in Limits? Y / N				
Surrogate in for Samples? Y / N				
List Failures:		List Diluted Out:		
Integrations checked? Y / N				
Manual Integrations Y / N	Sample no.(s);			
Postives Y / N	Confirmations Y / NA			
Repreps Needed? Y / N	Samples Rejected? Y / N			
Dilution Calculations Checked Y / N				
GC Elution Order Anomalies Checked (below) Y / N				
NCMs Needed? Y / N	CCV			
	Surrogate			
	Spike			
	DL			
	Other			
General Comments:				

NCMs Checked? Y / N **Modified Y / N** **Initials** _____ **Date** _____

GC Elution Order Anomalies

8081/608Pest ***RTX-CLPI Column***
4,4'-DDE & Endosulfan I
Methoxychlor & Endosulfan Sulfate
RTX-CLPII Column they are switched

8151 ***RTX-CLPI Column***
Picloram & Dinoseb
RTX-CLPII Column they are switched

MAEPH ***ZB-5 MS Column***
Benzo(b)flouranthene & Benzo(k)flouranthene
Manufacturer has them switched in their reference data

RSK-175 ***RT-Alumina Column***
Ethane & Ethene
RT-UPlotBond Column they are switched

Title: Determination of VOCs in Ambient Air EPA Compendium Methods TO14 and TO15

Approval Signatures:

Kirstin L. Daigle
Laboratory Director

Brad W. Chirgwin
Technical Manager

Ryan J. Hammond
Department Manager

Sara S. Goff
Quality Assurance Manager

Daniel W. Helfrich
Health & Safety Coordinator

Approval Date: October 6, 2014

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1.0 Scope and Application

This SOP describes the laboratory procedure for the analysis of polar and non-polar volatile organic compounds (VOCs) in ambient and non-ambient air. The procedure is applicable to those VOCs that have been evaluated by the laboratory for their consistent performance in meeting the control criteria put forth in Compendium Method TO-15. While the compendium method is specifically written for the analysis of ambient air samples collected in leak-free passivated stainless steel canisters, it may be applied to the analysis of samples that have employed the use of other collection devices such as Tedlar bags and solid absorbents, and are from sources other than ambient air such as soil gas, landfill gas, gas cleaning apparatuses and stack emissions.

1.1 Analytes, Matrix(s), and Reporting Limits

The target compound list and reporting limits for each compound are provided in Table 1.

2.0 Summary of Method

An aliquot of sample is pulled from the canister through a solid multi sorbent bed trap which reduces the water content of the sample. The sample is thermally desorbed and the VOCs are carried onto a GC column coupled to a mass spectrometer. Compounds are identified by comparison of the mass spectra for individual peaks in the total ion chromatogram to the fragmentation patterns of ions corresponding to VOCs including the intensity of primary and secondary ions as well as the patterns of stored spectra acquired under similar conditions. The concentration of the target compound is calculated by internal standard technique using the average response factor of that compound as determined by the initial calibration.

This procedure is based on EPA Compendium Method TO-15 "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry", US EPA, January, 1999.

If the laboratory has modified the method, a list of these modifications may be found in Section 16.0.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Contamination may occur if canisters or other equipment is not properly cleaned before use. The laboratory procedures for canister and flow controller cleaning procedures are provided in Appendices C and D.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety

problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The analytical system contains zones with elevated or depressed temperatures that are capable of causing injury upon direct contact. The analyst needs to be aware of the locations of those zones, and allow them to return to room temperature prior to maintenance activities or take measures to avoid contact with hot and/or cold surfaces. There are areas of high voltage in the analytical system. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

Liquid nitrogen (LN2) is used for cryogenic purposes. In addition to avoiding contact with LN2 cooled surfaces, analysts must be aware of the potential for oxygen depletion in a confined space in the event of an unexpected large release of the product. Users should evacuate a confined space in which large amounts of LN2 have been released.

Sample canisters are occasionally pressurized for cleaning or sample dilution purposes. Lab systems are designed to ensure that the cans are not pressurized above 40 psi. Eye protection must be worn when cans are pressurized in the event of a canister failure.

5.2 Primary Materials Used

There are no materials used in this method which have a serious or significant hazard rating **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment meets the specification of this SOP.

6.1 Sampling Equipment

- 6L, 3L, and 1L SUMMA® Canisters: Leak-Free, Passivated Stainless Steel, with Swagelok DSS4 Valves, or equivalent.
- 6L SUMMA® Canisters: Silicon lined-Leak-Free, Passivated Stainless Steel, with Swagelok DSS4 valves or equivalent.
- Flow Controllers: Restek Catalog #24239 or equivalent.
- Flow Controller Orifice: Various sizes ranging from 0.008” to 0.060”, Restek or equivalent.

- Flow Controller Vacuum Gauges: Capable of measuring vacuum to an absolute vacuum of -30" of HG, and pressure up to 30 psi, Grainger Catalog #5WZ37 or equivalent.

- Rain Guard: Stainless Steel Tubing ¼", 10ft. Grainger or Equivalent. Cut 8" and bend into a J shape using a pipe bender.

- Stainless Steel Pre-Filter (7 um): Swagelok Catalog# SS-4F-T7-7 or equivalent.

- Teflon Tape: Home Depot Brand or equivalent.

6.2 Analytical System

- Mass Spectrometer: Agilent 5973 or 5972 MSD or equivalent.
- Gas Chromatograph: Agilent 6890 or equivalent.
- VOC Autosampler: Entech 7016CA or equivalent.
- Cryogenic Concentrator: Equipped with an electronic mass flow controller that maintains a constant flow for carrier gas and sample over a range of 0-200 cc/min. Entech 7100A or equivalent.
- Low Pressure Liquid Nitrogen: Air Gas or equivalent.
- Glass Bead Cryotrap: Capable of effectively removing water while trapping polar and non-polar compounds. Entech catalog# 01-04-11320.
- TENAX Sorbent Trap: Capable of removing CO2 and trapping the polar and non-polar compounds. Entech catalog # 01-04-11330.Primary Column: Fused silica capillary column (60 m x 0.32 mm x 1.8 μm), Restek RTX-624 or equivalent.
- Data System: PC software for Entech instrumentation. Hewlett-Packard ChemStation data acquisition software and Hewlett-Packard ChemServer, Target 3.5 data processing software or TestAmerica Chrom and TestAmerica LIMS (TALS).

6.3 Cleaning System

- Canister Cleaner Module and Software: Capable of filling canisters with humidified air and evacuating canisters to 50 mtorr, Entech Model 3100A or equivalent.

- Vacuum Pump: Capable of evacuating sample canisters to full vacuum. Vacuubrand or equivalent.

- Cleaning Manifold: Equipped with stainless steel and Teflon transfer lines and connections for cleaning up to twelve canisters simultaneously.

- Heating Belts: Individual thermal-stated heating belts used to heat canisters to 100ºC during the manifolds cleaning cycles. Entech or equivalent.

- Cleaning oven: Capable of cleaning 6 Summa Cans simultaneously at a temperature of 100ºC. Entech or equivalent.

- Flow Controller Cleaning Manifold: Capable of flushing hot Nitrogen through 24 flow controllers simultaneously for cleaning.

6.4 Miscellaneous Supplies

- Mass Flow Controller, NIST Traceable: Capable of flow rate of 70 mL/min, McMillan Company 80SD or equivalent. Use for the preparation of calibration and working standards.

- Syringes: Gas tight with a Luer-Lok tip, assorted sizes ranging from 1.0 mL to 1.0 L, SGE or equivalent.

- Digital Pressure Gauges, NIST Traceable: Capable of measuring pressure in the range of -30" Hg to 100 psi, Dwyer Models DPGA-12 and 67100 or equivalent.

- Digital Flow Meter, NIST Traceable: Alltech or equivalent.

- Nitrogen Gas

7.0 Reagents and Standards

7.1 Reagents

- Ultra Pure Zero Air – AirGas or equivalent Insert Manufacturer information

7.2 Standards

Purchase the following stock standard mixtures from commercial vendors:

- Mixed Gas Stock Standard: - Commercially prepared standard that includes internal standard and tune standard compounds: Bromofluorobenzene, Bromochloromethane, 1,4-Difluorobenzene, and Chlorobenzene-d5, and at a concentration of 100 ppbv each. Spectra Gas or equivalent.

- Calibration Stock Standard: - Commercially prepared custom gaseous stock standard used by all network facilities that includes all target analytes at a concentration of 1.0 ppmv. Spectra Gases or equivalent.

- Calibration Ethanol Neat Material. >99.5 %

- ICV / LCS Stock Standard: - Custom made gaseous stock standard prepared from a different lot(s) of the source material(s) used to manufacture the calibration stock standard. The ICV/LCS stock standard includes all target analytes at a concentration of 1.0 ppmv. Spectra Gases.

- ICV/LCS Ethanol Neat material. >99.5% from a source other than the calibration source.

Prepare calibration and working standards mixtures by diluting a known volume of the stock standard with ultra pure zero air to a specified volume into a humidified summa canister. The summa canister is humidified by adding 100ul of VOA free reagent water. The volume of the standard added to the canister is calculated using the set flow rate of 70mL/min using a mass flow meter multiplied by the time of the standard addition, plus the inclusion of the 25ml volume

for the tubing connecting the mass flow meter to the summa canister. The formulations for standard preparation are provided in Appendix B along with recommended expiration dates and storage conditions.

Each stock standard is assigned a 1 year expiration date from manufacture and recertified annually. The ethanol neat material is assigned the expiration date given by the manufacturer.

The recertification procedure is as follows:

Internal Standard Mixed Gas Stock: Assay the active internal standard cylinders against a new, vendor certified cylinder purchased from Spectra Gas. Verify that the % difference between new, vendor certified cylinder and the active cylinder is within 20%. If this criterion is not met, replace the cylinder.

Calibration Stock Standard and the ICV/LCS Stock Standard: Return one of the cylinders to Spectra for recertification (rotate a different cylinder each year). When the re-certified stock standard cylinder is returned, assay against all active cylinders. The difference between the recertified value and the assay values should be within 15%. If these criteria are not met, return the cylinder that was not re-certified to the vendor for recertification or purchase a new stock standard.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Air	1L ,3L or 6L Passivated Summa Canister	1L	NA	30 days from collection	EPA TO-15

All samples should be collected in passivated stainless steel canisters that have been certified clean prior to sampling. The laboratory will provide certified clean canisters to the client upon request. The procedures for clean canister certification are provided in Laboratory SOP BR-AT-011.

The laboratory can also provide flow controllers set to the appropriate flow rate for the sampling time required by the client.

The laboratory ships air canisters in custom made boxes. The boxes are equipped with custom-made foam inserts to hold the pre-set flow-controllers. The custom shipping materials are designed to prevent damage of equipment to and from the sampling site. The laboratory checks the equipment to ensure it is in proper working order before shipment to the client and additional checks are performed on return of the equipment to the laboratory. Sampling instructions are provided with each sampling kit. The sampling crew is advised to handle the sampling equipment using the instructions provided by the laboratory to ensure optimum performance.

Samples should be stored at ambient temperature.
The analytical holding time is 30 days from the date of sample collection.

9.0 Quality Control

9.1 Sample QC

The following quality control samples are prepared with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3
Internal Standard (ISTD)	Every Sample	See Table 3
Laboratory Control Sample Duplicate (LCSD)	Client request	See Table 3
Sample Duplicate (SD)	Client Request Required for DoD 1 in 20 or fewer samples	See Table 3
Trip Blank (TB)	Client Request	See Table 3

NOTE: The compendium reference method does not require the analysis of a laboratory control sample (LCS) or provide criteria for the evaluation of an LCS. The laboratory performs an LCS at the above mentioned frequency as an evaluation of percent recovery in a blank matrix. The control limits set by the laboratory for the LCS (70-130) are those specified in Section 11.4 of the reference method for the audit accuracy evaluation.

The compendium method does not require analysis of a LCSD. Evaluations for precision should be derived from field samples. Duplicate precision should be measured by the analysis of a sample duplicate. Replicate precision should be measured from separate aliquots taken from the same sample canister. The laboratory will perform an LCSD to measure precision only per client request and analysis of the LCSD is considered a billable item. The acceptance criteria for duplicate and replicate precision is <25%. Unless otherwise specified by the client during project initiation, the LCSD will be used to measure precision only. The LCS will be used for evaluations for percent recovery and to determine if corrective action is necessary.

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Tune Standard (BFB)	Each Analytical Window	See Section 10.0
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Section 10.0
Initial Calibration Verification (ICV)	Once, after each ICAL	See Section 10.0
RT Window Establishment	Once per ICAL	See Section 10.0
Relative Retention Time (RRT)	With each sample	See Section 10.0
Continuing Calibration Verification (CCV)	Daily, after each BFB	See Section 10.0

10.0 Procedure

10.1 Support Equipment Calibration

Verify the calibration of the mass flow controller used to prepare standards, the calibration of the digital flow meter used to set and check the flow rates of the FC(s) used for sample collection, and the calibration of the digital pressure gauges used to check return canister pressure is current to the year. Immediately notify the QA department if the calibration is not current and wait for further instruction. Equipment whose calibration has expired may not be used without documented approval from the QA department.

NOTE: The QA department schedules the annual calibrations of the support equipment and maintains all Certificates of Calibration. The flow controllers are checked against a NIST traceable standard. This check is performed by the manufacturer of the equipment, when possible, or by an approved vendor that provides certification service.

10.2 Instrument Calibration

10.2.1 Tune Standard

Analyze a tune standard (BFB) prior at the beginning of each analytical window. The tune standard is a commercially prepared mixed gas stock standard that includes bromofluorobenzene (BFB) at a concentration of 100 ppbv.

To analyze the tune standard:

1) Establish the instrument operating conditions specified in Section 10.4.1.

2) Attach the mixed gas stock standard to the Entech concentrator by attaching the cylinder to the line dedicated for introduction of the internal standard (ISTD). The concentrator directly injects 20 mL of the 100 ppbv stock standard onto the instrument to yield an on column concentration of 10 ppbv.

3) Acquire the data and evaluate the results against the acceptance criteria given in Table 2. Criteria must be met prior to further analysis. The official start time of the 24 hour analytical window is the injection time of a passing tune standard. All samples must be injected within 24 hours of that time.

NOTE: The data processing system averages three scans (apex scan, scan prior, and scan following) and performs background subtraction of the single scan prior to the elution of BFB.

10.2.2 Initial Calibration (ICAL)

The instrument must be calibrated with a minimum of five calibration standards for each target analyte at concentrations that span the working range of the method.

The laboratory routinely analyzes 8 standards at the recommended concentrations of 0.04, 0.20, 0.50, 5.0, 10.0, 15.0, 20 and 40 ppbv, except for Ethanol. For Ethanol, a 6 point curve is analyzed at the following concentrations: 5, 10, 15, 20, 40, and 100 ppbv. Even though seven calibration standards are routinely analyzed not every calibration standard is used for each

analyte. Each analyte has been assigned to an analyte group that includes a calibration range of at least five standards. The analyte group associations for each target analyte are provided in Table 1. The calibration range for each analyte group is as follows:

- Group A: This analyte group is associated with a seven point calibration curve. The calibration range is 0.20 to 40 ppbv with the 0.04 ppbv standard routinely excluded. The limit of quantitation (LOQ) for this group of analytes is 0.20 ppbv

- Group B: This analyte group is associated with a six point calibration curve. The calibration range is 0.50 to 40 ppbv with the 0.04 and 0.20ppbv standards routinely excluded. The limit of quantitation (LOQ) for this group of analytes is 0.50 ppbv.

- Group C: This analyte group is associated with a five point calibration curve. The calibration range is 5.0 to 40 ppbv with the 0.20, 0.50, and 0.04 ppbv standards routinely excluded. The limit of quantitation (LOQ) for this group of analytes is 5.0 ppbv.

- Group D: This analyte group is an eight point calibration curve. The calibration range is 0.04 to 40 ppbv. The limit of quantitation (LOQ) for this group of analytes is 0.04 ppbv.

- Group E: (Ethanol : This analyte has a six point calibration curve. The calibration range is 5 to 100 ppbv. The limit of quantitation (LOQ) for this analyte is 5 ppbv.

Prepare the calibration standards using the formulations provided in Appendix B.

Analyze the standards in a sequence from lowest to highest concentration using the instructions provided in Section 10.4.2.

The data processing system calculates a relative response factor (RRF), for each analyte and isomer pair using the assigned internal standard. The internal standard associations for each target analyte are provided in Table 1. The data processing system also calculates a mean relative response factor, relative standard deviation (RSD), relative retention time (RRT) and the mean RRT.

The following criteria must be met for a calibration to be considered acceptable:

- The RSD for each target analyte must be <30% with at most 2 exceptions up to a limit of 40%**.**

- The area response for the primary quantitation ion for the internal standard for each ICAL standard must be within 40% of the mean area response over the calibration range for each internal standard.

- The RRT for each target compound at each calibration level must be within 0.06 RRT units of the mean RRT for the compound. The retention time shift for each of the internal standards at each calibration level must be within 20 seconds of the mean retention time over the initial calibration range for each internal standard.

If these criteria are not met inspect the system for problems and perform corrective action. Recommended corrective actions are provided in Section 10.2.5 and in Table 3.

Repeat initial calibration whenever instrument operating conditions are changed, a new column is installed, when significant instrument maintenance has been performed, and when the result of the CCV indicate the calibration is no longer valid.

10.2.3 Second Source Calibration Verification (ICV)

Immediately following an acceptable initial calibration verify the accuracy of the calibration by the analysis of the second source calibration verification standard (ICV).

Prepare the ICV following the formulation provided in Appendix B.

Analyze the ICV following the instructions provided in Section 10.4.2.

The percent recovery (%R) for each target analyte must be within 70-130%. If criteria are not met, perform corrective action. Recommended corrective actions are provided in Table 3. If corrective action is not successful, remake your standards and recalibrate.

If after successful analysis of the ICV, time remains in the 24-hour analytical window, QC and field samples may be analyzed without analysis of a continuing calibration verification check standard. If time does not remain in the analytical window, a new analytical sequence must be initiated with a Tune Standard followed by daily calibration (CCV).

10.2.4 Continuing Calibration Verification (CCV)

Analyze the CCV immediately after the tune standard unless the analytical window includes ICAL, in which case, a CCV is not required.

Prepare the CCV standard using the formulation given in Appendix B. The recommended concentration of the CCV for each target analyte is 10.0 ppbv.

Analyze the CCV following the instructions provided in Section 10.4.2. The data system calculates a response factor for each analyte and calculates the percent difference (%D) of the RRF relative to the mean RRF in the most recent initial calibration.

- The %D for each target analyte must be within ±30%. If the above criteria are not met, repeat the analysis of the CCV once. If the second CCV meets criteria, continue with the analytical sequence. If it fails, evaluate the data to determine if one of the following conditions is met. If these conditions are not met corrective action must be taken. Guidance for troubleshooting is provided in Section 10.2.5. After corrective action the analytical sequence may be continued only if two immediate, consecutive CCVs at different concentrations are within acceptance criteria. If these two CCVs do not meet the criteria, recalibration is required prior to further analysis.

  - If the CCV criteria are exceeded high, indicating a high bias, and the associated samples have non-detects for those analytes, the analytical data may be considered usable. In the absence of instructions otherwise, proceed with analysis.

  - If the CCV criteria are exceeded low, indicating a low bias, analytical results may be reported if those results exceed the project's regulatory decision level. In other words, if

the analytical results are sufficiently high to counter the low bias, results may be reported. Consult with the project manager to determine if the exception is allowable for each project.

10.2.5 Troubleshooting

Check the following items in case of calibration failures:

- Loss of sensitivity or unstable ISTD recoveries are usually the result of a leak. Check the union between the GC column and Entech transfer line.

- Loss of sensitivity for individual compounds may be a result of either an active site in a transfer line or a bad trap. Troubleshoot and perform maintenance as necessary.

- Poor chromatography usually requires GC column maintenance, perform as necessary.

- Carryover is usually caused by excessive amounts of analyte introduced to the system. Analyze blanks until the system is cleaned or replace the traps and transfer lines if necessary.

Refer to corporate policy CA-Q-S-005 for additional information of procedures to establish and troubleshoot initial calibration curves.

10.3 Sample Preparation

10.3.1 Post Sampling Canister Pressure Check Procedure

Perform the post-sampling canister pressure check within 1 business day of receipt of canisters in the laboratory so that any problems found are quickly identified and communicated to the client. Record the date and time the post-receipt check is performed is in the analytical record.

To perform the post- sampling canister pressure check:

1) Inspect the condition of equipment for signs of damage. If damage is observed, immediately notify the PM and await further instruction.

2) Record your checks on the Air Canister Post-Sampling Pressure Check Record.

3) Check to see if the sampling flow controller(s) (“FC”) were returned with the canister(s). If so, check the paperwork (Canister ID Tag, Field Test Data Sheet or Chain of Custody (COC) to determine if the sampling record identifies which FC was used for each canister. If the paperwork does not include this information, record the omission on the post-sampling check record.

   NOTE: The laboratory’s sample acceptance policy for air samples in canisters requires that the sampling crew record the ID of the FC used for sample collection on the tag attached to each canister, but the association may also be recorded on the Field Test Data Sheet or a COC. With this information the laboratory can review the history of use of the FC as needed to troubleshoot potential equipment problems. Without the association, the history of use of

the FC is unknown. The laboratory strongly recommends that field samplers be instructed to provide this information for each sampling event.

4) Check the pressure of each canister using a digital pressure gauge. Verify that the calibration of the gauge has not expired prior to use. If the calibration sticker indicates calibration checks are past due, notify department management and remove the gauge from service.

   Attach the gauge to the canister inlet. Check for the presence of burr or thread damage when attaching the pressure gauge to the canister inlet. If damage is observed, record the observation on the post-sampling check record

   Open the canister valve and record the pressure reading.

   The pressure should be between -10" Hg to -1"Hg, except for "grab" samples and samples whose sampling time is >100 mL/min, which do not have a return pressure criteria range.

   NOTE: The return canister pressure criteria of -10"Hg to -1"Hg was established based on the recommendations provided in Section V of Appendix I of the Vapor Intrusion Guidance Document prepared by the New Jersey Department of Environmental Protection (NJDEP). These sections of this document describe canister and quality assurance requirements for USEPA Methods TO-15 and TO-17. This document explains that due to recent advances in technology in concentrator units, such as with the Entech concentrators used by the laboratory, it is now possible to remove sample from canisters with a negative pressure of -10"Hg without having to add makeup air. Previous models of concentrators (such as NuTechs) required a pressure of at least -5"Hg. When the return negative pressure of a canister is greater than -10"Hg, the laboratory may need to add makeup air to the canister in order to provide a sufficient amount of sample for analysis. The need for the addition of makeup air depends on the concentrator unit. Some concentrator units used by the laboratory can pull sample without the addition of make-up air when the return negative pressure is up to -15"Hg. The amount of air added to the canister depends on the return pressure reading and will vary with each canister. See section 10.3 for the procedure of the determination of amount of makeup air needed. Except for "grab" samples and samples whose sampling time is set for <200 mL/min, the return pressure of a canister should never be zero negative pressure or a pressure equal to ambient pressure. If it is, the PM must consult with the client and obtain authorization for the laboratory to proceed with analysis.

5) If the return pressure is within range for all samples, photocopy the post-sampling canister pressure check record and attach the record to the screen worksheet.

   If the return pressure is not within range, initiate an anomaly report and perform one of the following actions:

   - Action 1: If the FC was not returned with the canister, attach a copy of the post-sampling pressure check record to the anomaly report and forward the paperwork to the PM who will notify the client of the situation and request further instruction. The PM will record any decisions made regarding the sample on the anomaly report and return the packet to you. Attach a photocopy of the complete anomaly report to the screen worksheet and forward the original anomaly report to the QA department.

- Action 2: If the FC was with the canister, perform a leak check on the FC gauge and re-check the FC's flow rate as follows. Record all measurements on the original Flow Controller Set Flow Rate & Leak Check Record. The protective sticker on the back of the FC will provide the page number that corresponds to the logbook record.

To check the flow rate and check the FC gauge for leaks:

1) Remove the stem from the FC.

2) Attach a dust cap where the stem was, and attach the FC to the control gauge/vacuum manifold.

3) Turn the calibrated digital flow meter on and zero the meter.

4) Turn on the vacuum pump and read the vacuum of the control gauge and the FC gauge and record these readings.

5) Turn off the vacuum. Wait ~30 seconds and read the vacuum of the control gauge and the FC gauge and record these readings.

6) The difference between the initial and final readings for the control gauge should be zero. If it is not, there is a leak in the manifold system. Stop work and correct the problem.

7) The difference between the initial and final readings for the FC gauge should be zero. If it is not, there is a leak in the FC assembly. Record the presence of a leak in the record and set aside the FC for service and repair.

8) Remove the dust cap from the FC and re-attach the stem.

9) Attach the flow meter tube to the stem of the FC.

10) Measure the flow rate. The flow rate should be within the ranges specified in the Set Flow Rate Table (See Table 4) for the sampling time requested. If the flow rate is not within range, record the situation on the anomaly report.

11) Attach a photocopy of the Flow Controller Set Flow Rate & Leak Check Record and a photocopy of the post sampling check record to the anomaly report and forward the paperwork to the PM who will notify the client of the situation and request further instruction. The PM will record any decisions made regarding the sample on the anomaly report and return the packet to you. Attach a photocopy of the complete anomaly report to the screen worksheets and forward the original anomaly report to the QA department.

10.3.2 Sample Screening

At the laboratory's discretion unknown samples may be screened prior to initial analysis to determine if the sample requires dilution. Unless otherwise requested by the client the

laboratory does not provide screen data with the data package report even when primary dilutions are performed based on the results of the screen analysis.

To prepare a sample for screen analysis connect the sample canister to the autosampler connected to screening instrument and analyze 20 mL of sample. Acquire and evaluate the results. If the results of screen analysis indicate that a target compound is above its upper range of calibration. Calculate a recommended dilution factor (DF) by dividing the concentration of analyte found by 30. Record the recommended DF on the screen worksheet.

NOTE: Samples are screened on a GC/MS instrument that is programmed with the operating conditions given in Section 10.4.1 of this SOP. The calibration is checked weekly with a single point calibration standard at a concentration of 10 ppbv for all target analytes. The calibration is checked more frequently when the results of instrument analysis do not correlate well with the results of the screen analysis.

10.3.3 Sample Dilutions & Pressure Adjustment

Field samples should be diluted prior to initial analysis when the screen results indicate that the concentrations are above calibration range and when the laboratory has sufficient knowledge of the sample (history) to know that the sample will require dilution. Field samples must be reanalyzed at a dilution initial analysis when the concentration of target compounds in initial analysis exceed of the upper range of calibration.

When the return negative pressure of a canister is greater than -15”Hg, make-up air is added to provide sufficient volume of make-up air in order to have an adequate sample volume for analysis. The addition of make-up air is considered a canister dilution.

To dilute the sample:

1) Attach the sample canister to the zero air line equipped with a pressure gauge that reads negative pressure in (“Hg) and positive pressure in (psig).

2) Ensure the valve of the zero air line is closed then open the valve of the sample canister. Record the negative pressure reading in the Canister Dilution Worksheet or on the canister’s tag.

3) Slowly open the valve of the zero air line and fill the canister until canister pressure gauge reads -10”Hg. Do not open the valve to such an extent that the zero air line pressure drops below 15 psig and do not allow the zero air line to reach equilibrium otherwise you will contaminate the zero air line.

4) When the desired pressure is achieved, close the canister valve and the valve on the zero air line; wait 15 seconds.

5) Open the canister valve and record the final pressure reading in psig.

6) Close the canister valve and remove the valve from the zero air line.

7) Record the initial and final pressure readings in the TALS canister dilution tracking module. If the final pressure is below ambient, the "HG reading must be converted to psig by dividing the value by 2 prior to entry into the TALS worksheet.

When the return pressure of a canister is positive, the pressure must be adjusted to near ambient (0"Hg) prior to analysis. To adjust the pressure to ambient, vent the canister to ambient in a fume hood by opening the canister value for ~4-5 seconds, close the valve. For higher pressure canisters, open the valve and listen for a release of air then close the valve when the sound recedes.

If a trip blank is provided, pressurize the trip blank canister to 10 psig. The pressurization of the trip blank is not considered a dilution.

10.3.4 QC Sample Preparation

To prepare the method blank (MB): Fill a clean canister that has never been used to collect environmental samples and has never left the laboratory to 20 psig with zero air. Continue to use this canister as the MB until the pressure of the canister reaches 0 psig, at which time, recharge with zero air to 20 psig and reuse.

To prepare the LCS: Follow the instructions provided in Appendix B for preparation of the working ICV/LCS standard. If an LCSD and replicate precision is requested, the aliquot for the LCSD must be taken from the LCS canister. If an LCSD and duplicate precision is requested, prepare another LCS in a separate canister to serve as the LCSD.

10.4 Sample Analysis

10.4.1 Instrument Operating Conditions

Optimize the GC and MS conditions for compound separation and sensitivity.

The recommended operating conditions are as follows:

Thermal Desorb:	Initial Trap #1 Temperature: -110ºC Desorb Temperature from Trap #1 to #2: 0 ºC Total Volume Transfer by Mass Flow Controller: 40 mL Initial Trap #2 Temperature: -15 ºC Desorb Temperature from Trap #2 to #3: 200ºC Transfer time 3.5 minutes Initial Trap #3 Temperature: -165 ºC Injection Trap #3 Temperature: 70ºC Injection Time: 1.5 minutes Trap #3 Temperature after Injection: -165 ºC
Carrier Gas:	Helium, Ultra High Purity
Cryogenic Focusing Gas:	Liquid Nitrogen
Flow Rate:	~1.5 mL/min
Temperature Program:	Initial Temperature: 40ºC Initial Hold Time: 4 minutes Ramp1 Rate: 20ºC/min. to 200ºC.

	Ramp 2 Rate: 40ºC/min. to 220ºC
	Final Temperature: 220ºC
	Final Hold Time: 6.5 minutes
Electron Energy:	70 electron volts
Mass Range:	35-265 amu
Scan Time:	≥1 scan per second

These operating conditions may be changed but once the operating conditions are established for initial calibration the same conditions must be used until a new calibration is performed.

10.4.2 Daily Instrument Maintenance

Prior to analysis initiate the flushing sequence using the Entech software. Then initiate the bake program using the Entech software.

10.4.3 Bi-Weekly Instrument Maintenance

At a minimum frequency of once every two weeks, perform an autosampler leak check. Cap all autosampler ports and initiate the leak check program using the Entech software.

10.4.4 Analytical Sequence

An example analytical sequence that includes initial calibration (ICAL) is provided below. When ICAL is not performed, the sequence begins with the tune standard and is followed by the CCV, LCS, LCSD, and method blank. If sufficient time remains in the 24 hours analytical window after initial calibration, QC and field samples may be analyzed without the CCV and the ICV will serve as the LCS for the sequence. The MB, LCS and LSCD must be analyzed at a frequency of every 20 samples or with each analytical sequence whichever is more frequent.

1. Tune Standard (BFB)
2. ICAL
3. ICV
4. CCV
5. LCS (repeat every 20 samples)
6. LCSD (when requested)
7. MB (repeat every 20 samples)
8. Field Samples (including trip blanks)

Attach the canisters to the autosampler inlet in the order of the analytical sequence then initiate the analytical sequence. The autosampler introduces 200 mL of sample volume from each canister to the instrument system and adds 20 mL of the mixed gas standard to each sample.

Acquire the data and evaluate the results to confirm qualitative identification and quantification.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data processing system tentatively identifies target analytes by comparing the retention time of the peaks to the window set around the continuing calibration standard, and searches in that area for the primary ion and up to two secondary ions characteristic of the target analyte.

All tentative identifications made by the computer are reviewed and either accepted or rejected by the primary analyst. The identification made by the system is accepted when the following criteria are met:

- The target analyte is identified by comparison of its background subtracted mass spectrum to a reference spectrum in the user-created database. In general, all ions that are present above 10% relative abundance in the mass spectrum of the standard should be present in the mass spectrum of the sample component and their relative abundances should agree within 20%. For example, if an ion has a relative abundance of 30% in the standard spectrum, its abundance in the sample spectrum should be in the range of 10-50%. Some ions, particularly the molecular ion, are of special importance if a tentative identification is to be made, and should be evaluated even if they are below 10% relative abundance.

- The GC retention time for the target analyte should be within 0.06 RRT units of the daily standard.

Identification requires expert judgment when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When GC peaks obviously represent more than one sample component (i.e., broadened peak with shoulder(s) or valley between two or more maxima), appropriate analyte spectra and background spectra can be selected by examining plots of characteristic ions for tentatively identified components. When analytes coelute (i.e., only one GC peak is apparent), the identification criteria can be met but each analyte spectrum will contain extraneous ions contributed by the coeluting compound. If the data system does not properly integrate a peak, perform manual integration. All manual integration must be performed and documented in accordance with laboratory SOP BR-QA-006 *Manual Integration*.

11.2 Quantification of Target Analytes

After a compound has been identified, the data system quantifies the on-column concentration of the target compound based on the integrated abundance of the characteristic ion from the EICP. If there is matrix interference with the primary ion, a secondary ion may be used for quantification by calculating a mean RF factor for that ion and using that ion to quantify the analyte in the sample. When secondary ion calculations are required, include this information in the non-conformance report and project narrative.

Final results are calculated in TALS.

11.3 Calculations

Analytical results are calculated as follows:

- **Dilution Factor**

$$DF = \frac{V_2}{V_1} x \frac{V_4}{V_3}$$

Where:
V_1 = Pre-Dilution Canister Volume
V_2 = Post-Dilution Canister Volume
V_3 = Sample Amount (mL)
V_4 = Base Sample Amount (200 mL)

- **Relative Response Factor (RRF)**

$$RRF = \frac{(A_x)(C_{is})}{(A_{is})(C_x)}$$

Where:
A_x = Area of the quantitation ion of the analyte
A_{is} = Area of the quantitation ion of the internal standard
C_x = Concentration of analyte in concentration units (ppbv)
C_{is} = Concentration of internal standard in concentration units (ppbv)

- **Percent Relative Standard Deviation (%RSD)**

$$\%RSD = \frac{SD}{Mean} x100$$

Where:
SD = Standard deviation individual response factors
Mean = Average of five response factors

- **Sample Concentration**

$$C_x = \frac{(A_x)(C_{IS})}{(A_{IS})(\overline{RRF})}(DF)$$

Where:
C_x = Compound concentration (ppbv)
C_{IS} = Concentration of associated internal standard (ppbv)
A_{IS} = Area of quantitation ion for associated internal standard
A_x = Area of quantitation ion for compound
DF = Dilution Factor
Mean RRF = Average Relative Response Factor from initial calibration.

- **Unit Conversion from ppbv to ugm3**

$$\text{Analytical Result (ug/m3)} = \text{Result(ppbv)} \times \left(\frac{mw}{24.45} \right)$$

Where:
mw = molecular Weight

Example:
Benzene Result = 56 ppbv
Benzene mw = 78.108

$$\text{Analytical Result (ug/m3)} = 56\ \text{ppbv} \times \left(\frac{78.108}{24.45} \right)$$

Result(ug/m3) = 178.9 ug/m3 reported as 180 ug/m3

- **Percent Recovery (%R)**

$$\%R = \frac{C_s}{C_n} \times 100\%$$

Where:
C_s = Concentration of the spiked sample (ppbv)
C_n = Nominal concentration of spike added (ppbv)

- **Precision (%RPD)**

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2} \right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

Formula of Standard Addition:

Volume (mL) = (FR x T) + 25 mL

Where:
FR = flow rate in mL/min
T= time in minutes

Example FR = 70ml/min
Time = 10.69 minutes
Volume = 25+ (70 x 10.69) = 773 mL

Total Volume of diluted standard

Volume (mL) = CV x P

Where:
CV = canister volume in mL
P = pressure in Bar (14.7psi per Bar)

Example: CV = 6185 mL
P= 2.5 Bar
Volume = 15462 mL

11.4 Data Review

11.4.1 Primary Review (Performed by Primary Analyst)

Upload the data files to TALS. Enter batch editor information and add the standards and reagents to the TALS batch. Review the results against acceptance criteria. If acceptance criteria are not met, make arrangements to perform corrective action.
Check the results of samples analyzed immediately after high concentration samples for signs of carry-over. Reanalyze the sample if carry over is suspected.

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should result in a determination within the upper half of the calibration curve.

Set results to primary, secondary, acceptable or rejected as appropriate.

Verify corrective action was taken for all results not within acceptance criteria. If corrective action is not taken or was unsuccessful, record all instances where criteria are not met with a nonconformance memo (NCM). Be sure to provide explanation of your decision making in the internal comment section of the NCM. The internal comment section should list the reason the NCM is suspected, which action (if any) was taken and why and the outcome of the action taken.

Review project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Set the batch to 1st level review.

Record your review on the data review checklist.

11.4.2 Secondary Review (Performed by Peer Reviewer)

Review the project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements and verify project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Review the TALS batch editor to verify information is complete. Review the batch to verify that the procedures in this SOP were followed. If discrepancy is found, resolve the discrepancy and verify any modifications to the SOP are were approved and are properly documented.

Spot-check 15% of samples in the batch to verify quantitative and qualitative identification.

If manual integrations were performed:

- Review each manual integration to verify that the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-005.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in laboratory SOP BR-QA-005.

- Generate a "before" and "after" chromatogram for every manual integration performed on an instrument performance check standard (Tune, ICAL, ICV, CCV), QC sample (MB, LCS) and for any manual integration performed on any surrogate or internal standard in any field sample.
- Generate the Manual Integration Summary Report. Document your review of manual integrations on the summary report and obtain any review signatures of integrations performed during secondary review as required.

  If the reviewer disagrees with the integration performed by the primary analyst, the secondary data reviewer should not change the integration. Instead, he/she should consult with the primary analyst that performed the integration and both the reviewer and the primary analyst should agree the integration should be changed. If consensus between the primary analyst and the peer reviewer cannot be achieved; both should consult with the Technical Manager or department management for resolution. Any changes to the integration should be performed by the primary analyst. If it is necessary for the secondary reviewer to perform the manual integration because the primary analyst is out of the office; the integration made by the peer reviewer must be reviewed by another peer reviewer or by department management to verify the integration was performed and documented in compliance to SOP BR-QA-005. If the original analyst that performed the integration is out of the office, the data reviewer may consult with the Department Manager (DM), Department Supervisor (DS) or the Technical Manager (TM) to verify the change he/she thinks is needed is warranted and should be made.

Verify that the performance criteria for the QC items listed in Table 1 were met. If the results do not fall within the established limits verify that corrective actions were performed. If corrective action was not performed; verify the reason is provided and that the situation is properly documented with an NCM. Set samples to 2nd level review.

Run the QC checker and fix any problems found. Run and review the deliverable. Fix any problems found. When complete set the method chain to lab complete and forward any paperwork to report/project management.

Record second level review on the data review checklist.

11.5 Data Reporting

Data reporting and creation of the data deliverable is performed by TALS using the formatters set by the project manager during project initiation.

Electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014 Laboratory Records.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

Perform a method detection limit (MDL) study at initial method set-up following the procedures specified in laboratory SOP BR-QA-005,

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*.

The following waste streams are produced when this method is carried out:

- None

15.0 References / Cross-References

- EPA Compendium Method TO-15, "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry", US EPA, January, 1999.
- Laboratory SOP BR-QA-005, Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).
- Laboratory SOP BR-QA-011 Employee Training
- Laboratory SOP BR-EH-001 Hazardous Waste
- Laboratory SOP BR-QA-014 Laboratory Records
- LaboratorySOP BR-QA-006 Procedures & Documentation Requirements for Manual Integration
- Laboratory Quality Assurance Manual (QAM)

16.0 Method Modifications

Not Applicable.

17.0 Attachments

- Table 1: Target Compound List, RL, Internal Standard and Ion Assignments
- Table 2: Ion Abundance Criteria (BFB)
- Table 3: QC Summary & Recommended Corrective Action
- Table 4. DOD QSM QC Requirements
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: DoD QSM LCS and MS/MSD Limits

18.0 Revision History

BR-AT-004r10.1:
Section 9.1: Updated Sample Duplicate requirement.
Table 3: Updated Sample Duplicate requirement.
Table 4: Updated Sample Duplicate requirement.

BR-AT-004r10:
- Title Page: Updated copyright date and approval signatures
- Section 5.2: Updated MSDS to SDS
- Section 6.4: Removed all references to zero-air generator.
- Section 7.1: Removed all references to zero-air generator.
- Section 7.2: Clarified standard preparation procedure
- Added section 10.4.2 Daily Maintenance
- Added section 10.4.3 Bi-Weekly Maintenance
- Added Table 4 DOD QSM QC Requirements
- Appendix B: Updated Initial Calibration Table
- Added Appendix C: DOD QSM LCS Limits

BR-AT-004r9:

- Title page: Updated approval signatures and copyright date.
- Section 1.0: Added non-ambient air to the matrix.
- Section 10.3.1.4: Changed sampling time from <200 to >100.

BR-AT-004, Revision 8:

- Title Page: Updated approval signatures
- All sections: Added procedure for ethanol
- Section 10: Changed calibration groups

BR-AT-004, Revision 7:
Section 11.4.1: Expanded on discussion of carry over.
Appendix C: Removed.
Appendix D: Removed.
Appendix E: Removed.

Table 1: Routine Compound List, Reporting Limit, Internal Standard and Ion Assignments

Analyte	CAS No.	6L RL (ppbv)	1L RL (ppbv)	Quantifier Mass	Qualifier Mass	Qualifier Mass	ISTD Group	Analyte Group
Dichlorodifluoromethane	75-71-8	0.5	5	85	87		1	B
Freon-22	75-45-6	0.5	5	51	67	69	1	B
1,2-Dichlorotetrafluoroethane	76-14-2	0.2	2	85	135	87	1	A
Chloromethane	74-87-3	0.5	5	50	52		1	B
n-Butane	106-97-8	0.5	5	43	41	58	1	B
Vinyl Chloride	75-01-4	0.04	0.40	62	64		1	D
1,3-Butadiene	106-99-0	0.5	5	54			1	B
Bromomethane	74-83-9	0.2	2	94	96		1	A
Chloroethane	75-00-3	0.5	5	64	66		1	B
Isopentane	78-78-4	0.2	2	43	57	56	1	A
Bromoethene (Vinyl Bromide)	593-60-2	0.2	2	106	108	81	1	A
Trichlorofluoromethane	75-69-4	0.2	2	101	103		1	A
Pentane	109-66-0	0.5	5	43	57	72	1	B
EthylEther	60-29-7	0.2	2	59	45	74	1	A
Acrolein	107-02-8	5	50	56	55	37	1	C
Freon TF	76-13-1	0.2	2	101	151	103	1	A
1,1-Dichloroethene	75-35-4	0.2	2	96	61	63	1	A
Acetone	67-64-1	5	50	43	58		1	C
Isopropyl Alcohol	67-63-0	5	50	45	43		1	C
Carbon Disulfide	75-15-0	0.5	5	76			1	B
3-Chloropropene (Allyl Chloride)	107-05-1	0.5	5	41	76		1	B
Acetonitrile	75-05-8	5	50	41	40	39	1	C
Methylene Chloride	75-09-2	0.5	5	49	84	86	1	B
tert-Butyl Alcohol	75-65-0	5	50	59	41	43	1	C
Methyl tert-Butyl Ether	1634-04-4	0.5	5	73	43		1	B
trans-1,2-Dichloroethene	156-60-5	0.2	2	61	96		1	A
n-Hexane	110-54-3	0.5	5	57	86		1	B
1,1-Dichloroethane	75-34-3	0.2	2	63	65	83	1	A
Methyl Ethyl Ketone	78-93-3	0.5	5	72	43		1	B
cis-1,2-Dichloroethene	156-59-2	0.2	2	96	98		1	A
Tetrahydrofuran	109-99-9	5	50	42	72		2	C
Chloroform	67-66-3	0.2	2	83	85		1	A
1,1,1-Trichloroethane	71-55-6	0.2	2	97	99	61	2	A
Cyclohexane	110-82-7	0.2	2	84	56		2	A
Carbon Tetrachloride	56-23-5	0.2	2	117	119		2	A
2,2,4-Trimethylpentane	540-84-1	0.2	2	57	41	43	2	A
1,2-Dichloroethene (total)	540-59-0	0.2	2	61	96		1	A
Benzene	71-43-2	0.2	2	78	77		2	A
1,2-Dichloroethane	107-06-2	0.2	2	62	98		2	A
n-Heptane	142-82-5	0.2	2	43	71		2	A
Trichloroethene	79-01-6	0.04	0.40	95	130	132	2	D
Methyl Methacrylate	80-62-6	0.5	5	69	41	39	2	B
1,2-Dichloropropane	78-87-5	0.2	2	63	41		2	A
1,4-Dioxane	123-91-1	5	50	88	58		2	C

Analyte	CAS No.	6L RL (ppbv)	1L RL (ppbv)	Quantifier Mass	Qualifier Mass	Qualifier Mass	ISTD Group	Analyte Group
Dibromomethane	74-95-3	0.2	2	174	93	172	2	A
Bromodichloromethane	75-27-4	0.2	2	83	85		2	A
cis-1,3-Dichloropropene	10061-01-5	0.2	2	75	110		2	A
Methyl Isobutyl Ketone	108-10-1	0.5	5	43	58		2	B
n-Octane	111-65-9	0.2	2	43	57	114	2	A
Toluene	108-88-3	0.2	2	92	91		3	A
trans-1,3-Dichloropropene	10061-02-6	0.2	2	75	110		2	A
1,1,2-Trichloroethane	79-00-5	0.2	2	83	97	85	3	A
Tetrachloroethene	127-18-4	0.04	0.40	166	168	129	3	D
Methyl Butyl Ketone	591-78-6	0.5	5	43	58		3	B
Dibromochloromethane	124-48-1	0.2	2	129	127		3	A
1,2-Dibromoethane	106-93-4	0.2	2	107	109		3	A
Nonane	111-84-2	0.2	2	57	71	128	3	A
Chlorobenzene	108-90-7	0.2	2	112	77	114	3	A
Ethylbenzene	100-41-4	0.2	2	91	106		3	A
Xylene (m,p)	1330-20-7	0.5	5	106	91		3	A
Xylene (o)	95-47-6	0.2	2	106	91		3	A
Styrene	100-42-5	0.2	2	104	78		3	A
Bromoform	75-25-2	0.2	2	173	175	171	3	A
Cumene	98-82-8	0.2	2	105	120	77	3	A
1,1,2,2-Tetrachloroethane	79-34-5	0.2	2	83	131	85	3	A
Xylene (total)	1330-20-7	0.2	2	106	91		3	A
n-Decane	124-18-5	0.5	5	57	71	142	3	B
n-Propylbenzene	103-65-1	0.2	2	91	120	92	3	A
1,2,3-Trichoropropane	96-18-4	0.5	5	75	110	112	3	B
4-Ethyltoluene	622-96-8	0.2	2	105	120		3	A
1,3,5-Trimethylbenzene	108-67-8	0.2	2	105	120		3	A
2-Chlorotoluene	95-49-8	0.2	2	91	63		3	A
tert-Butylbenzene	98-06-6	0.2	2	119	91	134	3	A
1,2,4-Trimethylbenzene	95-63-6	0.2	2	105	120		3	A
sec-Butylbenzene	135-98-8	0.2	2	105	134	91	3	A
4-Isopropyltoluene	99-87-6	0.2	2	119	134	91	3	A
1,3-Dichlorobenzene	541-73-1	0.2	2	146	111	148	3	A
1,4-Dichlorobenzene	106-46-7	0.2	2	146	111	148	3	A
n-Undecane	1120-21-4	5	50	57	71	156	3	C
Benzyl Chloride	100-44-7	0.2	2	91	126	65	3	A
n-Butylbenzene	104-51-8	0.2	2	91	134	92	3	A
1,2-Dichlorobenzene	95-50-1	0.2	2	146	111	148	3	A
n-Dodecane	112-40-3	5	50	57	71	170	3	C
1,2,4-Trichlorobenzene	120-82-1	0.5	5	180	182		3	B
1,3-Hexachlorobutadiene	87-68-3	0.2	2	225	223		3	A
Naphthalene	91-20-3	0.5	5	128			3	B
1,2,3-Trichlorobenzene	87-61-6	0.2	2	180	182	145	3	A
Propylene	115-07-1	5	50	41	42	39	1	C
Vinyl Acetate	108-05-4	5	50	43	86		1	C

Analyte	CAS No.	6L RL (ppbv)	1L RL (ppbv)	Quantifier Mass	Qualifier Mass	Qualifier Mass	ISTD Group	Analyte Group
Ethyl Acetate	141-78-6	5	50	43	74		1	C
Ethanol	64-17-5	5	50	46	45		1	E
Bromochloromethane	74-97-5	NA	NA	128	49	130	1	NA
1,4-Difluorobenzene	540-36-3	NA	NA	114			2	NA
Chlorobenzene-d5	3114-55-4	NA	NA	117			3	NA

Table 2: Tune Standard Criteria

Mass	Ion Abundance Criteria
50	8.0 to 40.0 percent of mass 95
75	30.0 to 66.0 percent of mass 95
95	Base Peak, 100 percent relative abundance
96	5.0 to 9.0 percent of mass 95
173	Less than 2.0 percent of mass 174
174	50.0 to 120.0 percent of mass 95
175	4.0 to 9.0 percent of mass 174
176	93.0 to 101.0 percent of mass 174
177	5.0 to 9.0 percent of mass 176

Table 3: TO15 QC Summary & Recommended Corrective Action

QC Check	Frequency	Acceptance Critera	Recommended Corrective Action
Tune Standard	Prior to calibration and every 24 hours	See Table 2	Correct Problem. Reanalyze. No samples may be analyzed without a valid tune.
ICAL	Prior to sample analysis and when CCV fails	RSD for each analyte ≤ 30% with 2 exceptions up to 40%	Correct problem and repeat calibration
ICV	Once after each ICAL	%R for all analytes within 70-130	Correct Problem. Reanalyze, re-make, re-verify & re-analyze. If that fails, re-make all standards and repeat calibration.
Retention Time Window	Once per ICAL	NA	NA
RRT	With each sample	RRT of each target analyte in each calibration standard within ± 0.06 RRT units.	Correct Problem. Repeat ICAL
CCV	Daily before sample analysis after tune standard	%D ≤ 30	Correct Problem. Reanalyze once. If that fails, see section 10.2.5 for instruction.
LCS	Each batch or every 20 samples, whichever is sooner.	%R for all analytes within 70-130	Reanalyze LCS, re-prep and reanalyze LCS and all associated samples if sufficient sample volume is available. If corrective action not successful, initiate nonconformance report and qualify sample results.
LCSD	Per Client Request	RPD ≤ 25	Reanalyze LCSD, re-prep and reanalyze LCSD and all associated samples if sufficient sample volume is available. If corrective action is not successful, initiate nonconformance report and qualify sample results.
Method Blank	Each batch or every 20 samples, whichever is sooner.	No analytes detected above RL	Reanalyze along with associated samples, unless detects for same compounds found in blank are greater than 10X the concentration found in the blank.
Internal Standard	All standards, field and QC samples	+/- 40% area response from last acceptable calibration. RT +/- 0.33 min (20 seconds) from last acceptable calibration.	Inspect system for malfunction. Reanalyze samples. Qualify data.
Sample Duplicate	Per Client Request	RPD ≤ 25 when one or both results are greater than five times the RL.	Consult with PM. Reanalyze or qualify data.

Table 4: DOD QSM 5.0 Quality Control Requirements

QC Check	Frequency	Acceptance Critera	Recommended Corrective Action
Tune Standard	Prior to calibration and every 24 hours	See Table 2	Correct Problem. Reanalyze. No samples may be analyzed without a valid tune.
ICAL	Prior to sample analysis and when CCV fails	• %RSD ≤ 15% • Correlation Coefficient : r ≥ 0.99	Correct problem and repeat calibration
ICV	After each initial calibration and prior to sample analysis	%R (80-120)	Correct Problem. Reanalyze, re-make, re-verify & re-analyze. If that fails, re-make all standards and repeat calibration.
Retention Time Window	Once per ICAL and at the beginning of the analytical sequence	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA
Evaluation of Relative Retention Times (RRT)	With each sample	RRT of each target analyte in each calibration standard within ± 0.06 RRT units.	Correct Problem. Repeat ICAL
CCV	Daily before sample analysis after tune standard, and at the end of the analytical sequence.	• %D for all analytes and surrogates : ≤ 20% • %D for all analytes and surrogates : ≤ 50% in closing CCV	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV
LCS	Each batch or every 20 samples, whichever is sooner.	See Attachment C, unless project limits are specified. If the analyte(s) are not listed, use in-house LCS limits.	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.
Method Blank	Each batch or every 20 samples, whichever is sooner.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct Problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.

Internal Standard	All standards, field and QC samples	• Area between -50 to +100% of the midpoint standard in the ICAL calibration • Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL	Inspect system for malfunction. Reanalyze samples. Qualify data.
Matrix Duplicate (MD)	Each batch or every 20 samples, whichever is sooner.	RPD ≤ 20	Examine the project specific requirements. Contact the client as to additional measures to be taken.

Appendix A: Terms and Definitions

Acceptance Criteria: Specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: Environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): An analytical standard gas mixture containing all target analytes and internal standard compounds that is used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Cryogen: A refrigerant used to obtain very low temperatures in the cryogenic trap of the analytical system. A typical cryogen is liquid nitrogen (bp -195.8℃) or liquid argon (bp -185.7℃).

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Initial Calibration Verification (ICV): An analytical standard mixture containing all target analytes and internal standard compounds that are prepared from a source independent of the source of the initial calibration standards. The purpose of the ICV is to verify that the initial calibration is in control.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Internal Standards (IS): Non-target analytes that are similar to the target analytes but are not expected to be found in environmental media (generally, isotopically labeled target analytes are used for this purpose). IS are added to every standard, quality control sample, and field sample at a known concentration prior to analysis. IS responses are used as the basis for quantitation of target analytes.

Laboratory Control Sample (LCS) – A QC sample of known composition spiked with analytes of interest. The LCS evaluates method performance and ability to successfully recover target analytes from a clean matrix. LCS recovery is typically expressed as percent recovery and provides a measure of accuracy. A LCSD is a duplicate LCS prepared and analyzed from a separate canister to provide a measure of replicate precision.

Method Blank (MB): A canister of humidified ultra pure zero air that is treated exactly as a sample. The MBLK is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Gas Mixture: A Commercially purchased concentrated gas mixture containing one or more method analytes

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration or volume of any of the stock standard changes, the standard preparation instructions must be adjusted accordingly. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance on the preparation of standard solutions.

Prepare all standards using the McMillan Company 80SD mass flow controller. Prepare the standard in zero air, demonstrated to be analyte free. Store the standard at ambient temperature. Unless otherwise specified, assign an expiration date of 30 days from date of preparation unless the parent standard expires earlier, in which case, use the earliest expiration date.

Intermediate Calibration Standard

Parent Standard	Vendor	Stock Standard Concentration (ppmv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
Custom Calibration Stock Standard	Spectra Gases Custom Made	1.0	7500	37.5	200

Prepare in 15 L Summa Canister Expiration Period 3months
This standard contains all the target analytes listed in table 1.

Working Calibration Standards

Parent Standard	Calibration Standard	Parent Standard Concentration (ppbv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
Cal Standard 20 ppbv	Cal Standard 0.2 ppbv	20	155	15.46	0.2
Cal Standard 20 ppbv	Cal Standard 0.5 ppbv	20	386	15.46	0.5
Intermediate Calibration Standard	Cal Standard 5 ppbv	200	386	15.46	5
Intermediate Calibration Standard	Cal Standard 10 ppbv	200	773	15.46	10
Intermediate Calibration Standard	Cal Standard 15 ppbv	200	1160	15.46	15
Intermediate Calibration Standard	Cal Standard 20 ppbv	200	1546	15.46	20
Intermediate Calibration Standard	Cal Standard 40 ppbv	200	3092	15.46	40

Prepare in 6 L Summa Canister Expiration Period 3 months
Each calibration standard contains all the analytes listed in table 1 at the above concentrations.

Intermediate ICV/LCS Standard

Parent Standard	Vendor	Stock Standard Concentration (ppmv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
ICV Stock Standard	Spectra Gases Custom Made	1.0	7500	37.5	200

Prepare in 15L Summa Canister Expiration period 3 months
This standard contains all target analytes listed in table 1.

Working ICV/LCS Standard

Parent Standard	Calibration Standard	Stock Standard Concentration (ppbv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
Intermediate ICV/LCS Standard	ICV Standard 10 ppbv	200	773	15.46	10

Prepare in 6L Summa Canister Expiration period 3 months
This standard contains all target analytes listed in table 1.

Initial Calibration Levels

Calibration Level	Working Calibration Standard	Volume Analyzed (mL)	Concentration on Column (ppbv)
Calibration Level 1	Cal Standard 0.2 ppbv	200	0.2
Calibration Level 2	Cal Standard 0.5 ppbv	200	0.5
Calibration Level 3	Cal Standard 5 ppbv	200	5
Calibration Level 4	Cal Standard 10 ppbv	200	10
Calibration Level 5	Cal Standard 15 ppbv	200	15
Calibration Level 6	Cal Standard 20 ppbv	200	20
Calibration Level 7	Cal Standard 40 ppbv	200	40
Calibration Level 8	Cal Standard 0.2 ppbv	40	0.04
ICV	Intermediate ICV 10ppb	200	10

Prepare in 6L Summa Canister

Intermediate Ethanol Calibration Standard at 500ppbv/v

1) Fill a 44 ml VOA vial with VOA free water. Remove 197ul of water from the vial.
2) Add 197 ul of >99.5% Ethanol neat material
3) Cap and shake/roll vial for 1 minute
4) Inject 10ul of the prepared water/ethanol mix into a fully evacuated 15 liter summa canister
5) Pump the syringe plunger 5 times to insure complete transfer of material
6) Immediately fill the canister to 22 psig with zero air.

Calibration Level	Working Calibration Standard	Volume added (mL)	Concentration on Column (ppbv)
Calibration Level 1	Cal Standard 0.5 ppbv	124	5
Calibration Level 2	Cal Standard 5.0 ppbv	309	10
Calibration Level 3	Cal Standard 10ppbv	464	15
Calibration Level 4	Cal Standard 15 ppbv	618	20
Calibration Level 5	Cal Standard 20 ppbv	1237	40
Calibration Level 6	Cal Standard 40 ppbv	3092	100

Appendix C; DOD QSM LCS and MS/MSD Limits

Analytes	CAS #	Lower Limit	Upper Limit	Units
Propene	115-07-1	57	136	%
Dichlorodifluoromethane	75-71-8	59	128	%
Chlorodifluoromethane	75-45-6	59	145	%
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2	63	121	%
Chloromethane	74-87-3	59	132	%
Butane	106-97-8	64	129	%
Vinyl chloride	75-01-4	64	127	%
Butadiene	106-99-0	66	134	%
Bromomethane	74-83-9	63	134	%
Chloroethane	75-00-3	63	127	%
Vinyl bromide	593-60-2	71	126	%
Trichlorofluoromethane	75-69-4	62	126	%
Ethanol	64-17-5	59	125	%
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	66	126	%
1,1-Dichloroethene	75-35-4	61	133	%
Acetone	67-64-1	58	128	%
Isopropyl alcohol	67-63-0	52	125	%
Carbon disulfide	75-15-0	57	134	%
3-Chloro-1-propene	107-05-1	71	131	%
Methylene Chloride	75-09-2	62	115	%
2-Methyl-2-propanol	75-65-0	24	150	%
Methyl tert-butyl ether	1634-04-4	66	126	%
trans-1,2-Dichloroethene	156-60-5	67	124	%
Hexane	110-54-3	63	120	%
1,1-Dichloroethane	75-34-3	68	126	%
Vinyl acetate	108-05-4	56	139	%
Ethyl acetate	141-78-6	65	128	%
2-Butanone (MEK)	78-93-3	67	130	%
cis-1,2-Dichloroethene	156-59-2	70	121	%
Chloroform	67-66-3	68	123	%
Tetrahydrofuran	109-99-9	64	123	%
1,1,1-Trichloroethane	71-55-6	68	125	%
Cyclohexane	110-82-7	70	117	%
Carbon tetrachloride	56-23-5	68	132	%
Isooctane	540-84-1	68	121	%

Benzene	71-43-2	69	119	%
1,2-Dichloroethane	107-06-2	65	128	%
n-Heptane	142-82-5	69	123	%
Trichloroethene	79-01-6	71	123	%
Methyl methacrylate	80-62-6	70	128	%
1,2-Dichloropropane	78-87-5	69	123	%
1,4-Dioxane	123-91-1	71	122	%
Dichlorobromomethane	75-27-4	72	128	%
cis-1,3-Dichloropropene	10061-01-5	70	128	%
4-Methyl-2-pentanone (MIBK)	108-10-1	67	130	%
Toluene	108-88-3	66	119	%
trans-1,3-Dichloropropene	10061-02-6	75	133	%
1,1,2-Trichloroethane	79-00-5	73	119	%
Tetrachloroethene	127-18-4	66	124	%
2-Hexanone	591-78-6	62	128	%
Chlorodibromomethane	124-48-1	70	130	%
Ethylene Dibromide	106-93-4	74	122	%
Chlorobenzene	108-90-7	70	119	%
Ethylbenzene	100-41-4	70	124	%
m-Xylene & p-Xylene	179601-23-1	61	134	%
o-Xylene	95-47-6	67	125	%
Styrene	100-42-5	73	127	%
Bromoform	75-25-2	66	139	%
Isopropylbenzene	98-82-8	68	124	%
1,1,2,2-Tetrachloroethane	79-34-5	65	127	%
N-Propylbenzene	103-65-1	69	123	%
2-Chlorotoluene	95-49-8	74	130	%
tert-Butylbenzene	98-06-6	65	124	%
1,2,4-Trimethylbenzene	95-63-6	66	132	%
sec-Butylbenzene	135-98-8	68	125	%
4-Isopropyltoluene	99-87-6	67	130	%
1,3-Dichlorobenzene	541-73-1	65	130	%
1,4-Dichlorobenzene	106-46-7	60	131	%
Benzyl chloride	100-44-7	50	147	%
n-Butylbenzene	104-51-8	66	130	%
1,2-Dichlorobenzene	95-50-1	63	129	%

1,2,4-Trichlorobenzene	120-82-1	55	142	%
Hexachlorobutadiene	87-68-3	56	138	%
Naphthalene	91-20-3	57	138	%
1,2,3-Trichloropropane	96-18-4	76	124	%
Acetonitrile	75-05-8	63	132	%
Acrolein	107-02-8	62	126	%
n-Decane	124-18-5	70	118	%
n-Nonane	111-84-2	63	128	%
n-Octane	111-65-9	69	121	%
Dodecane	112-40-3	62	147	%
Undecane	1120-21-4	69	123	%
Pentane	109-66-0	63	131	%
Acrylonitrile	107-13-1	71	137	%
Alpha Methyl Styrene	98-83-9	67	128	%
n-Butanol	71-36-3	62	133	%

Appendix B
Health and Safety Plan

HEALTH AND SAFETY PLAN

SITE ACTIVITIES FOR INVESTIGATIONS, REMEDIATION OM&M AND GROUNDWATER MONITORING
FORMER LOCKHEED MARTIN FACILITY
525 FRENCH ROAD
UTICA, NEW YORK

Prepared for:
LOCKHEED MARTIN
7000 CALMONT AVENUE
SUITE 300 MS 2010
FORT WORTH, TX 76116

Prepared by:
STANTEC CONSULTING SERVICES INC
61 COMMERCIAL STREET
ROCHESTER, NY 14614

March 13, 2014

Revision Record							
Revision	Description	Prepared By		Checked By		Approved By	
0	Final	R. Mahoney/F. Miller	03/13/14	RJM		P. Nielsen/F. Miller	3/13/14
1	2015 Update	L. Best/R. Mahoney	1/23/15	RJM		P. Nielsen	1/23/15
2	2015 Update #2	L. Best/R. Mahoney	8/11/15	RJM		P. Nielsen	

Emergency Contact List

Ambulance: 911			
Hospital: (Emergencies) *See Figure 1*	St Luke's Hospital Champlin Avenue Utica, NY 13503 315-624-6000	Urgent Care: (Minor injuries) *See Figure 2*	Genesee Urgent Care 1904 Genesee Street Utica, New York 13502 315-793-8856
Fire Department:	911	Poison Control Center:	800-222-1222
Police:	911	Utility Emergency:	911

Project Contacts:

Project Title	Name	Telephone Number	General Responsibilities
LMC Project Lead	Charles Trione	Office: 301-548-2223 Cell: 240-328-0905	Oversight of all project work
S&H Manager	Jimmy Yeager	Office: **301-873-1444**	Manage LMC Safety Program
CDM Smith Project Manager	Jim Zigmont	Office: **617-452-6327** Cell: **857-234-1661**	Environmental Program Mgmnt. for LMC
CONMED EHS Manager	Richard Zigenfus	Office: **315-624-3197** Cell: **315-790-3474**	Site EHS Management
EHS Specialist	Kevin Duchano	Office: **315-624-3159** Cell: **315-796-3047**	Site EHS
STANTEC			
Project Manager	Peter Nielsen	Office: **585-413-5280** Cell: **585-729-0848**	Direction of Stantec project activities
Assistant Project Manager	Bob Mahoney	Office: **585-413-5301** Cell: **585-645-2567**	Planning and oversight of field activities; Subcontractor coordination
Regional HSE Coordinator	Fred Miller	Office: **443-632-3046** Cell: **610-235-7315**	Oversight of US Region HSE Activities and investigation of injuries
Project Health and Safety Officer	Bob Mahoney	Office: **585-413-5301** Cell: **585-645-2567**	Oversight of Safety-related issues; safety audits, incident reporting.
Hydrogeologist and Sampling Coordinator	Stephanie Reynolds-Smith	Office: **585-413-5272** Cell: **585-298-2382**	Planning, coordination and oversight of groundwater sampling activities
Workers Compensation Claims Coordinator	Fred Miller	Office: **607-271-6115** Cell: **610-235-7905**	Provides WC compliance activities and medical treatment assistance
Site Safety Officer/H&S Coordinator	Ben Haravitch	Office: **585-413-5326** Cell: **585-978-5248**	Day-to-day onsite oversight of work activities; Implementation of H&S Plan requirements; Routine O&M and Groundwater Sampling

(continued on following page)

Environmental Technician	Ben Haravitch	Office: **585-413-5326** Cell: **585-978-5248**	O&M activities; Groundwater Sampling
Environmental EIT	Laura Lyons	Office: **585-413-5334** Cell: **585-278-3549**	O&M activities; Groundwater Sampling
Hydrogeologist	Laura Best	Office: **585-413-5327** Cell: **585-301-0166**	O&M activities; Groundwater Sampling
Environmental Scientist	AnneMarie Glose	Office: **585-413-5328** Cell: **585-319-8181**	O&M activities; Groundwater Sampling
Mechanical Engineer	John Yackiw	Office: **518-218-5846** Cell: **585-738-7826**	O&M activities

Health and Safety Plan Acknowledgement

The undersigned acknowledge they have read and understand this Health and Safety Plan and agree to abide by the requirements included in this document.

Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
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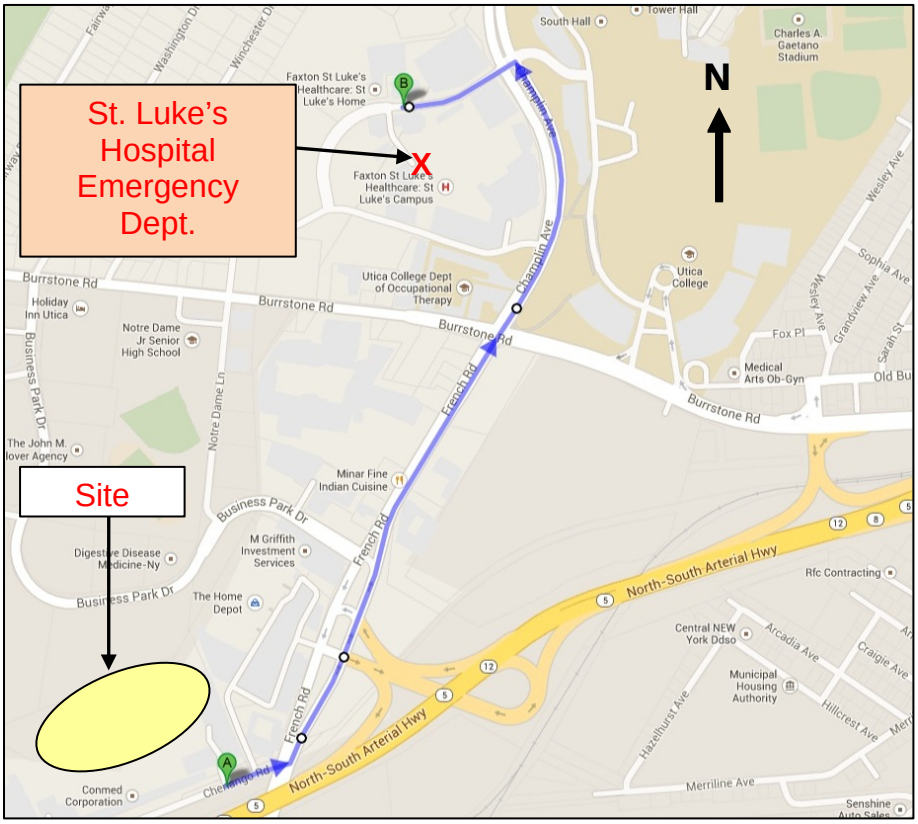
FIGURE 1

Directions and Map from the Site to St. Luke's Hospital, Utica, NY



DIRECTIONS TO ST. LUKE'S HOSPITAL

A **Chenango Rd**

1. Head **east** on **Chenango Rd** toward **French Rd**

394 ft

2. Turn left onto **French Rd**

0.5 mi

3. Continue onto **Champlin Ave**

0.3 mi

4. **Turn Left into Hospital Entrance**

0.1 mi

B **5. Turn Left into Emergency Dept. Entrance**

FIGURE 2

Directions and Map from the Site to Genesee Urgent Care, Utica, NY

A	**525 French Rd, Utica, NY 13502**	**A–B: 1.5 mi** 5 min
	1. Depart **French Rd / CR-28 S** toward Chenango Rd	0.2 mi
↑	2. Keep **straight** onto **French Rd**	135 ft
↰	3. Turn **left** onto **Seward Ave**	0.5 mi
↖	4. Bear **left** onto **Genesee St**	0.8 mi
B	5. Arrive at **1904 Genesee St, Utica, NY 13501** *The last intersection is Auburn Ave* *If you reach Rose Pl, you've gone too far*	

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Appendix B - Job Safety Analysis (JSA) Forms
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Appendix D - Safety Data Sheets
Appendix E - Stantec HazCom Program (SWP-104)

1.0 INTRODUCTION

The following Health and Safety Plan (HASP) describes personal safety protection standards and procedures to be followed by Stantec staff during activities related to operation, monitoring and maintenance (OM&M) of existing groundwater collection and treatment (GCT) and sub-slab depressurization system (SSDS), groundwater and vapor monitoring and sampling at the former Lockheed Martin Company (LMC) Utica site located at 525 French Road in Utica, Oneida County, New York. This work will include system operation, maintenance and repair, system influent and effluent (water and air) sampling, and groundwater sampling in existing monitoring wells. Prior to the development of the HASP, Stantec received and review the following documents, copies of which are included in Appendix A:

- *Remediation Contractor's ESH Handbook, Lockheed Martin Corporation, June 10, 2009;*
- *Criteria for Remediation System Site Work at Former Lockheed Martin French Road Facility Utica, NY, ConMed Corporation, January 2014;*
- *Contractor Safety Program Handbook UNYS 022-G, ConMed Corporation, August 12, 2011; and*
- *Lockheed Martin List of Exceptions to ConMed Contractor Safety Program Handbook UNYS 022-G, January 2014.*

This HASP establishes mandatory safety procedures and personal protection standards pursuant to the Occupational Safety and Health Administration (OSHA) regulations 29 Code of Federal Regulations (CFR) 1910.120. The HASP applies to all Stantec personnel conducting any site work, as defined in 29 CFR 1910.120(a). Prior to working on the site, all Stantec personnel involved in the mentioned activities must:

- Complete the required OSHA HAZWOPER 40-hour training and subsequent annual 8-hour refresher training, as needed;
- Participate in the medical surveillance program;
- Familiarize themselves with this HASP and comply with its requirements;

Persons serving in a supervisory capacity on this project who have received the 8-Hr. OSHA Supervisor Training include: Peter Nielsen (Project Manager) and Robert Mahoney (Assistant Project Manager/Project Health and Safety Officer).

Stantec and Subcontractor personnel new to the site will be given an on-site safety briefing to familiarize them with the site conditions, LMC and ConMed requirements and emergency procedures.

THIS HASP IS FOR THE EXPRESS USE OF STANTEC EMPLOYEES. ALL OTHER CONTRACTORS PERFORMING WORK ON THE SITE ARE REQUIRED TO DEVELOP THEIR OWN HASP THAT PROVIDES PROTECTION COMMENSURATE WITH THEIR DUTIES ON THE SITE AND WHICH MEETS ALL PERTINENT ASPECTS OF OSHA REGULATIONS. STANTEC RESERVES THE RIGHT TO STOP ANY SITE WORK WHICH IS DEEMED TO POSE A HEALTH AND SAFETY THREAT TO ITS STAFF OR THE STAFF OF SUBCONTRACTORS.

Stantec's current work scope does not require the use subcontractors, with the exception of a landscape firm which will perform brush clearing on the West Lot to provide access to monitoring

wells. These duties will not present a hazard relative to potential exposure to contaminant compounds. Accordingly, their personnel would not require HAZWOPER training. Stantec will provide safety orientation training to their personnel regarding relevant site and environmental conditions, however they will not be required to read and sign this HASP.

If manhole entry is required, (and therefore confined space entry) the subcontractor will be required to develop a Health and Safety Plan for its employees and submit a Confined Space Plan and documentation of employee training for such work. LMC will be allowed to review and comment on these plans before work commences.

Job Safety Analysis (JSA) sheets for the following tasks associated with this HASP are included in Appendix B:

1. Driving To/From/On The Site
2. Routine O&M Activities
3. Groundwater Well Gauging and Sampling
4. Portable Electric Compressor Use
5. Plumbing and Piping Work
6. Sequestering Agent Chemical drum change-out
7. Working at Height Using An Aerial Lift
8. Excavation Activities
9. Oversight of GW Well and Vapor Point Maintenance/Repair/Abandonment Activities
10. Geoprobe Drilling Activities

JSA's will be reviewed and revised as necessary to remain relevant to the tasks being performed.

1.1 Background

The Utica facility located at 525 French Road is a former LMC facility that consisted of manufacturing, assembly, and testing of electrical components for the defense and aerospace industries. LMC operated the facility until 1996. The facility is currently owned and occupied by ConMed, a medical supplies manufacturer and distributor, however LMC retains the liability for environmental remediation.

The Site consists of two distinct work areas: the Solvent Dock area, located in the northeast portion of the Site; and the West Lot, located west of the active facility. Each is discussed below (see Figure 3 for locations):

Solvent Dock Area: Releases of hazardous materials have impacted an area of the facility known as the Solvent Dock Area, which is subject to a Consent Order administered by the New York State Department of Environmental Conservation (NYSDEC).

Testing has detected volatile organic compounds (VOCs) in groundwater consisting primarily of chlorinated VOCs (principally 1,1-dichloroethane, cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene, trichloroethene (TCE), and vinyl chloride)); and other VOCs such as benzene, toluene, ethylbenzene, xylene, acetone and 2-butanone. Results indicated that VOCs in groundwater had migrated into the northern perimeter ditch and storm sewer beneath the manufacturing building. To address this contaminant presence, the groundwater collection and treatment system (GCTS) was designed in 1995 and installed in

1996. The system is designed to lower the groundwater table and keep impacted groundwater from entering the storm drain.

Sub-slab soil gas and indoor air sampling of the facility were performed beginning in 2006. Results identified levels of TCE that warranted mitigation. In response, the sub-slab depressurization system (SSDS) was installed at the northeast end of the building in November 2007. Continuous operation began in July 2008.

LMC entered into an Order on Consent with NYSEC in October 2008. The Order had requirements for certain recommended corrective measures which included upgrades to the existing GCTS and SSDS. Upgrade designs for the GCTS and SSDS were completed and approved by NYSDEC and the New York state Department of Health (NYSDOH) in 2010. Installation of the designed upgrades was completed in the spring of 2011 and the upgraded GCTS and SSDS are fully operational.

Lockheed Martin vacated the site several years ago, and the property is currently owned by the Oneida County Industrial Development Agency (OCIDA) and ConMed. ConMed, a manufacturer of medical equipment, is currently the sole occupant of the facility

The scope of this project is to provide operation, maintenance and monitoring services to continue operation of the GCTS and SSDS. Specific tasks include:

- System O&M, testing, alarm response, etc.
- System influent and effluent water and storm sewer sampling;
- Monitoring well gauging and groundwater sampling;
- Sub slab and indoor air sampling;
- Subslab air pressure testing; and
- SSDS Piping leak testing.

In response to NYSDEC's Statement of Basis (March 2015), additional tasks relating to investigation and remediation activities will be performed onsite including direct-push drilling of test borings and soil sampling.

West Lot: The West Lot Site is also located on French Road, to the west of the active ConMed facility. From the 1950s to the early 1960s, the site was used for waste disposal and fire training. The wastes were burned in an 80-foot diameter pit. The site is currently listed as a Class 4 on the New York State Registry of Inactive Hazardous Waste Sites. A Class 4 site is considered properly closed but requires continued management.

The West Lot Site encompasses approximately two acres and is currently undeveloped or partially covered with an unused asphalt parking lot. Extensive investigation of soil and groundwater was conducted in the early 1990s and the results indicated the presence of volatile organic compounds (VOCs) in soil and groundwater, as well as PCBs in soils. In 1994, in accordance with NYSDEC, soils from the burn pit area were excavated and placed into a containment cell as an Interim Remedial Measure. Further excavation activities were conducted in 1999 to remove additional impacted soils from the former burn pit area, fully satisfying the soil remedy requirement in the Record of Decision and the NYSDEC Order on Consent. Continued groundwater monitoring indicated a residual source of impacts to groundwater. Further soil removal in the burn pit area was conducted in 2005 to enhance the

clean-up of groundwater. A groundwater control system was installed in 2001 and became fully operational in 2002. An extraction well pumped water from the burn pit area to a groundwater collection and treatment unit. The treatment unit removed VOCs from the extracted groundwater with an air stripper prior to discharge to the municipal storm sewer. This extraction well was shutdown in January 2007. Groundwater monitoring was completed in 2014, and site closure documentation is in progress.

1.2 Site Access and Sign-in Procedures

In accordance with ConMed's *Criteria for Remediation System Site Work, Former Lockheed Martin French Road Facility, Utica, NY*, Stantec personnel will sign in during normal business hours at the ConMed front desk and receive a Visitor Pass, which must be worn at all times.

2.0 EMERGENCY PROCEDURES

2.1 Emergency Evacuation

In the case of an emergency requiring evacuation from either the interior of the ConMed facility, the exterior portions of the site within the fence, or from the remediation treatment buildings (located inside (SSDS) and outside (GCTS) the ConMed fence/gates), personnel will exit the site at the gate located in the northeast corner of the site (See Figures 3 and 4). Depending on the nature of the emergency, the need for immediate evacuation can be communicated verbally or by means of an air horn or vehicle horn. Three blasts on the air or vehicle horn would be used to signal distress. All evacuated personnel will assemble at the muster point located in the northeast corner of the parking lot (See Figure 4). The SSO or onsite designee (see Section 4) will coordinate emergency response activities and contact ConMed Facility and ESH managers (see contact list at front of this HASP).

2.2 List of Outside Emergency Contacts

See "Emergency Contacts List" at the front of this Plan. Project Contacts are included in Section 4.

2.3 Directions to Hospital and Urgent Care Facilities

For serious injuries, injured personnel shall be transported to St. Luke's Emergency on Champlin Street in Utica. A map presenting directions to the hospital is included in Figure 1 of this HASP.

For minor injuries, care can be sought at Genesee Urgent Care on Genesee Street in Utica. A map presenting directions to Urgent Care is included in Figure 2 of this HASP.

The routes to these facilities shall be reviewed at the initial site safety meeting and subsequent "tailgate" meetings on site.

2.4 Accident Investigation and Reporting

In the event of an injury or exposure, proper notifications will be made as soon as possible once emergency care (if required) has been provided to the affected employee(s). Stantec's HSE policy requires that such incidents be reported internally to the Stantec Project Manager and/or the project HSE representative. The LMC Project Lead and ConMed EHS Manager (see contact info below in Section 4) will also be informed as soon as is reasonably practicable, generally within 24 hours.

When an injury requires medical treatment for a non-life-threatening injury, the employee shall contact the Workers Compensation Claims Coordinator for assistance. All injuries are reportable, but when OSHA recordable injuries, illnesses, hospitalizations or fatalities occur to Stantec personnel, the necessary documentation required by OSHA will be submitted within timeframes required by law, many time within 8 hours of the event.

Stantec's HSE a policy requires that all incidents, hazards and "near misses" be reported and documented, using the RMS-3 Incident Report form included in Appendix C. The information required for the Incident Report will provide a thorough account of the incident/injury/ exposure, as well as an assessment of the immediate and root cause(s). Corrective action will also be performed as a followup, under the direction of the Stantec Regional Safety and Environment Coordinator, Project Safety Officer and SSO.

3.0 SITE-SPECIFIC CHEMICALS OF CONCERN

3.1 Chlorinated VOCs

Prior site investigations have detected VOCs in groundwater consisting primarily of chlorinated volatile organic compounds (principally 1,1-dichloroethane, cis-1, 2-dichloroethene (cis-1,2-DCE), tetrachloroethene, trichloroethene (TCE), and vinyl chloride); and other VOCs such as benzene, toluene, ethylbenzene, xylene, acetone and 2-butanone. Petroleum-related VOC compounds (BTEX) are also present in groundwater in the West Lot portion of the site at low levels.

Safety Data Sheets (SDSs) for the compounds of concern are included in Appendix D. See Table 1 below for health and safety data relative to these compounds.

Table 1

Health and Safety Data for Volatile Contaminants of Concern

Compound	PEL/ TWA	Physical Description	Odor Threshold	Route of Exposure	Exposure Symptoms	Target Organs
Chloroethane	1000 ppm	Colorless gas or liquid (below 54°F) with a pungent, ether-like odor.	4.07 ppm	inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact	incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage	Liver, kidneys, respiratory system, cardiovascular system, central nervous system
1,1-Dichloroethane (1,1-DCA)	100 ppm	Colorless, oily liquid with a chloroform-like odor.	255 ppm	inhalation, ingestion, skin and/or eye contact	irritation skin; central nervous system depression; liver, kidney, lung damage	Skin, liver, kidneys, lungs, central nervous system
1,1-Dichloroethene (1,1-DCE)	1 ppm	Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor.	35.5 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	Eyes, skin, respiratory system, central nervous system, liver, kidneys
cis- 1,2-Dichloroethene (cis-1,2-DCE)	200 ppm	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.	19.1 ppm	inhalation, ingestion, skin and/or eye contact	Irritation eyes, respiratory system; central nervous system depression	Eyes, respiratory system, central nervous system
Tetrachloroethene (aka Perchloroethene [PCE])	100 ppm	Colorless liquid with a mild chloroform-like odor.	6.17 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys, central nervous system

1,1,1-trichloroethane (1,1,1-TCA)	350 ppm	Colorless liquid with a mild, chloroform-like odor.	22.4 ppm	inhalation, ingestion, skin and/or eye contact	irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, central nervous system, cardiovascular system, liver
Trichloroethylene (TCE)	100 ppm	Colorless liquid with a chloroform-like odor.	1.36 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system
Vinyl chloride	1 ppm	Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations.	0.253 ppm	inhalation, skin, and/or eye contact (liquid)	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]	Liver, central nervous system, blood, respiratory system, lymphatic system
Benzene	10 ppm	Colorless liquid with a characteristic sweet aromatic odor	5 ppm (8.65 ppm)	Inhalation, Skin Absorption, Ingestion, Skin/Eye Contact	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression	Carcinogen; Eyes, Skin, Respiratory System, Blood, Central Nervous System, Bone Marrow
Ethylbenzene	100 ppm	Colorless liquid with an aromatic odor.	2.3 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eyes, skin, respiratory system, central nervous system
Xylenes	100 ppm	Colorless flammable liquid, sweet aromatic odor.	0.08 ppm (0.851 ppm, 0.324 ppm, and 0.49 ppm)	Inhalation, Skin Absorption, Ingestion, Skin/Eye Contact	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eyes, Skin, Respiratory System, Central Nervous System, Gastrointestinal Tract, Blood, Liver, kidneys

Notes:
PEL - permissible exposure limits
TWA - time weighted average, 8-hour workday
mg/m^3 - milligrams per cubic meter.
ppm - parts per million, in air

3.2 Non-VOC Compounds

The following additional, non-VOC compounds have also been identified in soil or groundwater, or are used at the site:

- PCBs (Aroclor 1254 and 1260)
- Hexavalent Chromium
- Lead
- Silver
- Cyanide

Note that these compounds are not currently being analyzed in the groundwater monitoring program, due to relatively minor, low-level presence. Proposed excavation activities have the potential to disturb particulates in soil. The SDSs for non-volatile contaminants are included in Appendix D.

- Relatively small amounts of hydrochloric acid (HCL; also known as muriatic acid) may be used to clean scale from the GCTS (See JSA No. 3). This HCL will be a relatively dilute, over-the-counter product. Necessary precautions must be taken to minimize the volume of acid used. The work should be performed outdoors in a ventilated area and gloves and a face splash guard must be worn.

  If required, larger-scale cleaning of system elements could be performed by a subcontractor at an offsite location in a controlled environment with appropriate protective measures.

- A sequestering agent ("Aries 2908"; [1-Hydroxy-ethylidene] diphosphonic acid) is also used to pre-treat the air stripper influent stream, to reduce scale buildup. The Aries 2908, a liquid, is stored in 30-gallon plastic drums in the GCTS building on a spill containment basin. JSA No. 6 (Appendix B) discusses specific potential hazards for changing out drums of this material.

3.3 Site Monitoring

Field activities associated with O&M activities or groundwater monitoring and sampling may create potentially hazardous conditions due to the migration of contaminants into the breathing zone. These substances may be in the form of mists, vapors, dusts, or fumes that can enter the body through ingestion, inhalation, absorption, and direct dermal contact. Monitoring for VOCs and particulates will be performed as needed to ensure appropriate personal protective measures are employed during site activities.

The following describes the conditions that may need to be monitored during site work activities. Instrument calibrations, background and site measurements will be recorded.

Organic Vapor Concentrations – Organic vapors will be monitored continuously in the breathing zone in the work area with a portable photoionization detector (PID), such as a miniRAE Model 2000 with a 10.2 eV lamp. The instrument will be calibrated daily or as per the manufacturer's recommendations. PID readings will be used as the criteria for

upgrading or downgrading protective equipment and for implementing additional precautions or procedures.

If applicable, split spoons or other soil sampling devices will be monitored using the PID at the time they are opened, with appropriate PPE to be used where soils exhibit measurable volatile organic compound levels.

Explosivity - Explosivity will be monitored continuously when working in areas if the potential exists for flammable petroleum vapors to collect (note that based on the understanding of current site conditions this potential hazard is not anticipated). Measurements obtained from this monitoring instrument will also be used as criteria for implementation of work stoppage or site evacuation. A combination combustible gas/oxygen (CGO_2) instrument, calibrated per manufacturer's recommendations, will be used.

3.4 Air Monitoring Action Levels

The air monitoring action levels are shown below in Table 2.

Table 2
Air Monitoring Action Levels

CHEM-ICAL CLASS	MONI-TORING EQUIPMENT	MONITORING FREQUENCY/ LOCATION	LEVEL FOR RESPIRATOR* USE	LEVEL FOR WORK STOPPAGE
Volatile Organic Vapors	PID (10.2 eV bulb)	Sampling should be continuous in the breathing zone while working in the presence of petroleum product or impacted groundwater. Sample at the exclusion zone (if one is established) boundaries every 30 minutes. Continuously sample during each soil and groundwater sampling interval	If VOC levels of **5 ppm** are sustained in the breathing zone, and no compound-specific (i.e. benzene) monitoring data is available go to Level C PPE (respirator).	**If no compound-specific monitoring data is available, stop work at 50 ppm on the PID. Assess possible engineering controls, or potential need for Level B Protection.** Continuously attempt to determine cause of exposure and usage of engineering controls to attempt to never reach the stop work level.

Table 2 Notes:

1. * - At levels requiring respirator use, determine cause of exposure and implement engineering controls to reduce concentrations. Respirator to be used will be full-face piece respirator with **organic vapor/P 100 Combination Cartridges**.
2. If concentrations in the work zone exceed 50 ppm for a period of 5 minutes or longer, work will be terminated by the SSO. Options to allow continued work activities would then be discussed amongst all parties. Supplied-air respiratory protection is generally required for drilling to resume under these conditions. If Level B protection is not used, work may resume in Level C once monitoring concentrations have decreased below 25 ppm.

3.5 Air Purifying Respirator Use (Level C)

Although unlikely given the levels identified in Site investigations, the potential exists for contaminants to be detected in work areas at levels requiring respiratory protection. If monitoring detects contaminant concentrations at levels requiring an upgrade to Level C protection (i.e. air purifying respirator), the following considerations and restrictions will apply:

- Use of Level C protection will only be employed after engineering controls (e.g. ventilation, etc.) have been attempted;
- Only those personnel trained in use of a respirator and fit-tested (annually, at a minimum) on a specific respirator will be allowed to perform duties;
- Medical clearance for respirator use must have been received by any employees using one;
- Employees will have no facial hair that will impact the effectiveness of the respirator;
- Stantec personnel will use North P-100 Combination Cartridges (or equivalent);
- Respirators will be properly cleaned after each usage, maintained in a manner that will prevent damage, and inspected before each use;
- A seal check will be performed with each day's usage;
- Cartridges will be disposed and replaced after 8 hours of usage, or more frequently if an employee notices smell or taste indicative of a possible chemical breakthrough inside the respirator, or if they notice a change in breathing resistance.
- Any employee will immediately cease work and notify the SSO if they if they experience dizziness, nausea, weakness, breathing difficulty, coughing, sneezing vomiting, fever or chills or other symptoms potentially related to their work.
- A clearly-marked exclusion zone will be established around a work area under level C condition; air monitoring will be performed in the worker's breathing zone as well as the perimeter of the exclusion zone, to establish that contaminant vapors are not present at hazardous levels at the perimeter.

4.0 PROJECT PERSONNEL

The following personnel will be involved in health and safety operations at the Lockheed Martin Utica Site (also see Project Contact List at front of this HASP):

4.1 Client and Site Contacts

- LMC Project Lead: *Charles Trione*	Office	301-548-2223
	Cell	240-328-0905
- LMC S&H Manager: *Jimmy Yeager*	Office	(301) 873-1444
- CDM Smith Manager: *James Zigmont*	Office	(617) 452-6327
	Cell	(857) 234-1661
- ConMed EHS Manager: *Richard Zigenfus*	Office	(315) 624-3197
	Cell	(315) 790-3474

4.2 Primary Stantec Personnel

Telephone numbers for all Stantec Personnel are included in the Contacts Listing at the front of this HASP.

Mr. Peter Nielsen, P.E., Senior Associate, is the Project Manager. Mr. Nielsen is responsible for ensuring that all Stantec procedures and methods are carried out, and that all Stantec personnel abide by the provisions of this Health and Safety Plan.

Mr. Robert Mahoney, P.G. will serve as the Assistant Project Manager (APM) during this project. The APM will report directly to the Project Manager and will be responsible for the implementation and updating, as required, of this HASP. Mr. Mahoney will also serve as the Project Safety Officer and will have overall responsibility for implementation of this HASP, review and auditing of work practices, revisions to this HASP, and incident reporting and followup.

Mr. Ben Haravitch will serve as the Site Safety Officer/Health and Safety Coordinator (SSO/HSC) and will serve at the primary on-site representative. Other staff may serve in this capacity depending on actual staff on the site at any one time. The SSO will be responsible for overall coordination of Health and Safety issues on the project, as well as daily calibration of Stantec's safety monitoring instruments.

5.0 MEDICAL SURVEILLANCE REQUIREMENTS

5.1 Introduction

A. Hazardous waste site workers can often experience high levels of physical and chemical stress. Their daily tasks may expose them to toxic chemicals, physical hazards, biologic hazards, or radiation. They may develop heat stress while wearing protective equipment or working under temperature extremes, or face life-threatening emergencies such as explosions and fires. Therefore, a medical program is essential to: assess and monitor worker's health and fitness both prior to employment and during the course of the work; provide emergency and other treatment as needed; and keep accurate records for future reference. In addition, OSHA requires a medical evaluation for employees that may be required to work on hazardous waste sites and/or wear a respirator (29 CFR Part 1910.120 and 1910.134), and certain OSHA standards include specific medical surveillance requirements (e.g., 29 CFR Part 1926.62, Part 1910.95 and Parts 1910.1001 through 1910.1045).

5.2 Medical Examinations

A. All Stantec personnel working in areas of the site where site-related contaminants may be present shall have been examined by a licensed physician as prescribed in 29 CFR Part 1910.120, and determined to be medically fit to perform their duties for work conditions which require respirators. Employees will be provided with medical examinations as outlined below:

- Pre-job physical examination;
- Annually thereafter if contract duration exceeds 1 year;
- Termination of employment;
- Upon reassignment in accordance with CFR 29 Part 1910.120(e)(3)(i)(C);
- If the employee develops signs or symptoms of illness related to workplace exposures;
- If the physician determines examinations need to be conducted more often than once a year; and
- When an employee develops a lost time injury or illness during the Contract period.

B. Examinations will be performed by, or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and will be provided without cost to the employee, without loss of pay and at a reasonable time and place. Medical surveillance protocols and examination and test results shall be reviewed by the Occupational Physician.

6.0 HAZARD COMMUNICATION

Stantec has a hazard Communication (HazCom) program designed to provide a framework under which all Stantec US employees are adequately protected from the hazards of toxic, reactive, flammable or explosive chemical exposure. This program is written to meet the requirements of US hazard communication regulations in 29 CFR 1910.1200.

The HazCom Program is described in detail in Stantec Safe Work Practice SWP-104. A copy of this written program in included in Appendix E.

7.0 ON-SITE HAZARDS

7.1 Onsite Meetings and Recordkeeping

Stantec personnel and contractors working at the site will conduct daily onsite safety meetings to discuss potential hazards for each day's activities. The meeting content will be recorded on the Stantec Risk Management Strategy 2 (RMS2) Fit for Duty form included in Appendix C. Daily meeting forms, dedicated calibration logs, Safety Data Sheets, and other applicable documentation will be kept with the HASP on the Site at a known and accessible location.

7.2 Chemical Hazards

The primary potential chemical hazards on-site are expected to be exposure to the VOCs detailed in Table 1. Safety data sheets for the documented VOCs are presented in Appendix D.

The soil and groundwater contaminants are volatile; therefore, any activity at the site which involves recovered groundwater or treatment system vapor or sub-slab vapor can potentially allow the release of VOCs into the air. Such an occurrence may be recognized by noticeable chemical odors. Field personnel should be aware of the odor threshold for these chemicals and their relation to the action levels and Permissible Exposure Limits. See Table 3 below for First Aid responses to potential exposure. Disturbance of site soils may cause the particulate contaminants to become airborne. Ground-intrusive work (such as excavation) presents additional possible exposure pathway risks through inhalation and dermal contact. Field personnel should be aware of odor thresholds, PELs, First Aid responses (Table 3), and appropriate personal protective equipment (PPE) described below.

Symptoms of overexposure to primary compounds of concern are detailed in Table 1. To prevent exposure to these chemicals, dermal contact will be minimized by using disposable surgical gloves with work gloves (as appropriate) when handling soil, groundwater equipment or samples. Real time, breathing zone levels of total VOCs will be monitored using a portable photoionization detector (PID). If ambient levels exceed action levels (See table 2), site activities will be performed using level C personal protection until ambient concentrations dissipate. If levels are sustained in excess of 50 ppm, work will cease and the Project Manager will be notified immediately.

In addition to the VOCs listed in Table 1, other chemicals are considered contaminants of concern based on past practices at the site and on a recent site-wide surface soil sampling program. These include PCBs (Aroclor 1254, Aroclor 1260), Hexavalent Chromium, Cyanide, Lead, and Silver.

Table 3
Exposure Pathways and First Aid Response for Contaminants of Concern

Substance	Exposure Pathways	First-Aid Instructions
VOCs listed in Table 1	Eye	Irrigate immediately
	Dermal	Soap wash promptly (soap flush immediately for 1,1-DCE)
	Inhalation	Respiratory support
	Ingestion	Medical attention immediately
PCBs	Eye	Flush with water
	Dermal	Soap wash promptly
	Inhalation	Move to fresh air
	Ingestion	Rinse with water. Seek medical help.
Cyanide	Eye	Remove contact lenses, flush with water for fifteen minutes
	Dermal	Flush skin with water and antibacterial soap, remove all contaminated clothing, seek medical help
	Inhalation	Move to fresh air
	Ingestion	Do not induce vomiting, seek medical help
Lead, Silver	Eye	Remove contact lenses, flush for fifteen minutes
	Dermal	Flush skin immediately with soap and water (lead)
	Inhalation	Move to fresh air
	Ingestion	Do not induce vomiting, seek medical help

7.3 Physical Hazards

Hazards typically encountered at manufacturing sites will be a concern at this site. These hazards include large truck traffic, slip, trip and fall hazards, and operation of heavy machinery and equipment. In addition, the GCTS and SSDS buildings contain equipment under high-voltage electrical charge, and elevated pressures. Other potential concerns include work at height on ladders or lifts, oversight of drilling activities and sampling, and confined space entry in the event activities related to the GCTS manholes is required. JSAs are included in Appendix B for applicable activities.

Field team members shall wear proper PPE at all times when on site, including:

- Steel-toed shoes

- Hard hat
- Safety glasses
- Chemical-resistant gloves when the potential exists for contact with contaminants
- Impact-resistant gloves when using hand tools or performing tasks with the potential for pinching or impact from tools or moving parts.
- Reflective safety vest when working in any exterior areas or inside the ConMed facility. Vests are not required when working inside the GCTS or SSDDS treatment buildings; however it is recommended they be worn at all times.

Field personnel working around the systems will be familiar with power controls, circuit breakers and related equipment.

Multi-purpose fire extinguishers, functional and within annual inspection period, are staged in readily-accessible locations in the GCTS and SSDS buildings.

The use of electrical equipment in any established exclusion zones will be limited to areas verified as containing non-explosive atmospheres (<10% LEL) prior to operation, unless the equipment has been previously demonstrated or designed to be FM or UL rated as intrinsically safe. Care will be taken to avoid an ignition source while working in the presence of vapors.

7.3.1 Ground-Intrusive Activities

Any work constituting ground disturbance must include pre-clearance activities in accordance with “Lockheed Martin Minimum Requirements for Intrusive Fieldwork Work Plans”. See Appendix A of Lockheed Martin – “Remediation Contractor’s ESH Handbook”. Pre-clearance activities include completion and sign off of the Dig Permit and Risk Handling Checklist that are included within the above referenced document (provided in Appendix A).

7.3.2 Excavation Activities

Excavation activities present hazards related to open excavations, large equipment, and exposure to chemical vapors.

The potential exists for falling into the excavation due to a slip or trip and also due to potential caving, depending on the size and shape of the excavation area. During excavation activities, field personnel will generally perform observation from the end of the excavation opposite the operating equipment and will avoid standing along the long walls of the pit. If it is necessary to make observations from a point along the long side of the pit, field personnel will maintain adequate distance between themselves and the walls, and be mindful of signs that caving may be likely. These could include raveling of sidewall material into the pit, or the development of cracks in the ground surface. Field personnel will not enter excavations greater than 4 feet deep per OSHA regulations.

As with any soil disturbance, monitoring for VOCs with a photoionization detector will be performed continuously during test pit excavation and logging activities. Work

will be stopped and the area vacated is sustained PID readings are observed at concentrations in excess of the Action Levels specified in Section 3.4.

7.3.3 Geoprobe Drilling Activities

Direct-push drilling activities will likely utilize a Geoprobe rig. Drilling activities present hazards related to powered equipment with moving parts, elevated noise levels and exposure to chemical vapors. The potential also exists for falling into the excavation due to a slip or trip and also due to potential caving, depending on the size and shape of the excavation area. As with any soil disturbance, monitoring for VOCs with a photoionization detector will be performed continuously during drilling, logging, and soil sampling activities. Work will be stopped and the area vacated is sustained PID readings are observed at concentrations in excess of the Action Levels specified in Section 3.4.

7.3.4 Noise

The use of heavy machinery/equipment and operation may result in noise exposures, which require hearing protection. Exposure to noise can result in temporary hearing losses, interference with speech communication, interference with complicated tasks or permanent hearing loss due to repeated exposure to noise.

All field staff will use hearing protection when sound levels are in excess of 90 dB TWA.

7.3.5 Heat and Cold Stress Exposure

Heat is a potential threat to the health and safety of site personnel. The Site Safety Officer under the direction of the Project Manager will determine the schedule of work and rest. These schedules will be employed as necessary so that personnel do not suffer adverse effects from heat. Table 4 summarizes exposure symptoms and first aid instructions for heat stress. Non-caffeinated, thirst replenishment liquids will be available on-site.

Cold stress is also a potential threat to the health and safety of site personnel. Symptoms of cold stress include, shivering, blanching of the extremities, numbness or burning sensations, blue, purple or gray discoloration of hands and feet, frostbite, hypothermia, and loss of consciousness. Cold stress can be prevented by acclimatizing one's self to the cold, increasing fluid intake, avoiding caffeine and alcohol, maintaining proper salt and electrolyte intake, eating a well-balanced diet, wearing proper clothing, building heated enclosures to work in, and taking regular breaks to warm up. If any of the above symptoms are encountered the person should be removed from the cold area. Depending on the severity of the cold stress, 911 should be contacted and first aid administered. No fluids should be given to an unconscious person. Field personnel will communicate with the project manager and assistant project manager should weather conditions become dangerous for the field work to continue.

Table 4
Exposure Symptoms and First Aid for Heat Exposure

Hazard	Exposure Symptoms	First-Aid Instructions
Heat Stress	Fatigue, sweating, irritability	rest; take fluids
	Dizziness, disorientation, perspiration ceases, loss of consciousness	remove from hot area, activate 911, administer first aid, no fluids to be administered to unconscious victim.

7.3.6 Roadway Hazards

If field activities are planned to take place near active roadways, personnel shall assure that protective measures including signage, cones, and shielding through use of vehicles parked at workmen perimeter, are in place. All contractors shall be responsible for meeting signage requirements of NYSDOT. Reflective safety vests shall be worn by all personnel during activities in or adjacent to roadways and driveways.

7.3.7 Electrical Work

Site work involving electrical installation or energized equipment must be performed by a qualified electrician. All electrical work will be performed in accordance with the OSHA electrical safety requirements found in 29 CFR 1926.400 through 1926.449. Workers are not permitted to work near electrical power circuits unless the worker is protected against electric shock by de-energizing and grounding the circuit or by guarding or barricading the circuit and providing proper personal protective equipment. All electrical installations must comply with NEC regulations. All electrical wiring and equipment used must be listed by a nationally recognized testing laboratory.

All electrical circuits and equipment must be grounded in accordance with the NEC regulations. The path to ground from circuits, equipment, and enclosures will be permanent and continuous. Ground fault circuit interrupters (GFCIs) are required on all 120-volt, single phase, 15- and 20-amp outlets in work areas that are not part of the permanent wiring of the building or structure. GFCIs must be tested regularly with a GFCI tester.

Heavy-duty extension cords will be used; flat-type extension cords are not allowed. All extension cords must be the three-wire type, and designed for hard/extra hard usage. Electrical wire or cords passing through work areas must be protected from water and damage. Worn, frayed, or damaged cords and cables will not be used. Walkways and work spaces will be kept clear of cords and cables to prevent a tripping hazard. Extension cords and cables may not be secured with staples, hung from nails, or otherwise temporarily secured. Cords or cables passing through holes in covers, outlet boxes, etc., will be protected by bushings or fittings.

All lamps used in temporary lighting will be protected from accidental contact and breakage. Metal shell and paper-lined lamp holders are not permitted. Fixtures, lamp holders, lamps, receptacles, etc. are not permitted to have live parts. Workers must not have wet hands while plugging/unplugging energized equipment. Plugs and receptacles will be kept out of water (unless they are approved for submersion).

If required, and prior to any electrical work, appropriate lock-out/tag-out procedures will be implemented (see discussion below in Section 7.3.8).

7.3.8 Lock-Out/Tag-Out

Before a worker sets up, services, or repairs a system where unexpected energizing (or release of stored energy) could occur and cause injury or electrocution, the circuits energizing the parts must be locked-out and tagged. Only authorized personnel will perform lock-out/tag-out procedures. All workers affected by the lock-out/tag-out will be notified prior to, and upon completion of, the lock-out/tag-out procedure.

Lock-out/tag-out devices must be capable of withstanding the environment to which they are exposed. Locks will be attached in such a way as to prevent other personnel from operating the equipment, circuit, or control, or from removing the lock unless they resort to excessive force. Tags will identify the worker who attached the device, and contain information, which warns against the hazardous condition that will result from the system's unauthorized start-up. Tags must be legible and understood by all affected workers and incidental personnel. The procedures for attaching and removing lock-out/tag-out devices include the steps outlined in the following table.

If maintenance work is required, the electrical supply to the equipment must be disconnected. Turning off the MAIN breaker using the disconnect switch will disconnect all power to the system. Once the disconnect switch has been turned off, the switch will be locked-out using the steps outlined on the following page.

STEP	LOCK-OUT/TAG-OUT PROCEDURES
1	Disconnect the circuits and/or equipment to be worked on from all electrical energy sources.
2	Ensure that the system is completely isolated so that it cannot be operated at that shut-off point or at any other location.
3	Release stored electrical energy.
4	Block or relieve stored non-electrical energy.
5	Place a lock on each shut-off or disconnect point necessary to isolate all potential energy sources. Place the lock in such a manner that it will maintain the shut-off/disconnect in the off position.
6	Place a tag on each shut-off or disconnect point. The tag must contain a statement prohibiting the unauthorized re-start or re-connect of the energy source and the removal of the tag, and the identity of the individual performing the tag and lock-out.

(continued next page)

7	Workers who will be working on the system must place their own lock and tag on each lock-out point.
8	A qualified person must verify the system cannot be re-started or re-connected, and de-energization of the system has been accomplished.
Once the service or repairs have been made on the system:	
1	A qualified person will conduct an inspection of the work area, to verify that all tools, jumpers, shorts, grounds, etc., have been removed so that the system can then be safely re-energized.
2	All workers stand clear of the system.
3	Each lock and tag will be removed by the worker who attached it. If the worker has left the site, then the lock and tag may be removed by a qualified person under the following circumstances: a. The qualified person ensures the worker who placed the lock and tag has left the site; and b. The qualified person ensures the worker is aware the lock and tag has been removed before the worker resumes work on-site.

7.3.9 Ladders

One-third of worker deaths in construction result from falls. Many falls occur because ladders are not placed or used safely. Ladder use will comply with OSHA 1926.1053 through 1926.1060, including the following safety requirements:

STEP	PROPER LADDER USE PROCEDURE
1	Choose the right ladder for the task--the proper type and size, with a sufficient rating for the task.
2	Check the condition of the ladder before climbing. • Do not use a ladder with broken, loose, or cracked rails or rungs. • Do not use a ladder with oil, grease, or dirt on its rungs. • The ladder should have safety feet.
3	Place the ladder on firm footing, with a four-to-one pitch.
4	Support the ladder by: • Tying it off; • Using ladder outrigger stabilizers; or • Have another worker hold the ladder at the bottom. If another worker holds the ladder, they must: • Wear a hard hat; • Hold the ladder with both hands; • Brace the ladder with their feet; and

	• Not look up.
5	Keep the areas around the top and bottom of the ladder clear.
6	Extend the top of the ladder at least 36 inches (3 feet) above the landing.
7	Climb the ladder carefully - facing it - and use both hands. • Use a tool belt and hand-line to carry material to the top or bottom of the ladder. • Wear shoes in good repair with clean soles.
8	Inspect the ladder every day, prior to use, for the following problems: • Rail or rung damage • Broken feet • Rope or pulley damage • Rung lock defects or damage • Excessive dirt, oil, or grease If the ladder fails inspection, it must be removed from service and tagged with a "Do Not Use" sign.

Ladders with non-conductive side rails must be used when working near electrical conductors, equipment, or other sources. Ladders will not be used horizontally for platforms, runways, or scaffolds.

7.3.10 Hydraulic Man-lifts

All hydraulic man-lifts will be operated in accordance with 29 CFR 1926, Subpart 1926.556. A JSA for anticipated aerial lift usage on this site is included in Appendix B.

7.3.11 Hand and Power Tools

All hand and power tools will be maintained in a safe condition and in good repair. Hand and power tools will be used in accordance with 29 CFR 1926, Subpart I (1926.300 through 1926.307). Neither Stantec nor its subcontractors will issue unsafe tools, and workers are not permitted to bring unsafe tools on-site. All tools will be used, inspected, and maintained in accordance with the manufacturer's instructions. Throwing tools or dropping tools to lower levels is prohibited. Hand and power tools will be inspected, tested, and determined to be in safe operating condition prior to each use. Periodic safety inspections of all tools will be conducted to assure that the tools are in good condition, all guards are in place, and the tools are being properly maintained. Any tool that fails an inspection will be immediately removed from service and tagged with a "Do Not Use" sign.

Workers using hand and power tools, who are exposed to falling, flying, abrasive, or splashing hazards will be required to wear personal protective equipment (PPE). Eye protection must always be worn when working on-site. Additional eye and face protection, such as safety goggles or face shields, may also be required when working with specific hand and power tools. Workers, when on-site, will wear hard

hats. Additional hearing protection may be required when working with certain power tools. Workers using tools, which may subject their hands to an injury, such as cuts, abrasions, punctures, or burns, will wear protective gloves. Loose or frayed clothing, dangling jewelry, or loose long hair will not be worn when working with power tools.

Electric power-operated tools will be double insulated or grounded, and equipped with an on/off switch. Guards must be provided to protect the operator and other nearby workers from hazards such as in-going nip points, rotating parts, flying chips, and sparks. All reciprocating, rotating and moving parts of tools will be guarded if contact is possible. Removing machine guards is prohibited.

Abrasive wheels will only be used on equipment provided with safety guards. Safety guards must be strong enough to withstand the effect of a bursting wheel. Abrasive wheels will not be operated in excess of their rated speed. Work or tool rests will not be adjusted while the wheel is in motion. All abrasive wheels will be closely inspected and ring tested before each use, and any cracked or damaged wheels will be removed immediately and destroyed.

Circular saws must be equipped with guards that completely enclose the cutting edges and have anti-kickback devices. All planer and joiner blades must be fully guarded. The use of cracked, bent, or otherwise defective parts is prohibited. Chain saws must have an automatic chain brake or kickback device. The worker operating the chain saw will hold it with both hands during cutting operations. A chain saw must never be used to cut above the operator's shoulder height. Chain saws will not be re-fueled while running or hot. Power saws will not be left unattended.

Only qualified workers will operate pneumatic tools, powder-actuated tools, and abrasive blasting tools.

7.3.12 Manual Lifting

Back injuries are among the leading occupational injuries reported by industrial workers. Back injuries such as pulls and disc impairments can be reduced by using proper manual lifting techniques. Leg muscles are stronger than back muscles, so workers should lift with their legs and not with their back. Proper manual lifting techniques include the following steps:

STEP	PROPER MANUAL LIFTING PROCEDURE
1	Plan the lift before lifting the load. Take into consideration the weight, size, and shape of the load.
2	Preview the intended path of travel and the destination to ensure there are no tripping hazards along the path.
3	Wear heavy-duty work gloves to protect hands and fingers from rough edges, sharp corners, and metal straps. Also, keep hands away from potential pinch points between the load and other objects.
4	Get the load close to your ankles, and spread your feet apart.

	Keep your back straight and do not bend your back too far; instead bend at your knees.
5	Feel the weight; test it.
6	Lift the load smoothly, and let your legs do the lifting. If you must pivot, do not swing just the load; instead, move your feet and body with the load.

If the load is too heavy, then do not lift it alone. Lifting is always easier when performed with another person. Assistance should always be used when it is available.

7.3.13 Weather-Related Hazards

Weather-related hazards include the potential for heat or cold stress (see Section 7.3.13), electrical storms, treacherous weather-related working conditions, or limited visibility. These hazards correlate with the season in which site activities occur. Outside work will be suspended during electrical storms. In the event of other adverse weather conditions, the Site Safety Officer will determine if work can continue without endangering the health and safety of site personnel.

7.3.14 GCTS Manholes and Storm Sewer Catch Basins

The groundwater collection manholes are up to 17 ft deep and contain contaminated groundwater, piping and electrical equipment. The Site's storm water catch basins also potentially contain contaminated water and are not designed for personnel occupancy. Accordingly, each of these structures are classified as "Permit-Required Confined Space" in accordance with OSHA Standard 1910.146, and entry can only be performed under a proper Confined Space Entry Permit. Stantec personnel are not currently authorized to enter confined spaces. As such, if entry into a manhole or catch basin is necessary to perform OM&M duties (inspection, repair, etc), only a subcontractor with properly-trained and experienced personnel will be allowed to perform these duties, under Stantec oversight. Any such entry would be performed under a Confined Space Permit. The subcontractor will be required to submit a Confined Space Plan, including documentation of training for its personnel to Stantec and LMC for review and approval prior to performing confined space entry.

Stantec Personnel will be allowed to open the GCTS manholes for observation and sampling purposes only. The manholes contain a safety net that covers the opening and that will help prevent an accidental fall into the manhole. Traffic cones will be placed around the manhole prior to opening. Activities that require reaching down into the manhole or catch basin will not be allowed.

The storm water catch basins can typically be sampled without removing the cover, since the sample is obtained remotely using a hand pump and tubing extended through openings in the basin cover. If the catch basin cover requires removal for inspection or other reasons, caution must be used to remove the cover in a manner

that minimizes the potential for injury due to pinching, crushing or back strain. It is recommended that two people perform the removal, and that a properly-designed and properly-sized lifting mechanism be employed.

7.3.15 Working Alone

There will be instances where Stantec personnel will be performing site activities alone. In such instances, personnel will follow the guidelines included in Stantec Safe Work Practice No. 118, "Working Alone in the Field" (see Appendix C).

7.3.16 West Lot

Conditions on the West Lot portion of the site are significantly different from the Solvent Dock Area. The West Lot is a mixture of paved, brush-covered and wooded areas, and is located somewhat remotely from the ConMed Facility proper. Potential hazards associated with working in this area include:

- Walking in dense brush
- Poison ivy
- Bees, ticks or other biting insects, and snakes.
- Uneven terrain
- Areas of standing water and potentially iced-over, ponded areas.

Precautions must be taken when working in this area to avoid these potential hazards. These can include:

- Wearing steel-toe, ankle-high boots and safety glasses;
- Wearing heavy pants and long sleeves;
- Employ a contractor with brush removal equipment prior to accessing wells;
- Inspecting well protective casings for possible bees nests prior to opening, and opening slowly. Bee spray may be necessary;
- Using established trails and roadways to the extent possible.

7.4 Housekeeping

Stantec recognizes that housekeeping practices can have an impact on project task execution efficiency as well as worker's safety. Accordingly, the work areas in the GCTS and SSDS buildings will be kept neat and free of loose debris, materials or trash. When performing sampling in interior areas of the main ConMed facility, all tools and materials will be used and temporarily stored in an orderly fashion such that they do not impact or impede ConMed employees working in the area. This includes securing electrical cords, and sampling or datalogging equipment in a manner that minimizes trip hazards.

Waste materials generated during execution of field work tasks may consist of:

- Spent PPE (gloves, respirator cartridges, etc);
- Disposable sampling equipment (bailers, rope, filters, tubing etc);
- Mechanical system-related materials (PVC or other piping);

Containers will be provided for the collection of these materials. Accumulated trash will be placed in an onsite solid waste container as directed by ConMed. The closed-top poly drums of liquid sequestering agent, when emptied, will be cleaned, rinsed and removed from the site.

8.0 SITE WORK ZONES

The following work zones will be physically delineated by Stantec when subsurface investigation activities are required. Currently-anticipated activities include direct-push Geoprobe drilling of test borings, operation of downhole and surface Membrane Interface Probe (MIP) equipment, and soil sampling in unoccupied interior and exterior areas. Work will also include possible water and sediment sampling/removal/containerization in the sump in the Pole Barn. Geoprobe drilling is relatively non-intrusive, i.e. boreholes are small diameter, small quantities of subsurface soil are disturbed and brought to the surface, and the impact of chemical vapors from contaminated soil is generally very low in an outdoor setting. Air monitoring will be performed in the worker's breathing zone during active work.

The Pole barn has a large overhead door and a smaller access door that will remain open for ventilation during drilling activities. If necessary, an electric fan can be employed as an engineering control to provide more aggressive ventilation; the need for this will be evaluated based on PID readings in the work zone. In addition, if necessary the drill rig exhaust can be ventilated to the outside with flexible piping.

Eating and smoking will not be allowed in either the exclusion or decontamination zones.

8.1 Control Zones

Control zone boundaries will be established within the areas of site activities. Zone boundaries will be dynamic, and will be determined by the planned activities for the day, weather and wind conditions, etc. The Health and Safety coordinator will record the names of visitors to the site and insure they do not access areas for which they are not protected with the proper PPE.

8.2 Exclusion Zone

The exclusion zone will consist of the work area in close proximity to the drill rig, estimated to consist of a radius of approximately 25 ft. from the working borehole. This area will be delineated by stakes and flagging, with a single entrance location, and the highest level of personal protective equipment will be required for entry during intrusive activities. PPE for Geoprobe drilling is anticipated to be Level D: hard hat, safety glasses, steel-toe boots, and glove appropriate for the work activities. Tyvek or other protective suits will be optional, unless grossly-contaminated soils are encountered during drilling. If such conditions are encountered, personnel within the exclusion zone will be required to don Tyvek suits. In addition, if air monitoring indicates VOC threshold levels are being exceeded, PPE will be upgraded accordingly, as described in Section 9 below.

The exclusion zone will include a work area where Geoprobe sample sleeve will be opened to expose the soil for PID screening and obtaining samples for laboratory analysis. Drums for placing unused drill cuttings will be located within the exclusion zone while open.

A "super exclusion" zone will be established within approximately 10 ft. radius of the borehole which will not be entered by Stantec personnel at any time during any active drilling, slam bar, cathead, silica sand dumping, or other related activities (note that most of these do not apply to Geoprobe drilling). The drilling contractor will be directed to stop such activity if Stantec site team members have a need to enter this zone.

8.3 Personnel and Monitoring Equipment Decontamination Zone

The decontamination zone will be located immediately outside the entrance to the exclusion zone on its apparent upwind side, if feasible, and will be delineated with stakes and flagging or traffic cones as needed. Personnel leaving the exclusion zone will be required to adhere to proper decontamination procedures. Equipment utilized within the exclusion zone will also require decontamination at completion of the work.

This zone will contain the necessary decontamination materials for personnel decontamination. The ground will be covered with poly sheeting to insure impacted soils are not tracked onto the ground outside the exclusion zone.

Decontamination procedures are outlined in Section 10.0 of this plan.

8.4 Drill Equipment Decontamination

Drilling tools that are exposed to subsurface soil will be decontaminated with a “three-bucket” system using an Alconox wash and two tap water rinses. The cleaning fluids will be transferred to drums with other decontamination fluids for characterization and disposal as investigation-derived waste.

9.0 PERSONAL PROTECTIVE EQUIPMENT

Based on an evaluation of the hazards at the site, personal protective equipment (PPE) will be required for all personnel and visitors entering the drilling exclusion zone(s). It is anticipated that all Stantec oversight work will be performed in Level D. All contractors will be responsible for selection and implementation of PPE for their personnel.

9.1 Protective Clothing/Respiratory Protection:

Protective equipment for each level of protection is as follows:

When PID readings range between background and 5 ppm use Level D:

Level D

* Safety glasses (for working with liquids-chemical goggles or a full-face splash shield;
* Steel-toed boots;
* Protective cotton, latex or leather gloves, or acid-resistant gloves if working with acid solutions;
* Hard hat; and
* Tyvek suit (optional).

When PID readings range between 5 and 50 ppm (without compound-specific (i.e. benzene) monitoring data, upgrade to Level C:

Level C

* Full face, air purifying respirator with acid gas/HEPA cartridge;
* Disposable chemical resistant one-piece suit (Tyvek or Saranex, as appropriate);
* Inner and outer acid-resistant gloves;
* Hard hat;
* Steel-toed boots; and
* Disposable booties.

If PID readings are above 50 ppm (without compound-specific (i.e. benzene) monitoring data requiring an upgrade to Level B, site work will be halted pending review of conditions and options by Stantec and other involved parties.

10.0 DECONTAMINATION

10.1 Personnel Decontamination

If working in an established Exclusion Zone (typically anticipated for activities that disturb significant amounts of soil only) personnel will observe the following procedures upon leaving the exclusion zone:

1. Remove outer boots and outer gloves and place in disposal drum.
2. If using a respirator, remove respirator, dispose of cartridges if necessary, and set aside for later cleaning.
3. Remove disposable chemical resistant suits and dispose of in drum.
4. Remove and dispose of inner gloves.

Decontamination solutions shall be supplied at the decontamination zone. The wash solution will consist of water and detergent such as Alconox or trisodium phosphate (TSP), and the rinse solution will consist of clean tap water.

Contaminated wash solutions shall be collected in drums for disposal. All other disposable health and safety equipment will be decontaminated and disposed of as non-hazardous waste.

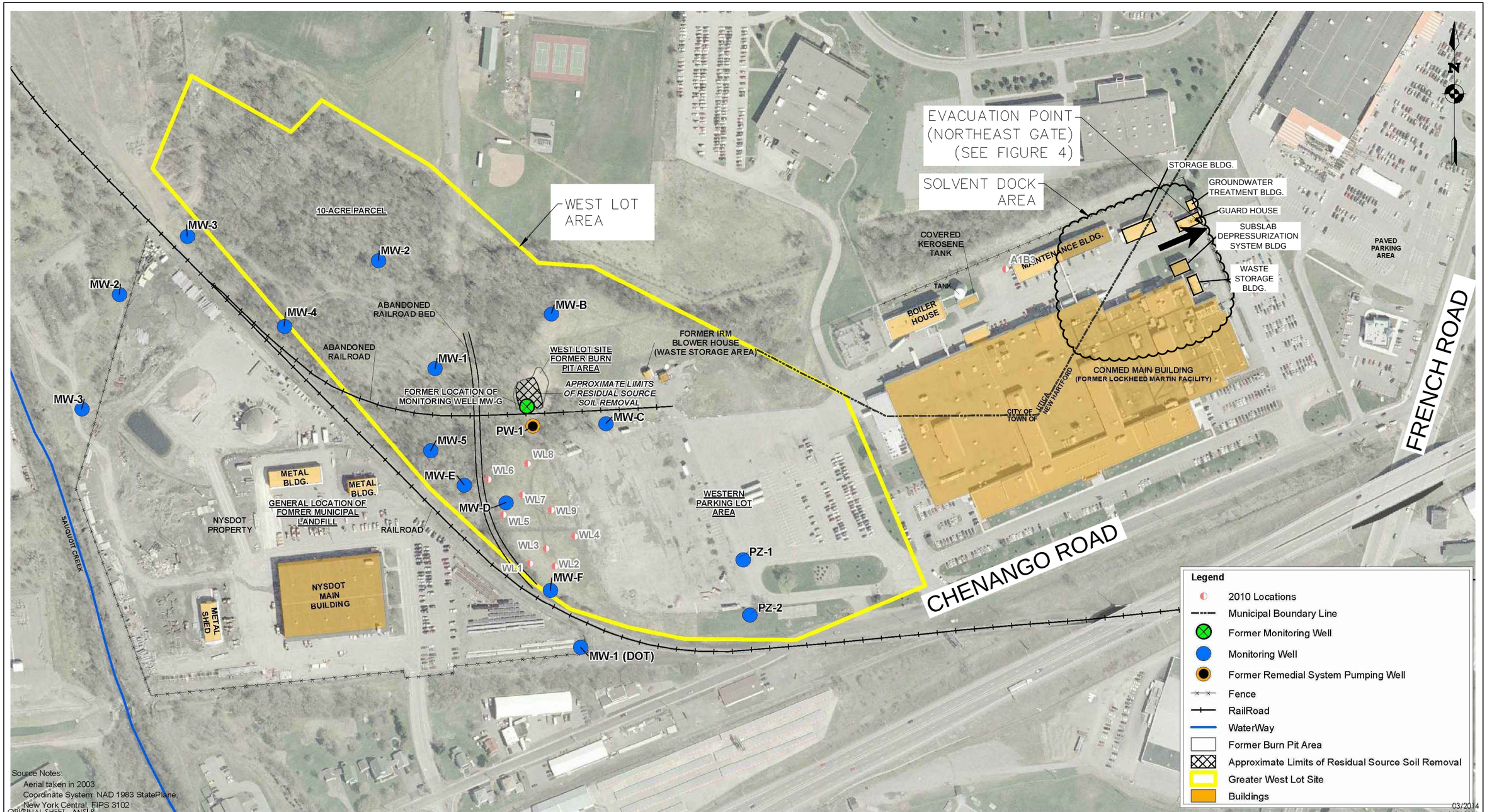
10.2 Equipment Decontamination

Equipment used during O&M activities that has potentially been exposed to site contaminants will be properly washed or steam-cleaned prior to exiting the decontamination zone. Pre- or post-use rinsing using solvents will be done wearing appropriate PPE.

Monitoring instruments will be cleaned with disposable alcohol-based wipes in the decontamination zone.

FIGURES

(Figures 1 and 2 are located at the front of the document)



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2014/03/11 3:02 PM By: Less, Andy

Stantec

61 Commercial Street, Suite 100
Rochester, New York USA 14614
585.475.1440 www.stantec.com

Notes

1.) Adapted from drawing entitled: "Monitoring Well Network, West Lot Site, Former Lockheed Martin French Road Facility, Utica, New York, " by ARCADIS, dated Sept. 19, 2013

Client/Project
FORMER LOCKHEED MARTIN FACILITY
525 FRENCH ROAD, UTICA , NEW YORK
HEALTH AND SAFETY PLAN

Figure No.
3

Title
SITE PLAN

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Rochester, New York USA 14614
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Client/Project

FORMER LOCKHEED MARTIN FACILITY
525 FRENCH ROAD, UTICA , NY
HEALTH AND SAFETY PLAN

Figure No.

4

Title

EMERGENCY
EVACUATION PLAN

APPENDIX A

LMC AND CONMED SAFETY DOCUMENTS

LOCKHEED MARTIN

REMEDIATION CONTRACTOR'S ESH HANDBOOK

June 10, 2009

Revision 1

Lockheed Martin Corporation
Energy, Environment, Safety & Health

A COPY OF THE JOB SPECIFIC HASP SHALL BE AVAILABE AT THE JOB SITE FOR THE DURATION OF THE PROJECT

REVISION STATUS

REVISION	DATE	COMMENTS
1	06/10/2009	

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CONTRACTOR'S ESH HANDBOOK

GENERAL

Lockheed Martin Corporation management at all levels is committed to conducting operations and activities in a manner that provides and maintains safe and healthful working conditions, protects the environment, and conserves natural resources.

This *Contractor's ESH Handbook* has been prepared to assist each project jobsite employer/contractor in satisfying its' contractual and legal accident prevention responsibilities, in such a manner that a safe, efficient operation is assured. All applicable requirements outlined in this handbook shall be incorporated into the contractor's site specific Safety and Health Plan The site specific Safety and Health plan shall be submitted to the Lockheed Martin Project Lead at least two weeks prior to starting work on any Lockheed Martin remediation projects.

This material must not be considered to be all inclusive as to the hazards that might be encountered, safe practices that should be performed, or safe conditions that should be maintained during the course of any project. Moreover, this handbook does not replace the contractor's legal obligation to its employees under all relevant environmental, safety and health requirements and laws. All legal standards not specifically referenced in this handbook shall apply when applicable.

1 CONTRACT RESPONSIBILITIES

The Contractor agrees to comply with all rules and procedures contained in this document, known as the *Remediation Contractor's ESH Handbook*, unless Lockheed Martin specifically agrees, in writing, to a modification or exemption. In addition, the Contractor and subcontractors, at any tier, shall:

1.1 Lockheed Martin is a drug free-work workplace. This requirement extends to contractors working on Lockheed Martin remediation projects. Additionally, the use of tobacco is not permitted on Lockheed Martin owned property.

1.2 Take all prudent and proper environmental, safety and health (ESH) precautions to protect Lockheed Martin employees, all other workers, and the public from ESH hazards associated with contractor activities.

1.3 Comply with all applicable Federal, State, municipal, local, and any other applicable occupational safety and health statutes, rules, ordinances, regulations, and requirements issued or imposed by any governmental authority (including, but not limited to *Title 29, Code of Federal Regulations Parts 1903, 1904, 1910* and *1926*).

1.4 Comply with all applicable Federal, State, municipal, local, and any other applicable air pollution statutes, rules, ordinances, regulations, and requirements issued or imposed by any governmental authority.

1.5 Comply with all Federal, State, municipal, local and Lockheed Martin hazardous materials, hazardous waste, and non-hazardous waste statutes, rules, ordinances, regulations, and requirements (including, but not limited to *Title 40, Code of Federal Regulations*).

1.6 Obtain the applicable ESH permits to conduct the work in compliance with local, state, federal ESH regulations and site requirements (including, but not limiting to *Title 29, Code of Federal Regulations, 1910 and 1926*).

1.7 Ensure that all employees and subcontractors have received the appropriate level of ESH training in accordance with applicable ESH regulations necessary for the performance of the work requested by Lockheed Martin.

1.8 To instruct, prior to commencement of operations, all employees on the jobsite about relevant governmental laws and regulations, specific hazards expected to be encountered and proper safety precautions to be observed. In addition, jobsite employees shall read and certify that they have read and understand the job specific health and safety plan (HASP). The certification forms provided by the contractor within the HASP shall be electronically sent to the Lockheed Martin Project Lead.

1.9 Provide all jobsite visitors with a safety orientation prior to commencing work or touring the site. A visitor log shall be kept to document the orientation.

1.10 To ensure Contractor's job specific health and safety plan (HASP) encompasses Federal, State, municipal, local and the Lockheed Martin requirements found within this document the HASP should contain a section on crisis management / emergency response. A copy of the job specific HASP shall be maintained at the job site where jobsite employees have access to a copy. All Contractor Project Managers shall be provided a copy of the *Contractor's ESH Handbook* found within the Lockheed Martin Request for Proposal or as an appendix of the Key National Contractor Agreement. Contractors shall flow these requirements down to their subcontractors.

1.11 Contractor understands that Lockheed Martin may immediately stop Contractor's work if Contractor violates any applicable Federal, State, municipal, local, or any other rules, regulations, and requirements, *Remediation Contractor's ESH Handbook* provisions, or other contract terms and conditions regarding environmental, safety and health compliance. Lockheed Martin shall not incur work stoppage charges unless the contractor demonstrates that the work stoppage was unwarranted for any of the reasons stated above. Any dispute regarding work stoppage charges must be resolved through binding arbitration.

1.12 Contractor is advised that the Project may be inspected from time to time by Lockheed Martin or a representative of Lockheed Martin. Periodic Lockheed Martin inspections in no way relieve the Contractor of their obligation to maintain its own inspection program to identify unsafe conditions or acts. ESH violations will be considered in evaluation of Contractor's performance.

1.13 Lockheed Martin is not responsible for training or supervising Contractor employees or abating workplace hazards created by the Contractor or to which the Contractor's employees are exposed.

1.14 Contractor agrees to maintain copies of all pertinent ESH records at the job site. Pertinent records include, but is not limited to, personnel training documentation, evidence of enrollment in a medical surveillance program, accident/injury reporting, work area inspections, periodic safety meetings, MSDS's, air monitoring data, waste container inspections, etc. These records shall also be provided electronically to the Lockheed Martin Project Lead.

1.15 Contractor shall contact the Lockheed Martin Project Lead immediately in the event of a fatal or serious injury, an unpermitted environmental release, or any ESH incident that is likely to generate significant publicity or an adverse situation for Lockheed Martin (e.g., alleged releases of contaminants beyond property boundaries, purported fish or wildlife impacts, allegations of adverse community health or property impacts, etc.)

2 DEFINITION

2.1 Contractor: any agent/agency engaged by Lockheed Martin through written contract (or other written agreement) to perform work on Lockheed Martin Remediation Sites. For the purposes of this *Remediation Contractor's ESH Handbook*, "Contractor" shall also include Contractor's subcontractors at any tier.

2.2 EPA: the Environmental Protection Agency.

2.3 Fed/OSHA: the Federal Occupational Safety and Health Administration

2.4 Hazard Communication Program: a written program meeting the requirements of Title 29, Code of Federal Regulations, Section 1910.1200 - Hazard Communication.

2.5 Lockheed Martin: Lockheed Martin Corporation, Corporate Energy, Environment, Safety & Health

2.6 Lockheed Martin Project Lead: the Lockheed Martin Corporate Environment, Safety & Health individual that has been designated to manage a specific project.

2.7 Lockheed Martin Contract Representative: the Lockheed Martin Corporate Environment, Safety & Health contract representative (Contract Administrator/Buyer) for the project.

2.8 RCRA: the Federal Resource Conservation and Recovery Act and all amendments or revisions.

3 SAFETY & HEALTH

Contractor shall comply with applicable provisions of Federal, State, municipal, local, and any other applicable occupational safety and health statutes, rules, ordinances, regulations and requirements. Contractor shall take all precautions for the protection of the safety and health of Contractor employees, subcontractor employees, and Lockheed Martin employees to prevent accidents or injury to them or to other persons on, about, or adjacent to site of work performance. Notwithstanding this handbook, Contractor will hold harmless Lockheed Martin for any incident, violation, regulatory agency inspection resulting in a finding, or any other ESH issue that occurs to a Contractor employee.

Within Section 3.0, Lockheed Martin is identifying specific requirements within the Federal regulations that need extra attention. These are not all encompassing and adherence to the all rules and regulations must be followed.

3.1 PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

1926 Subpart E or 1910 Subpart I
1910.139 / 1926.103
ANSI Z87.1
ANSI Z41 Standard
ANSI Z89.1 Standard

3.1.1 Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

- Eye Protection. Safety eyewear meeting ANSI Z87.1 shall be worn in areas designated as "Eye Protection Required" and on all jobs where a potential injury to the eyes is possible whether or not the area is posted.
- Foot Protection. Affected employee(s) shall wear protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. Safety shoes and boots which meet the ANSI Z41 Standard shall be provided when impact and/or compression hazards exist. Soft-shoes, including but not limited to, tennis shoes, athletic shoes, moccasins, sandals, and open-toed or open-heeled shoes shall not be worn.
- Respiratory Protection Devices. Appropriate, MSHA/NIOSH-approved respiratory protective devices must be worn when applicable state and/or federal action levels or OSHA permissible exposure levels (PELs) are exceeded. Contractor must have fully implemented a respiratory protection program meeting the requirements of *Title 29, Code of Federal Regulations, Section 1910.139 / 1926.103* or applicable state OSHA regulations prior to issuing and using respiratory equipment. Contractor shall supply and maintain

appropriate air monitoring and respiratory protection equipment if inhalation hazards are anticipated.

- Protective Clothing such as suits, aprons, boots, or gloves shall be worn where there is a hazard to the body through dermal contact with chemicals, dusts, heat or other harmful agents or conditions.
- Hearing Protection (muffs and/or plugs) must be worn in all areas posted to indicate high noise level or where Contractor employees are exposed to noise levels in excess of the OSHA action level (85 dBA over a 8-hour time-weighted average or a dose of fifty percent).
- Hard Hats will be worn in all areas where there is a danger of impact to the head or hazard from falling or moving objects. Hard hats must meet the ANSI Z89.1 Standard.

3.1.2 Contractor will issue or cause to be issued prior to commencing the job all necessary personal protective equipment and air monitoring equipment to all its agents and employees, together with full instructions and training on the use of said equipment.

3.1.3 Contractor will meet all applicable Federal, Sate, municipal, local, and Lockheed Martin requirements for protective clothing and equipment. Contractor will properly supervise all its agents and employees to ensure protective clothing and equipment are used in conformance with applicable rules and regulations.

3.2 HAZARD COMMUNICATION - USE OF HAZARDOUS MATERIALS

Title 29, Code of Federal Regulations, Section 1926.59 Hazard Communication
Title 29, Code of Federal Regulations, Section 1910.1200 Hazard Communication

3.2.1 Contractor personnel shall not bring any hazardous substances (as defined by OSHA) onto Lockheed Martin remediation sites unless accompanied by a Material Safety Data Sheet (MSDS) and the containers are appropriately labeled. MSDS's must be maintained at the job site.

3.2.2 Contractor shall notify the Lockheed Martin Project Lead prior to bringing onto Lockheed Martin remediation sites any quantity of hazardous materials.

3.2.3 Contractor shall ensure all containers of hazardous materials are labeled in accordance with the Fed OSHA Hazard Communication Standard, 29 CFR 1910.1200 or applicable state OSHA standard.

3.2.4 Do not handle or use any hazardous material that does not have adequate safety warning labels.

3.2.5 Do not dump, drain or discharge any hazardous materials or wastes into any sink, drain or sewer.

3.2.6 The Lockheed Martin Project Lead shall inform the Contractor(s) of the identity of hazardous chemicals to which Contractor's employees may be exposed from

Lockheed Martin operations, if applicable. The Lockheed Martin Project Lead shall provide the following information:

- Where to obtain information concerning any hazardous substances used in Lockheed Martin operations that the Contractor's employees may come in contact with while performing their work;
- If Lockheed Martin owns or uses chemicals on a remediation site for any process where contractors could be exposed, Lockheed Martin shall make available to the Contractor Material Safety Data Sheets (MSDS) and sufficient information to permit the Contractor to train its employees on the hazards of the chemical Appropriate protective measure Contractor employees may take to protect themselves from exposure to known hazards from Lockheed Martin operations; and
- Appropriate work practice procedures (safety rules) for the location where work is to be performed.

3.2.7 Contractor shall ensure its employees are trained in the safe handling and use of hazardous materials in accordance with *29 CFR 1910.1200 - Hazard Communication* or the applicable state-OSHA hazard communication standard.

3.2.8 Contractor shall ensure that all applicable employees are medically qualified (as defined by OSHA) to perform the work assigned.

3.2.9 Hazardous materials shall be stored in designated areas and all containers effectively closed. Spill equipment/supplies shall be readily available to contain and/or mitigate accidental spills of hazardous materials.

3.3 CONFINED SPACE ENTRY

Title 29, Code of Federal Regulations, Section 1910.146 Permit-Required Confined Spaces

3.3.1 If Contractor or any other employee must enter a confined space (tank, vat, pit, sewer, etc.), the entry must be performed in accordance with the applicable state OSHA or federal OSHA regulations.

3.3.2 Before Contractor's employees are permitted entry into any confined space, the internal atmosphere shall be tested with a calibrated direct-reading instrument for the following conditions in the order given: 1) Oxygen content, 2) Flammable gases & vapors, and 3) Potential toxic air contaminants. Contractor shall furnish the air testing equipment and a person competent in the use of the testing equipment.

3.3.3 When possible, the Contractor shall notify the Lockheed Martin Project Lead prior to entering a permit required confined space. A permit shall be issued by the contractor prior to entry and electronically submit a copy to the Lockheed Martin Project Lead.

3.3.4 To ensure the safety of Contractor personnel during entry into confined spaces, the Contractor shall have a written confined space entry program.

3.4 HOT WORK REQUIREMENTS (i.e., welding, torch cutting, brazing, etc.)

Title 29, Code of Federal Regulations, Section 1910 Subpart Q
Title 29, Code of Federal Regulations, Section 1926 Subpart J

3.4.1 All hot work activities shall be conducted in accordance with the hot work permit requirements outlined in the site specific HASP (i.e., fire suppression equipment availability, removal of combustibles, fire watch, etc.).

3.4.2 Contractor personnel must secure all oxygen and acetylene cylinders in a manner that will prevent them from falling or tipping over. Oxygen and acetylene cylinders must be stored separately. Oxygen cylinders in storage must be separated from fuel gas cylinders a distance of 20 feet or by a noncombustible barrier 5 feet high. Acetylene cylinders shall not be stored horizontally, lying on their side.

3.4.3 When welding, Contractor personnel shall use welding curtains and/or suitable protective devices to protect persons from indirect exposure to welding flashes.

3.5 LOCKOUT / TAGOUT - Control of Hazardous Energy

Title 29, Code of Federal Regulations, Section 1910.147

3.5.1 Contractors are required to establish a written program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start-up or release of stored energy in order to prevent injury to employee.

3.5.2 Contractor shall not service and/or maintain machines and equipment in which the unexpected energization or start up of the machines or equipment, or release of stored energy could cause injury to employees. Servicing and/or maintaining such equipment shall not be conducted until appropriate energy control methods have been initiated.

The Contractor shall provide training to ensure that the purpose and function of the energy control program are understood by their employees and that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by the employees.

3.5.3 If Contractor needs to service or maintain Lockheed Martin equipment, Contractor(s) shall notify the Lockheed Martin Project Lead and/or on-site facility operator (if applicable) of the intended equipment service for any unscheduled maintenance.

3.5.4 Upon completion of the job, Contractor is to notify the Lockheed Martin Project

Lead and/or on-site facility operator (if applicable) so power can be resumed to the equipment after the lock-outs and tags have been removed.

3.6 USE OF LOCKHEED MARTIN MATERIALS AND EQUIPMENT

3.6.1 Contractor's employees shall not use Lockheed Martin tools, equipment, materials, or personal protective equipment unless otherwise authorized by Lockheed Martin.

3.6.2 Contractor shall not start or stop any production equipment without the approval of the Lockheed Martin Project Lead.

3.6.3 Contractor shall not adjust or relocate any Lockheed Martin process equipment without the approval of the Lockheed Martin Project Lead.

3.7 DANGEROUS OPERATIONS - WARNINGS AND BARRICADES

Title 29, Code of Federal Regulations, Section 1926, Subpart G-Signs, signals and barricades

3.7.1 Contractor shall isolate their work areas from Lockheed Martin operations, employees, and the public by using barricades or other effective means of isolation. Signs, signals and barricades shall be visible at all times where a hazard exists.

3.7.2 Contractor personnel shall erect and properly maintain, at all times, all necessary safeguards for the protection of Contractor personnel, Lockheed Martin employees and the public. This includes:

- If doing any overhead work, Contractor must utilize warning signs and barricades, or station someone on the ground to prevent passers-by from entering the area below the overhead work;
- Contractor must effectively barricade excavations, floor openings, etc., as required by OSHA regulations;
- Contractor must construct and maintain all scaffolds and working platforms in accordance with OSHA regulations; and
- If Contractor's equipment, barricades or other safeguards restrict fire lanes or fire equipment access, the Contractor shall notify the Lockheed Martin Project Lead about its notification to the local fire department.

3.7.3 Prior to commencing work, Contractor must inform Lockheed Martin Project Lead of any work posing a potential danger to personnel.

3.8 EXCAVATIONS, TRENCHES, EARTHWORK

Title 29, Code of Federal Regulations, Section 1926 Subpart P

3.8.1 Review the Lockheed Martin intrusive fieldwork requirements in Appendix A.

3.8.2 If workers are to enter excavations, a competent person must be designated and trained in soil classification and the recognition of trenching and excavation hazards.

3.8.3 Excavations and trenches shall be inspected by a competent person daily and after every rainstorm, earthquake, or other hazard-increasing occurrence.

3.8.4 Inspect the face, banks, and top daily when workers are exposed to falling or rolling materials.

3.8.5 Shore, bench, slope, or use equivalent methods to protect workers in excavations four feet deep or more.

3.8.6 Locate soil at least two feet from the edge of the excavation, or one foot from the edge when the excavation is less than five feet deep.

3.8.7 Ladders or steps shall be provided and secured in all trenches four feet or more in depth. Ladders shall be located to require no more than twenty-five feet of lateral travel before having access or egress and shall extend three feet above the top of the trench bank.

3.8.8 Install crossings with standard guardrails and toeboards when the excavation is more than 7½ feet deep.

3.8.9 All open trenches and other excavations shall be provided with suitable barriers, signs, and lights to the extent that adequate protection is provided to the public.

3.8.10 Do not excavate beneath the level of adjacent foundations, retaining walls, or other structures until a qualified person has determined that the work will not be hazardous. Support undermined sidewalks.

3.9 ELECTRICAL SAFETY

Title 29, Code of Federal Regulations, Section 1926 Subpart K-Electrical
Title 29, Code of Federal Regulations, Section 1910.269 Electrical Power Generation, Transmission and Distribution

3.9.1 Only qualified persons are permitted to work on electrical systems, as defined by *Title 29, Code of Federal Regulations Section 1910.269(a)(2).* Qualified persons shall be trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electrical equipment;
- The skills and techniques necessary to determine the nominal voltage of exposed live parts;
- The minimum approach distances specified by OSHA corresponding to the voltages to which the qualified employee will be exposed; and

- The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment.

3.9.2 Contractor personnel shall properly ground all electrical tools, mechanical digging or concrete breaking equipment and all other electrical equipment while in use.

3.9.3 All electrical work, installation and wire capacities shall be in accordance with the pertinent provisions of the National Electrical Code, ANSI and OSHA.

3.9.4 Covers or barriers must be installed on boxes, fittings, and enclosures to prevent accidental contact with live parts.

3.9.5 Temporary wiring installations must be grounded.

3.9.6 Electrical systems shall be de-energized utilizing appropriate lockout/tagout procedures prior to conducting work.

3.10 ELEVATED LOCATIONS / FALL PROTECT

Cal/OSHA General Industry Safety Orders, 8 CCR 3210
Title 29, Code of Federal Regulations, Section 1926 Subpart M – Fall Protection

3.10.1 California employers: Guardrails shall be provided on all open sides of unenclosed room openings, open and glazed sides of landings, balconies or porches, platforms, runways, ramps, or working levels more than 30 inches above the floor, ground, or other working areas. The railing must be provided with a toeboard where the platform, runway, or ramp is 6 feet or more above places where employees normally work or pass and the lack of a toeboard could create a hazard from falling tools, material, or equipment.

3.10.2 Contractor must provide fall protection systems whenever a worker is exposed to a fall of four feet or more (in construction the threshold is six feet). Guardrails are the most common forms of fall protection systems. If guardrail systems are not feasible, safety nets, personal fall arrest systems, positioning device systems, warning line systems, or some other demonstrated, effective means of fall protection shall be used. Fall protection systems and devices shall be inspected prior to each use Title 29, Code of Federal Regulations, Section 1926 Subpart M.

3.11 LADDERS

Title 29, Code of Federal Regulations, Section 1910 Subpart D – Walking and Working Surfaces
Title 29, Code of Federal Regulations, Section 1926 Subpart X - Ladders

3.11.1 The use of ladders with broken or missing rungs or steps, broken or split rails or other defective construction is prohibited.

3.11.2 Ladders shall extend no less than 36 inches above landing and be secured to

prevent displacement.

3.11.3 Portable ladders must be equipped with safety shoes.

3.11.4 Wooden ladders shall not be painted.

3.11.5 Do not use metal ladders for electrical work or near live electrical parts.

3.12 SCAFFOLDS

Title 29, Code of Federal Regulations, Section 1910.28 – Safety Requirements for Scaffolding
Title 29, Code of Federal Regulations, Section 1926 Subpart L - Scaffolds

3.12.1 Scaffolds must be provided for all work that cannot be done safely by employees standing on solid construction at least 20 inches wide, except where such work can be safely done from ladders.

3.12.2 Erection and dismantling of scaffolds shall be performed in accordance with good engineering practice.

3.12.3 Footings or anchorage for any scaffold shall be sound, rigid and capable of carrying the maximum intended load without settling or displacement.

3.12.4 No unstable objects such as concrete blocks shall be used to support scaffolds or planks.

3.12.5 Any part of a scaffold weakened or damaged shall be repaired or replaced immediately.

3.12.6 All scaffold planking shall be free of knots and cracks (Class A number) and shall completely cover the work platform.

3.12.7 Scaffold planks shall be laid tight, cleated at both ends or overlapped a minimum of 12 inches and nailed or bolted to prevent movement. Overlaps to occur directly above scaffold supports.

3.12.8 A safe and unobstructed means of access, such as a walkway, stair, or ladder shall be provided to all scaffold platforms.

3.13 HEAVY EQUIPMENT, INDUSTRIAL VEHICLES, AND CRANES

Title 29, Code of Federal Regulations, Section 1926 Subparts N, O and W

3.13.1 Only trained and authorized workers may operate heavy equipment, industrial vehicles, and/or cranes.

3.13.2 The Contractor shall designate a competent person who shall inspect all machinery and equipment prior to each use to make sure it is in safe operating condition.

3.13.3 The Contractor shall comply with the manufacturer's specifications and limitations applicable to the operation of any and all heavy equipment, industrial vehicles, and cranes.

3.13.4 Seatbelts are required to be worn if the vehicle has Roll-Over Protection Structures (ROPS).

3.13.5 The swing radius of cranes shall be barricaded.

3.13.6 Equipment shall not be lubricated while in use.

3.13.7 Rated load capabilities, recommended operating speeds, special hazard warning, specific hand signal diagrams and special instructions shall be visible to the operator while he is at the control station.

3.13.8 Contractor's employees shall not be allowed to work under the load of cranes. Tag lines shall be used on all loads.

3.14 OVERHEAD POWER LINES

Title 29, Code of Federal Regulations, Section 1926.550 (a) (15)

3.14.1 If work is to be performed near overhead power lines, the lines must be de-energized and grounded by the owner or operator of the lines, or other protective measures must be provided before work is started. Protective measures (such as guarding or insulating the lines) must be designed to prevent employees from contacting the lines.

3.14.2 Unqualified employees and mechanical equipment must stay at least 10 feet away from overhead power lines. If the voltage is over 50,000 volts, the clearance should be increased by four inches for each additional 10,000 volts.

3.14.3 When mechanical equipment is being operated near overhead lines, employees standing on the ground may not contact the equipment unless it is located so that the required clearance cannot be violated even at the maximum reach of the equipment.

3.14.4 A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.

3.14.5 Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicates that it is not energized.

3.15 FIRE PREVENTION / FLAMMABLE LIQUIDS

Title 29, Code of Federal Regulations, Section 1926 Subpart F or 1910 Subpart E

3.15.1 Contractor shall be responsible for fire protection in its work and operational areas,

including offices, tool rooms, and storage areas 24 hours per day, seven days per week through the duration of this Contract. Approved fire-fighting equipment, in adequate quantities, must be provided.

3.15.2 Contractor shall familiarize Contractor's employees with the locations of fire extinguishers in their respective work areas and ensure they are prepared to use them safely if necessary. In certain remote field locations or within abandoned (discontinued) facilities where fire extinguishers may not exist in the immediate work area, contractor shall provide and locate fire extinguisher(s) in close proximity to the active work area(s).

3.15.3 In case of fire, Contractor shall call 9-1-1. Contractor shall also inform all Contractor and Lockheed Martin employees in the area to evacuate to a safe place and direct arriving fire response personnel to the fire. Notify the Lockheed Martin Project Lead as soon as reasonably possible.

3.15.4 Contractor employees shall only attempt to put out a fire when such action can be performed safely.

3.15.5 If a Contractor employee uses a Lockheed Martin fire extinguisher, Contractor shall report its use to the Lockheed Martin Project Lead.

3.15.6 Contractor shall report all fires extinguished by the Contractor to the Lockheed Martin Project Lead.

3.15.7 Contractors are to store, dispense, and use flammable and combustible liquids in accordance with OSHA regulations and the Uniform Fire Code. Bonding and grounding of containers containing flammable liquids will be required.

3.15.8 Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas.

3.15.9 Contractor shall provide sufficient fire extinguishers necessary for their work activities.

3.16 HAND AND POWER TOOLS

Title 29, Code of Federal Regulations, Section 1910 Subpart P – Hand and Portable Powered Tools and Other Hand-Held Equipment
Title 29, Code of Federal Regulations, section 1926 Subpart I – Tools Hand and Power

3.16.1 All hand and power tools, whether furnished by Contractor, or by Contractor’s employee, shall be maintained in a safe condition.

3.16.2 Electrical power tools shall be grounded or double insulated with proper assured equipment grounding inspections or Ground Fault Interrupter (GFI) circuit protection provided.

3.16.3 Pneumatic power tools shall be secured to the hose or whip by some positive means.

3.16.4 Only properly trained Contractor employees shall operate power-actuated tools.

3.16.5 All grinding machines shall conform to OSHA and ANSI requirements.

3.17 COMPRESSED GAS CYLINDERS

Title 29, Code of Federal Regulations, Section 1910.101 – Compressed Gases
Title 29, Code of Federal Regulations, Section 1926.350 – Gas Welding and Cutting

3.17.1 Compressed gas cylinders shall be secured in an upright position at all times.

3.17.2 When transporting, moving and storing cylinders, valve protection caps shall be in place and secured.

3.17.3 Compressed gas cylinders shall be kept away from excessive heat, shall not be stored where they might be damaged or knocked over by passing or falling objects, and shall be stored at least 20 feet away from highly combustible materials.

3.17.4 Cylinders shall be labeled as to the nature of their contents.

3.17.5 Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials a minimum of 20 feet or by a noncombustible barrier at least five feet high having a fire-resistant rating of at least one-half hour.

3.17.6 Acetylene cylinders shall be stored and used in a vertical, valve-end-up position only.

3.17.7 Anti-flashback arrestors shall be installed on all oxygen and acetylene cylinders.

3.18 INCIDENTAL CONTACT WITH ASBESTOS

3.18.1 This section applies to all contractors who incidentally disrupt the matrix of asbestos containing material (ACM) or presumed asbestos containing material (PACM); i.e., contractors who have not been specifically hired to perform ACM abatement.

3.18.2 Contractor shall immediately report to the Lockheed Martin Project Lead and to other employers of employees working at the job site any discovery, disturbance, and/or spill of ACM and/or PACM. Contractor(s) is to cease all operations in the immediate area of the suspect ACM and/or PACM and demarcate the area. The approval of the Lockheed Martin Project Lead is required before resuming operations.

3.18.3 Contractor shall not disturb any pipe insulation, boiler insulation, or any other material reasonably suspected of containing asbestos until the Contractor notifies the Lockheed Martin Project Lead. Lockheed Martin approval is required before operations may commence.

3.18.4 Abatement of asbestos can be performed only by persons properly trained and licensed to perform such activities

3.19 ASBESTOS ABATEMENT CONTRACTORS

3.19.1 This section applies to Contractors performing maintenance, construction, repair, renovation, demolition, salvage, or any other operation in which any material containing more than 1% asbestos is sanded, abrasive blasted, sawed, shoveled, removed, or otherwise handled in a manner that would generate airborne asbestos fibers. These requirements are in addition to any requirements contained in Contractor's scope of work.

3.19.2 All Contractors working with asbestos shall comply with applicable federal and state OSHA, EPA, local air district, and other applicable Federal, State, municipal, and local statutes, regulations, rules, and ordinances; and specific contract terms and conditions regarding the handling of, use of, and work involving asbestos.

3.19.3 The contractor shall ensure that a competent person, as defined by OSHA supervises all asbestos work performed within regulated areas.

3.19.4 Before commencing work, all asbestos abatement contractors shall supply to Lockheed Martin proof of:

- Asbestos abatement contractor certification by the state Contractor's License Board
- Liability insurance for Contractor employees engaged in asbestos work operations
- Copies of asbestos work notification letters to state OSHA
- Local air district Asbestos Demolition/Renovation Notification

3.19.5 Contractors shall minimize the creation and spread of airborne asbestos fibers by using appropriate work practices, engineering controls, and established procedures (i.e., wet methods, HEPA filter vacuums, negative pressure enclosure, local exhaust ventilation equipped with HEPA filter dust collection system, etc.).

3.19.6 All Class I, II and III asbestos work shall be conducted within regulated areas. The regulated area shall be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they may demarcate the regulated area. Signs shall be provided and displayed at each location where a regulated area is required to be established. Signs shall be posted at such a distance from such a location that an employee may read the signs

and take necessary protective steps before entering the area marked by the signs. Warning signs shall bear the following information:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY

3.19.7 On multiple employer worksites requiring the establishment of a regulated area, the asbestos Contractor shall inform other employers on the site of the nature of the work with asbestos and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other employers are not exposed to asbestos.

3.19.8 Contractors shall package and label asbestos waste in accordance with federal and or applicable state OSHA requirements and federal or applicable state hazardous waste regulations. Labels shall be affixed to all products containing asbestos and to all containers containing such products, including waste containers. Labels shall be printed in large, bold letters on a contrasting background and shall contain the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

3.19.9 Contractors shall properly dispose of all asbestos waste. Proper disposal includes the use of hazardous waste manifests and Lockheed Martin approved and licensed waste haulers, and disposal facilities according to federal RCRA law and applicable state hazardous waste regulations. Contractor shall contact the Lockheed Martin Project Lead before transporting or disposing of any hazardous waste. Lockheed Martin must review all hazardous waste manifests prior to shipment.

3.19.10 Contractors shall ensure that employee exposure air monitoring is conducted as required by federal or applicable state OSHA regulations. All other air monitoring (i.e. clearance sampling) shall be conducted by a third-party contracted air monitoring firm not affiliated with the Contractor.

3.19.11 Contractor shall, at no cost to the employee, institute a training program for and ensure the participation of all employees engaged in asbestos-related work who may reasonably be expected to be exposed to asbestos fibers from asbestos containing construction materials.

3.19.12 Contractor shall institute a medical surveillance program for all employees who are or will be exposed to airborne concentrations of fibers of asbestos at or above the TWA and/or excursion limit.

3.20 HAZARDOUS WASTE OPERATIONS and EMERGENCY RESPONSE (HAZWOPER)

Title 29, Code of Federal Regulations, Section 1910.120 - Hazardous Waste Operations and Emergency Response

Title 29, Code of Federal Regulations, Section 1926.65 – Hazardous Waste Operations and Emergency Response

This section applies to Contractors performing hazardous waste-type activities. This includes operations that pose a potential or reasonable possibility for employee exposure to hazardous waste/chemical contaminants during site investigations, clean-up operations, abatement, or hazardous substance removal work (remedial actions). These requirements are in addition to any requirements contained in Contractor's scope of work.

3.20.1 Contractor shall provide a **site-specific safety and health plan** at least two (2) weeks prior to field mobilization to the Lockheed Martin Project Lead (global statement – move to the beginning).

Contractor shall provide a **safety and health plan** in accordance with *Title 29, Code of Federal Regulations, Section 1910.120 - Hazardous Waste Operations and Emergency Response* or the applicable state OSHA standard and, at a minimum, shall contain the following elements:

- Safety and health risk or hazard analysis for each anticipated site task
- Employee training requirements
- Personal protective equipment to be used by employees for each of the site tasks and operations
- Medical surveillance requirements
- Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used
- Site control measures
- Decontamination requirements and procedures
- Emergency response plan
- Confined space procedures (if applicable)
- Emergency response plan
- Confined space procedures (if applicable)
- Spill containment program
- Periodic documented safety meetings
- Periodic documented work area safety inspections and corrective actions

3.20.2 Contractors performing hazardous waste-type operations shall adhere to the requirements specified in *29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response* or the applicable state OSHA standard.

3.20.3 Training: All Contractor and subcontractor employees working on site who are potentially exposed to hazardous substances shall receive initial and annual

refresher training in accordance with *29 CFR 1910.120(e) – Hazardous Waste Operations and Emergency Response* or the applicable state OSHA standard. Lockheed Martin shall be provided with electronic copies of the training certificates.

3.20.4 Medical Surveillance: Contractor employees must be enrolled in a medical surveillance program prior to performing hazardous waste operations. Upon Lockheed Martin request, Contractor shall provide evidence of employee enrollment in a medical surveillance program. Lockheed Martin does not provide medical surveillance examinations to Contractor employees.

3.20.5 Periodic work area inspections: Contractor agrees to perform periodic work area inspections to determine the effectiveness of the site safety and health plan and to identify and correct unsafe conditions in contractor's responsible work area. These inspections shall be documented and available to Lockheed Martin upon request for review.

3.21 MANAGEMENT OF NANOTECHNOLOGY

3.21.1 The Lockheed Martin Project Lead shall work with the designated contractor responsible for nanotechnology to implement this procedure and ensure areas where nanomaterials (materials incorporating engineered nanoparticles or nanoscale features that exhibit unique physical and chemical properties as a result of the nanoparticles or nanoscale features) will be used meet engineering control requirements of this procedure.

3.21.2 The contractor shall ensure that the safety and environmental hazards of nanomaterials are managed as described in the requirements of this section.

3.21.3 A plan must be developed and executed that addresses the following requirements:

3.21.3.1 **Hazard Analysis:** Identify potential adverse health effects and environmental impacts that could result from the chemical and physical properties exhibited by the nanomaterials and/or nanoparticles in use, to be used, under development, or to be developed at the site.

3.21.3.2 **Exposure Assessment**: Evaluate all tasks involving nanomaterials and identify where exposures could occur. The evaluation must include at a minimum, an evaluation of materials; chemical intermediates; by-products; end-products; waste products; processes; process equipment; the amount of material used; material form; degree of containment; duration of use; and work space including laboratory and manufacturing space.

3.21.3.3 **Exposure Control**

- Implement appropriate controls to mitigate worker exposure and environmental emissions identified in sections 3.21.2.1 and 3.21.2.2 of this procedure.

- Implement Control Bands as indicated on the Control Band Matrix below.

Exposure Duration	Bound Materials	Potential Release	Free / Unbound
Hazard Group A (Known to be inert)			
Short	1	1	2
Medium	1	1	2
Long	1	2	2
Hazard Group B (Understand reactivity/function)			
Short	1	2	2
Medium	1	2	3
Long	1	3	3
Hazard Group C (Unknown Properties)			
Short	2	2	3
Medium	2	3	4
Long	2	4	4

Duration Key:
Short - Less than 4 hrs/day; 2 days/week
Medium - Between 4 to 6 hrs/day; 3 to 5 days/week
Long - 6 to > 8 hrs/day; 3 to 5 days/week

Release Key:
Bound Materials: Nanoparticles in a solid matix e.g. polycarbonate
Potential Release: Nanoparticles in friable or solgel matrix
Free / Unbound: Nanoparticles unbound, not aggregated

Control Band:
1. General Ventilation and PPE
2. Engineering Controls and/or Respirators and additional PPE
3. Containment e.g. glove box
4. Specialist Advise

- Establish designated areas for Control Banding. The designated area shall, at a minimum, include warning signs informing employees that they are entering a nanomaterial work area as well as signs specifying administrative controls and personal protective equipment (PPE) required for entry.
- Identify appropriate administrative controls (e.g. good housekeeping methods, HEPA vacuums, wet wipe methods, employee training, safe work practices), engineering controls (e.g. containment, exhaust ventilation) and Personal Protective Equipment (e.g. respiratory protection, protective coveralls, gloves, goggles) based on Control Band and best industry practices.
- Develop and execute procedures for housekeeping, including clean-as-you-go practices that do not re-suspend particles.
- Develop and execute procedures for management of nanomaterial-associated waste.

4 ENVIRONMENTAL

Contractors shall comply with all applicable provisions of Federal, State, municipal, local, and other environmental statutes, rules, and regulations. Contractor shall take all necessary precautions to protect the environment. Contractor shall also store, transport, dispose, or otherwise handle hazardous wastes and non-hazardous wastes to prevent discharges of materials into the environment except in accordance with applicable governmental regulations.

4.1 HAZARD COMMUNICATION - USE OF HAZARDOUS MATERIALS

4.1.1 Contractor shall develop a Waste Management Plan in accordance with the requirements outlined in the LMC Remediation Waste Management Procedure in

Appendix B. Lockheed Martin shall approve the Waste Management Plan prior to work commencement.

4.1.2 Contractor must segregate hazardous from non-hazardous waste; all hazardous waste generated by its operations must be labeled in accordance with all governmental regulations.

4.1.3 Contractor shall dispose of all hazardous waste within the time frame stipulated by local, state, or federal regulations. Contractor shall not leave behind on Lockheed Martin remediation sites any containers of hazardous materials or waste (including drums, roll-offs, maintenance chemicals, etc.), empty or not, after the termination of operations.

4.1.4 In case of a spill or release of hazardous materials or waste, Contractor shall immediately notify the Lockheed Martin Project Lead and if the severity of the spill warrants, notify the local fire department (Call 9-1-1). The Contractor shall be liable for the costs of any spill resulting from Contractor's actions, including, but not limited to, costs of containment, cleanup, and disposal.

4.2 NON-HAZARDOUS WASTE DISPOSAL

4.2.1 Contractor shall develop a Waste Management Plan in accordance with the requirements outlined in the LMC Remediation Waste Management Procedure in Appendix B. This plan must be approved by the Lockheed Martin Project Lead.

4.3 WORK INVOLVING AIR EMISSIONS

4.3.1 Contractor shall work with the Lockheed Martin Project Lead to identify applicable Federal, state, and/or local permit application requirements for air emission sources (i.e., stationary point source, fugitive emissions, etc.) associated with the anticipated project.

4.3.2 Contractor shall submit permit applications and/or notifications to the Lockheed Martin Project Lead for review prior to submittal to the applicable regulatory agency.

4.3.3 Contractor shall abide by the requirements of the permit(s) and gather emissions data (as applicable) to document compliance. This data shall be electronically submitted to the Lockheed Martin Project Lead.

4.3.4 Contractor shall immediately contact the Lockheed Martin Project Lead in the event permit conditions are not met.

4.3.5 Ensure permits are posted on permitted equipment (or in close proximity) as required by the respective permit.

4.4 WORK INVOLVING WATER DISCHARGES

4.4.1 At no time is an unauthorized, unpermitted release allowed. Contractor shall notify the Lockheed Martin Project Lead in the event of a release and obtain the approval of Lockheed Martin before discharging any material into storm drains or sewers.

4.4.2 Contractor shall work with the Lockheed Martin Project Lead to identify applicable National Pollutant Discharge Elimination System (NPDES), Stormwater Pollution Prevention Plans (SWPPP), and POTW requirements associated with the anticipated project.

4.4.3 Contractor shall submit permit applications and/or Notice of Intent forms to the Lockheed Martin Project Lead for review prior to submittal to the applicable regulatory agency.

4.4.4 Contractor shall abide by the requirements of the discharge permit(s) and maintain discharge monitoring information and inspection data to document compliance. This documentation shall be electronically provided to the Lockheed Martin Project Lead.

4.4.5 Contractor shall immediately contact the Lockheed Martin Project Lead in the event permit conditions are not met.

5 HOUSEKEEPING / CLEANUP

5.1 Ensure discharge permits and/or SWPPP plans (as applicable) are available at the project job site.

5.2 Contractor shall continuously clean up its respective work area(s). Contractor shall maintain its work areas free from all slip, trip, and fall hazards at all times.

5.3 Debris shall be kept cleared from work areas, passageways, stairs, and in and around buildings or other structures. The work area must be left free from accumulation of waste and rubbish at the end of each work shift.

5.4 Combustible scrap and debris shall be removed at regular intervals during the course of work performed by Contractor. Safe means shall be provided to facilitate such removal.

5.5 At the end of each working day and/or the conclusion of work being performed, Contractor shall restore the work area to the same degree of neatness as when work commenced.

5.6 Contractor shall furnish necessary equipment and/or receptacles to remove waste and rubbish from the job site unless otherwise specified by the Lockheed Martin.

6 CHANGE MANAGEMENT

If deviations are encountered from the field work plan, the contractor shall A) notify to the Lockheed Martin Project Lead and B) suspend work to assess changes to the work plan(s) and the HASP. Changes to the work plan(s) and the HASP shall be reviewed by the PL.

7 REQUIREMENT TO PERFORM & DOCUMENT SELF-AUDITS

7.1 Contractor agrees to perform periodic work area/project field inspections to monitor compliance with project environmental, safety and health (ESH) requirements. The name of Contractor's jobsite ESH representative will be provided to Lockheed Martin prior to the Contractor starting work at the jobsite.

7.2 For jobs that are ongoing, an annual ESH audit shall be conducted and for jobs with a duration of less than one year at least one audit shall occur. A competent ESH representative designated by the Contractor shall perform the audit. Unsafe acts and/or non-compliance conditions noted during inspections shall be corrected immediately.

7.3 The documentation related to the audits and inspections shall be submitted electronically to the Lockheed Martin Project Lead.

8 ACCIDENT, INJURY, ILLNESS, INCIDENT and SPILL REPORTING

8.1 Contractor shall immediately contact the Lockheed Martin Project Lead and/or Lockheed Martin Safety & Health Manager in the event of a fatality, injury, environmental release (spill), near-miss incident, or any ESH incident that is likely to generate significant publicity. A written report of the incident/injury/spill and corrective action(s) taken shall be submitted to the Lockheed Martin Project Lead within one (1) day of the incident. Representatives from Lockheed Martin may conduct joint investigations with the contractor if deemed necessary.

8.2 In case of a spill or release of hazardous chemicals, Contractor shall immediately notify the Lockheed Martin Project Lead, and/or if the severity of the spill warrants, the local fire department by calling 9-1-1. Contractor shall take all necessary steps to control the spread of the release and to provide site control to prevent unauthorized personnel from entering the affected area. The Contractor shall be liable for the costs of any spill resulting from Contractor's actions, including, but not limited to, costs of containment, cleanup, and disposal.

9 FINES, PENALTIES AND COSTS

9.1 Contractor shall indemnify and hold Lockheed Martin harmless from any and all liability (including but not limited to fines and penalties), loss, cost, damage, or expense (including attorney's fees) suffered or incurred by Lockheed Martin by reason of Contractor's failure to comply with Federal, State, municipal, local or other laws, rules, regulations, ordinances and requirements, or failure to comply with generally accepted environmental safety and health practices.

10 LOCKHEED MARTIN ESH MANAGER

10.1 The Lockheed Martin ESH Manager is Jimmy Yeager. Contact Jimmy regarding any questions or concerns at (301) 873-1444 or via email at james.l.yeager@lmco.com.

Appendix A – LMC Requirements for Invasive Fieldwork

LMC Minimum
Requirements for Inv

Appendix B – LMC Waste Management Procedure

LMC Waste Mgmt
Procedure Rev 4

LOCKHEED MARTIN

CONTRACTOR'S ESH HANDBOOK

COMPLIANCE AGREEMENT

The Key National Contractor Program Manager has read and understands the contents of the *Contractor's ESH Handbook*. Contractor agrees while performing work on Lockheed Martin-owned or Lockheed Martin-controlled premises, that the Contractor shall require its employees and subcontractors at any tier to comply with the contents of this *Contractor's ESH Handbook* and the job specific HASP. A copy of the HASP shall be maintained at the job site and made readily available to contractor and subcontractor employees for their information. All contractor employees and subcontractors shall read and certify that they have read and understand the job specific health and safety plan (HASP). The certification forms shall be electronically sent to the Lockheed Martin Project Lead.

I further understand that this handbook and the rules and regulations it contains do not in any way relieve the Contractor (employer) of its responsibility to comply with the applicable environmental safety and health (ESH) regulations and its obligation to implement and enforce its own written ESH programs while working on this project.

Company: _____

Name: _____

Signature: _____

Title: _____

Date: _____

COMPLETE, SIGN AND RETURN THIS CERTIFICATE TO THE LOCKHEED MARTIN ESH MANAGER.

Lockheed Martin Minimum Requirements for Intrusive Fieldwork Work Plans

PURPOSE

The purpose of this requirements document is to prevent damage to subsurface and overhead utilities and structures and unexpected chemical releases during ground disturbance activities such as drilling, augering, direct-push technologies, excavation, trenching, chemical injection, grading or other similar operations.

SCOPE

This document provides minimum requirements for subsurface clearance activities, which must be followed prior to and during ground disturbance activities at any Lockheed Martin remediation project sites. Even after completing the subsurface clearance activities identified in this procedure, all ground disturbance activities shall proceed with caution.

This document also provides requirements on implementing in situ chemical injection programs, on managing significant field changes in field work plans and worksite housekeeping.

The Lockheed Martin Project Lead (PL), the managing contractor, and the performing contractor will be responsible for fulfilling the objectives of this document by ensuring that these requirements are carried out by the performing contractor's employees, sub-contractors and their employees and any other persons involved in the intrusive activity. The work requirements outlined below shall be incorporated into the work plan.

WORK REQUIREMENTS

General

The performing contractor's project manager and the supervisor of the intrusive field work subcontractor must review and sign the Risk Handling Checklist and complete Dig Permit found within the Corporate Staff Procedure EO-28, Digging Projects. Requirements and questions within the Risk Handling Checklist including identification of potential failure modes and hazards, traffic control, and excavation requirements shall be addressed in the work plan. In addition to the provisions of CS-28, relevant state, local and facility requirements must be identified in the work plan and in place before initiating any work. CS-28, the Risk Handling Checklist and the Dig Permit are included in Appendix A of this document.

The permit and the checklist shall be completed and approved by the PL before initiating any ground disturbance activities. The PL shall forward these items to the Environment, Safety and Health (ESH) professional, the performing contractor responsible for oversight, and the facility manager, as necessary, for their review.

Utility and Underground Structure Clearance

A utility and underground structure location survey which includes, but is not limited to records research, consultation with site facilities personnel, site inspection to locate physical evidence of underground or overhead utilities or structures and geophysical or other appropriate remote sensing techniques must be performed by a qualified utility location firm at least two weeks prior to initiating any intrusive activities. The survey shall include the appropriate equipment necessary to detect buried foundations and slabs, piping, direct-bury cables and other buried conduits and structures using the technologies appropriate to the anticipated utilities such as electromagnetic detector; ground penetrating radar; acoustic plastic pipe locator; probe, beacon, or trace wire; or cesium magnetometer. A table summarizing applicability of technologies for detecting various utilities is presented in Appendix B.

Because undocumented or inactive utilities can result in problems as severe as or more severe than documented utilities, utility location work must include, at minimum, ground penetrating radar as a screening tool to identify objects that may not be documented on utility record plans and other records.

The utility location/survey firm operators shall have at least 2 years of experience on industrial sites and preferably direct experience on the site under review. The utility survey firm shall be approved by the Lockheed Martin PL.

In addition to the utility survey, the state or other legally-mandated utility clearing organization ("Dig Safe," "U-Dig" or other such organization) having jurisdiction over the region in which the work is to occur, shall be notified within the time period required by that organization, state and local regulations. Even if all of the work is conducted entirely on Lockheed Martin or other private property, the utility clearing organization shall be contacted.

All aboveground indicators of subsurface and overhead utilities/services that may be leading to or from buildings and structures within the planned intrusive work area must be located and marked out in the field. Locations of utilities and structures detected by remote sensing equipment shall also be marked out in the field. Public utility mark-outs by for all exterior locations must be identified within required time period. Physical evidence of underground or overhead utilities may include, but is not limited to lights, signs, telephone systems, drains, electrical junction boxes, manhole covers, valve boxes, hand holes, pavement patching or other evidence of prior excavations, and natural gas meters.

The contractor shall make all efforts to avoid known or observed utilities in planning the work. If, however, subsurface structures are known or observed by geophysical survey within five feet of the work area and the work area cannot be moved, the performing contractor and/or its subcontractor shall carefully excavate to within two vertical feet of the expected top of the utility, then hand dig, air lance or otherwise gently remove the remaining soil to expose the utility. Additional precautions shall be described in the work plan if the intrusive work is to be performed in frozen soils.

The performing contractor must witness the utility clearance work to verify that the expected scope is performed and be available to work with the utility location contractor to answer questions and facilitate additional research or discussions with site facilities personnel.

The utility clearance contractor's report must include details concerning the methods used to locate utilities and documentation of how specific utilities were located in plan and depth, including a copy of instrument output when instruments producing output are used. It is not sufficient for the report to merely state that the utilities on the site plan were verified or that no utilities were found without providing supporting documentation.

Pre-Planning for Soil Fracturing and In Situ Injection Work

If subsurface disturbance activities such as soil fracturing or geophysical techniques that significantly alter the natural soil conditions are to be employed, the utility location survey shall be conducted at least one month prior to any chemical injection. Attention must be given not only to the locations of utilities and underground structures but also to the fact that utilities, structures and earth bedding can provide short-circuit pathways for the injected substance to travel significant distance to be intercepted by other utilities (sewers and drains), to be accumulated in undesirable locations (manholes or handholes) or to be discharged to surface waters.

Additionally, an aquifer assessment should be conducted to determine the nature of the aquifer receiving the chemical injections before and after any subsurface disturbance is conducted. Calculations and chemical injection volumes shall be determined as to what volume of chemical would be expected to fill the opened up pore space. An evaluation must be made of the quality and quantity of the data and assumptions that form the basis for design. Examples of typical data requirements that form the basis for design include aquifer

transmissivity, soil type, effective porosity, contaminated thickness, presence of confining layers, potentiometric surface configuration, and ambient groundwater flow velocity.

Upon completion of soil fracturing, the field data collected shall be thoroughly reviewed and assessed relative to the types and sizes of the resultant fractures and potential connection of fractures to short circuit migration pathways. Injection can proceed only after this review is completed and appropriate monitoring and contingency measures are in place to detect and prevent unwanted migration of injected medium.

A technical expert in the injection technique shall be employed and fully integrated in the project team. The PL will have responsibility for engaging the technical expert. This expert will be part of the managing contractor staff and shall have responsibilities including reviewing and approving the technical and functional requirements, the design, the work plan, and the injection procedures. This expert will engage with the PL to ensure that all potential failure modes and effects have been identified and mitigation strategies employed as necessary. The failure modes and mitigation strategies shall be documented and submitted to the PL for records retention.

Field Implementation Activities

All field personnel must review the approved work plan, subsurface utility location survey data, and related information prior to becoming involved in subsurface disturbance/intrusive activities. The field personnel must sign the authorization form in Appendix C indicating their review. This form shall be scanned and electronically submitted to the PL once all personnel have signed the form.

Change Management

Significant changes made during the field implementation should be avoided as much as possible. If such changes are required to the field work plan, the program should be temporarily suspended as long as is necessary so that effectiveness and unintended consequences can be thoroughly evaluated by the project manager, PL and performing contractors (including specialty subcontractors) and the necessary equipment and procedural changes can be developed, communicated, approved and implemented. The PL should be contacted immediately and the performing contractor overseeing the work shall be included in any decisions to modify the approved work plan.

In Situ Injection Implementation

If soil fracturing is required before chemical injection, injection can proceed only after review of the fracture patterns is completed, as stipulated in the "Pre-Planning" section and appropriate monitoring and contingency measures are in place to detect and prevent unwanted migration of injected medium. The contingency measure shall be outlined in the work plan. If monitoring shows that the injected compound is detected in unwanted locations (such as a storm drain or sewer), injection shall be halted and measures taken to prevent further unwanted migration.

The chemical injection method should be thoroughly defined in the work plan and followed during the field implementation program. If chemical daylighting (surface leaks from subsurface injections) or seeps are observed the injection should be immediately stopped. The surface leaks should then be properly contained to prevent runoff and allowed, if feasible, to percolate back into the subsurface. As a result of this condition, subsequent injection rates should be reduced by at least 20% or until chemical daylighting is no longer observed.

In most cases, low pressure methods should be employed whereby gravity or low flow recirculation systems are established to let the chemical slowly percolate into the subsurface. In no case should the injection pressures at or near the surface be greater than the available water table elevation distance to the ground surface unless approved by the PL or the PL's designated representative. Water table elevation changes as a result of chemical injections must be monitored and kept to a minimum as much as practicable.

Spill Prevention, Containment, Cleanup and Reporting

Chemicals stored onsite, including oil and fuels, reagents, injection medium, shall be placed in vessels within 110% volume secondary containment. Good housekeeping procedures must be practiced. Even benign reagents are contaminants if they migrate to a sensitive receptor. In no case should incidental spills or transfer leaks be tolerated on the site. All spills must be contained, cleaned and reported immediately to the site's spill response coordinator and the Lockheed Martin PL. Local storm drains should be temporarily plugged or booms or berms be placed to divert storm water flow from the storage area away from active storm drains.

DEVIATIONS

All deviations from this procedure must have prior approval by the Director of Environmental Remediation. The approval shall be documented and uploaded to the Lockheed Martin Document Management System.

APPENDIX A

EO-28

Dig Permit

Risk Handling Checklist

APPENDIX B

Utility / Underground Structure Clearance T

APPENDIX C

Invasive Fieldwork Authorization

LOCKHEED MARTIN

Risk Handling Checklist

Project Manager: Use this checklist to develop risk handling plans before the dig starts. You must also review Enterprise Operations Procedure EO-28, Digging Projects.

General Questions	☐ What Lockheed Martin processes could be affected by the dig?
	☐ What are the safety hazards?
	☐ What could fail?
	☐ How could it fail?
	☐ Does the area need to be returned to its normal state when the work is complete?
	☐ How could the dig affect operations/test/production?
	☐ Have potential risks been addressed with area management?
	☐ Am I comfortable with any risk handling plans, understanding the potential impact?
Traffic Control	☐ Ensure proper signage and communication.
	☐ Coordinate road or access closures through Industrial Security before starting the dig.
	☐ Ensure the work area is isolated from foot traffic by placing barriers and warning lights as required by EO-28.
	☐ Ensure that vehicle traffic will be safe.
	☐ Ensure that product transport will be safe.
Excavation	☐ Review facility drawings to identify utilities. Research old drawings as necessary.
	☐ Discuss the project with Facility Engineering/Maintenance staff who may have unique knowledge about the construction area not documented in facility drawings.
	☐ Process form EO-28-1, Dig Permit. Use this opportunity to explain the process and relate expectations to the contractor/LM organization that will perform the dig.
	☐ Have LM Telecommunications and the local utility identification service locate and mark utilities/underground obstacles.
	☐ Coordinate with other ongoing projects in the affected area.
	☐ Make every effort not to excavate around live utilities in service. Schedule an outage in advance or have Maintenance temporarily shut down and isolate the utilities while excavating.
	☐ If live utilities cannot be shut down while excavating, know where to isolate or shut them down if they are damaged while excavating.
	☐ Have a spotter(s) work with the equipment operator. Hand dig when necessary.
	☐ Excavate along the side of the utility; not on top.
	☐ Weather may affect the dig. Ensure water pipes are protected during freezing weather, especially if the trench will be left open over night. Rain may cause the side of the trench to slough, which can undermine and break pipes/conduit.
	☐ Ensure care when moving trench boxes in and out of trenches so pipes/conduit aren't damaged by the boxes.
	☐ Ensure surface drainage is controlled so that water doesn't get into the excavation and undermine soil supporting utilities.
	☐ Ensure stocked material is kept far enough back (minimum 2 feet) so that material and rocks don't fall on utilities in the open hole.
	☐ Ensure backfilling is done carefully: Re-bed utilities with proper material, filling all voids below. Keep inappropriate material from falling on or being placed in the trench. Be careful when compacting backfill in the two feet directly above the utility.
	☐ Keep the as-built utility drawing in the field while the excavation site is open. Take pictures if possible (horizontal alignment and elevations), if known utilities deviate from facility drawings or if utilities are found that are not on facility drawings. Give the modified as-built drawings to the Building/Facility Manager, who will update the drawing database.
	☐ Ensure that the equipment operator digs slowly and remains in control.
Personal Safety	☐ Ensure that trenching and shoring methods comply with the applicable OSHA regulations and are overseen by a "Competent Person," as defined in those regulations.
	☐ Regularly inspect methods to prevent violations.
	☐ Ensure LM employees do not dig or enter any excavation that is more than four feet deep.

Project Manager signature indicating completion of checklist review	Date

LOCKHEED MARTIN

Dig Permit

See Enterprise Operations Procedure EO-28, Digging Projects, for instructions.

Date	Project Manager
Building/Location	
Purpose of excavation	
Company/LM organization performing dig	

Planned dig date	Duration	Start time
Expected depth	Width	Length

Underground utilities identified?	Overhead utilities?	Electrical lines?	Gas lines?
☐ Yes ☐ No	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No	☐ Yes ☐ No
Sewer?	Water?	Telecommunications?	Other? Specify:
☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

Site-specific or customer utility locating requirements completed?

☐ Yes ☐ No ☐ N/A

Sketch of dig project (or attach drawing)

Project Manager	Date	Customer	Date
Telecommunications	Date	Customer	Date
ESH	Date	Customer	Date
Building/Facility Manager			Date

Enterprise Operations Procedure EO-28
Revision No: Original
Effective: January 26, 2009
Copyright 2009 Lockheed Martin Corporation
Current policies and procedures are on the Lockheed Martin Intranet

Digging Projects

Form EO-28-1, Dig Permit | Form EO-28-2, Risk Handling Checklist

1.0 Applicability

This procedure applies to digging projects at facilities operated by Corporate Headquarters or Enterprise Business Services (collectively, "Enterprise Operations"). A "digging project" or "dig" is any subsurface excavation, including trenching. Small areas of hand excavation (less than four inches deep), where the excavated material is put back in the same location, are not considered digs and are excluded from this procedure.

2.0 Purpose

To prevent facility damage, minimize disruptions to operations, provide for the proper handling of environmental issues, and ensure that digs are properly coordinated and safely performed.

3.0 Implementation

3.1 The Project Manager (the Lockheed Martin employee responsible for the dig) will complete the activities below before the dig begins:

- Coordinate with Enterprise Operations Environment, Safety & Health (ESH), who will review the project plans for environmental risk and develop handling plans as required, obtain any environmental permits required by law or regulation, and determine the method of soil disposal when part of the project.
- Have the local utility identification service and Lockheed Martin organizations such as Telecommunications identify and mark underground utilities/obstacles within 10 feet of the dig area.
- Prepare and sign form EO-28-1, Dig Permit. Obtain signatures from the Building/Facility Manager, local internal customers, Telecommunications, and ESH.
- Review and sign form EO-28-2, Risk Handling Checklist.
- Meet with the contractor or Lockheed Martin organization that will perform the dig to communicate the location of underground utilities/obstacles; ensure that appropriate safety precautions such as those in EO-20, Contractor Requirements, have been taken; and identify any state or local requirements, customer direction such as launch lock-down periods, or other conditions that will affect the dig.
- Inform Industrial Security of the dig and support requirements such as traffic control.
- Put barricades around the excavation site to prevent unauthorized persons from approaching. Put warning lights around the site if the excavation will remain uncovered at night, unless the dig location does not warrant warning lights.

3.2 Lockheed Martin employees must not dig or enter any excavation that is more than four feet deep.

3.3 As applicable, ESH will monitor the dig for environmental compliance, and oversee the implementation of risk handling plans, and disposal of soil.

3.4 When the dig is complete, the Project Manager will inform the individuals who signed the Dig Permit.

4.0 Responsibilities

Building/Facility Manager

4.1 Have overall approval authority and responsibility for dig projects.

Project Manager

4.2 Ensure that the dig complies with this procedure.

4.3 Retain the Dig Permit and Risk Handling Checklist until the project is complete. Any other permits related to the dig must be retained in accordance with RM-001, Corporate Records Retention Schedule.

Contractors

4.4 Are responsible for ensuring that their work complies with OSHA regulations.

5.0 Deviation

Any deviation from this procedure requires the prior approval of the Vice President Human Resources Enterprise Operations or designee.

//s// Kimberly S. Adams
Vice President Human Resources Enterprise Operations

ENVIRONMENT, HEALTH & SAFETY DEPARTMENT

Criteria for Remediation System Site Work at Former Lockheed Martin French Road Facility Utica, NY

The criteria described below are required by ConMed Corporation for contractor work to be performed inside or out at the French Road facility in Utica, NY.

In addition to the specific requirements described below ConMed will require:

1. Sign in at the main lobby at the beginning and end of each work day anyone is on-site or as soon as the lobby is open (ConMed receptionist will call Environment, Health & Safety (EHS) or Facilities & Maintenance Department). The lobby hours are 8:00 AM to 5:00 PM. *Exception – see Note #1& 2*
2. A ConMed visitor pass is required for each person whenever any site work is completed. *Exception – see Note #1*
3. Before work begins a written Health and Safety Plan must be provided to ConMed and a copy maintained on-site by the contractor.
4. The EHS will review the ConMed safety requirements with the contractors and any sub-contractor with advance notice before beginning work on-site. A copy of "Contractor Safety Program Handbook," UNYS 022-G will be provided.
5. An overall schedule of planned site activities to be completed each year. This includes all activity inside and outside of the building. The activity plan to be submitted by December 15 of the previous year. Dates can be approximate.
6. Two-weeks advanced notice of routine Operation and Maintenance activities prior to accessing the site. Provide a minimum of 48-hours notification for non-routine activities. This is to allow for coordination with ConMed operations, parking, pedestrian access etc. *Exception – see Note #1& 2*
7. No talking with ConMed employees except those authorized from the Facilities or Environment, Health & Safety Departments.
8. Notification to the ConMed EHS Department of any incidents or accidents that occur at the facility.

All work will require close coordination with ConMed to minimize any disturbance to the operations; this includes basic dust control and monitoring, and restoration of all impacted areas to existing conditions or better. Specific work practices or procedures required to work in different portions of the facility are defined below.

1. NO equipment (i.e. molding machines etc.) or shelves will be moved to accommodate contractor activities without written approval by ConMed.

2. All activity that can generate air-borne dust such as coring of the slab or pavement areas will require agreement with ConMed in advance. Any such activity will be completed as follows:

    a. The Molding Department work is to be done on Saturdays and Sundays. No work is to be done during the week. We are a 24/5 operation.

    b. Protective measures such as negative pressure tent or controlled water mist etc. will be used to prevent air-borne dust. All surfaces in or adjacent to the work area shall be wiped down clean and no residue left on the surfaces.

3. Check with ConMed Staff to verify the presence of any asbestos containing surfaces before any penetration through walls is made. The use of the ConMed licensed asbestos contactor is preferred.

4. Movement of any existing electrical or piping systems is not allowed without advance written approval by the ConMed Facilities Department.

5. Restoration of all impacted areas to their former condition acceptable to ConMed.

6. For any chemical that is brought on site, the contractor shall:

    a. Provide a Safety Data Sheet (Material Safety Data Sheets).
    b. Provide a written description to the ConMed – French Road Environment, Health & Safety Department of where and how the chemical will be used.
    c. Assure that the contractor does not use volatile organic compounds that are site contaminants of concern in groundwater and soil.

Notes:
#1 – Sign in and securing a visitor pass can be completed after Lockheed Martin or their contractor(s) have responded to an emergency alarm to Lockheed Martin on-site system.
#2 – Notice will be provided to the EHS or Facilities Department's while Lockheed Martin or their contractor are responding to an emergency alarm to the on-site system. This will allow ConMed the ability to initiate the appropriate response in the event the emergency has an impact to employees or Operations.

Contractor Safety Program Handbook

UNYS 022-G

For ConMed Facility Located at:
525 French Road
Utica, NY 13502

Rev: B 8-12-11

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Appendix A – Contractor Safety Program Review Acknowledgment Form

1. PURPOSE OF THE HANDBOOK

This handbook was developed to be used as a learning tool and a source to refer to access basic ConMed site environment, health and safety program requirements. Contractor employees are expected to follow the procedures outlined in this plan.

The Contractor Safety Program Handbook UNYS 022 G is to be used in conjunction to the Contractor Safety Program Procedures as defined in UNYS 022.

2. OBJECTIVE/POLICY

Provide contractors with a clear and concise understanding of the environment, health and safety requirements and responsibilities while working on the ConMed property. Also, to reduce exposures that cause personal injury, property damage, and liability losses due to construction, renovation and demolition of ConMed-owned buildings and facilities.

The major objectives of the Contractor Safety Program are to:

- Inform contractors of their responsibilities when working on ConMed property.
- Protect employees, visitors, property, and the environment from potential hazards.
- Comply with all federal and local safety and environmental regulations

3. SITE SPECIFIC PROCEDURES

Described below are the specific environment, health and safety procedures that may apply to a contractor working on ConMed property. Not all procedures will always apply, however each is described and reviewed with the contractor.

ACCOUNTABILITY

Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.1 ASBESTOS

PURPOSE
To inform contractors of their responsibilities under the ConMed Asbestos Management Program, in order to prevent the unintentional disturbance of Asbestos Containing Materials (ACM).

ASBESTOS-CONTAINING MATERIALS (ACM)

Types of ACM found in ConMed buildings include:
• Thermal system insulation (pipe, boiler, breaching, fume hoods)
• Compounds (caulking, mastics, adhesives, plaster, joint compound)
• Flooring (vinyl floor tile, sheet goods, resilient)

RESPONSIBILITIES
Before undertaking any projects of repair, renovation or construction that may impact asbestos, contractors shall:
• Request from the ConMed Project Manager the location of asbestos containing building materials in the work area.
• Ensure all work is compliant with all applicable federal and local regulations.
• Understand if a suspect material is encountered, they should immediately stop work and notify the ConMed Project Manager.
• In the event that asbestos is impacted, take all necessary precautions to protect ConMed employees, and visitors from the exposure to asbestos fibers or contamination.
• Make certain that their employees and subcontractors have had the appropriate level of awareness training as required by OSHA.
• Only ConMed approved Asbestos Abatement companies can be used to remove asbestos.
• Contact the ConMed Project Manager, or Facilities or Environment, Health and Safety (EH&S) Department with any questions regarding asbestos.

REGULATIONS
- OSHA 29 CFR 1910.1001, Toxic and Hazardous Substances; OSHA 29 CFR 1926.1101, Asbestos Construction;
- DOT 49 CFR 171-172, Hazardous Materials Transportation Regulation;
- EPA 40 CFR 61, Subpart M, NESHAP
- ConMed procedure UNYS 021 Asbestos Management Program

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.2 BARRICADING & FENCING

PURPOSE
To inform contractors of their responsibility to maintain a safe and accessible path-of-travel for all pedestrians, including those with disabilities, around and/or through construction sites. Barricades act as warning devices, alerting others of the hazards created by construction activities, and should be used to control traffic, both vehicular and pedestrian, safely through or around the work site.

ACTIVITIES
While barricades shall be used wherever necessary for the physical protection of people or property, the following is a list of activities where their use may be required:
• Wherever construction debris is dropped without the use of an enclosed chute.
• Areas with temporary wiring operating at more than 600 volts.
• Work areas for electrical equipment with exposed, energized parts.
• The swing radius of the rotating superstructure of cranes or other equipment.
• Wherever equipment is left unattended near a roadway at night.
• Excavations.
• Areas used for the preparation of explosive charges or blasting operations.
• Street openings, such as manholes.
• Construction areas in energized electrical substations.

RESPONSIBILITIES
The contractor shall:
• Erect and maintain for the duration of the Contract proper barricades including fencing material, traffic cones, A-frames, caution tape and temporary curb ramps complying with all access codes and regulations at all closed
crosswalks and existing closed curb ramps.
• Obtain all applicable permits required by the regulations.
• Furnish, erect, and maintain all necessary signs, barricades, lighting, fencing, bridging, and flaggers that conform to the requirements set forth by OSHA.
• Ensure that no construction materials be stored and/or placed on the path-of travel.
• Maintain the construction barriers in a sound, neat, and clean condition.
• Not occupy public sidewalks except where pedestrian protection is provided. The Contractor shall not obstruct free and convenient approach to any fire hydrant, alarm box, or utility box.
• Remove barriers and enclosures upon completion of the work in accordance with applicable regulatory requirements and to the satisfaction of the owner.
• Provide protection for pedestrians consistent with all local and federal codes, including the Americans with Disabilities Act.

REGULATIONS
OSHA 29 CFR 1926 Subpart G - Signs, Signals, and Barricades; OSHA 29 CFR 1926 – Demolition; OSHA 29 CFR 1926
Subpart K – Electrical; OSHA 29 CFR 1926 Subpart N - Cranes, Derricks, Hoists, Elevators, and Conveyors; OSHA 29
CFR 1926 Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations; OSHA 29 CFR 1926 Subpart P –
Excavations; OSHA 29 CFR 1926 Subpart U - Blasting and Use of Explosives; OSHA 29 CFR 1910 General Industry, and any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.3 CONFINED SPACE

PURPOSE
To inform contractors of their responsibilities when performing confined space entry activities at ConMed. Workers must be protected from toxic, explosive, or asphyxiating atmospheres, and from engulfment when working in and around confined spaces.

ACTIVITIES
Types of confined space entries include, but are not limited to: Telecommunication manholes, HVAC systems, crawlspaces, boilers, injector pits, tanks, and water-meter manholes.

RESPONSIBILITIES
The contractor shall:
• Identify permit-required confined spaces.
• Evaluate each confined space for the following the procedure defined in the OSHA regulations OSHA 29 CFR 1910.146, Permit Required Confined Spaces.
• Contractor shall develop their own procedures for hazard control, personal protective equipment, rescue operations before entering confined spaces.
• Provide the ConMed Project Manager with advance notice of a confined space entry and all appropriate signed documentation as required under the OSHA regulations OSHA 29 CFR 1910.146, Permit Required Confined Spaces.
• Obtain any available information about permit space hazards and entry operations from the ConMed Project Manager.
• Coordinate entry operations when employees are working in or near the area.
• Inform the ConMed Project Manager Project of entry procedures that will be followed and of any hazards identified or created.
• Provide documentation of their company's entry procedures to the ConMed Project Manger before work begins.

RESCUE OPERATIONS
In the event of an emergency requiring entry rescue services, the attendant shall immediately CALL 911. Only a trained rescue team supplied by the Local Fire Department can perform emergency rescues.

REGULATIONS
OSHA 29 CFR 1910.146, Permit Required Confined Spaces;
OSHA 29 CFR 1926.353(b) Ventilation for Welding, Cutting, and Heating; and any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.4 INDOOR ENVIRONMENTAL QUALITY

PURPOSE
To inform contractors of their responsibility to minimize the impact construction-related activities have on indoor environmental quality at ConMed.

ACTIVITIES IMPACTING AIR QULAITY
Many construction-related activities generate and disperse contaminants that adversely impact indoor environmental quality. Examples include but are not limited to:

- Activity Contaminant/Physical Agent
- Sanding and grinding: Dust, fibers & particulates
- Roofing Coal tar pitch volatiles
- Flooring, painting Volatile organic compounds
- Welding and cutting Lead, carbon monoxide, ozone
- Demolition Asbestos
- Jack-hammering Noise, vibration

RESPONSIBILITIES
Prior to performing construction-related activities including repair projects, contractors shall eliminate or minimize any potential contaminant/physical agent exposures by implementing the following procedures:

• Maintain good housekeeping habits to contain dust and construction debris. Use a HEPA filtered vacuum to minimize recirculation of contaminants.
• Implement engineering controls, such as dilution or local exhaust ventilation and isolation of mechanical systems.
• Install critical barriers made of polyethylene sheeting on doors, windows, vents, etc. in order to isolate the specific work area.
• To minimize dust, use wet methods when appropriate.
• Have trained employees and approved equipment on site prior to performing work.
• Conduct work activities in a safe manner.
• Use the least toxic material suitable for the application (for example, latex paint rather than oil-based).
• Communicate with ConMed Project Manager to implement effective strategies (for example, working off hours) to minimize occupant exposure.
• Relocate sources of contamination (for example, a diesel generator or tar kettle) away from the building air intake.

REGULATIONS
The current regulatory permissible exposure limits (PEL's) as set by the Occupational Safety & Health Administration, and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.5 LOCKOUT/TAGOUT

PURPOSE
To inform contractors of their responsibilities when performing lockout/tagout activities at ConMed to ensure all persons potentially affected by de-energizing or re-energizing of building systems are properly protected and notified.

ACTIVITIES
Hazardous energy must be isolated or "locked and tagged out" before servicing and/or maintenance activities are performed. The following types of hazardous energies are typically found at ConMed:
• Electrical
• Pneumatic
• Mechanical
• Thermal
• Hydraulic
• Chemical

RESPONSIBILITIES
The contractor is responsible for the following at ConMed:
- Having a lockout/tagout program prior to performing work.
- Having trained employees prior to performing work.
- Understanding and complying with the ConMed lockout/tagout program.
- Informing the ConMed Project Manager if their program deviates from the ConMed program.
- Coordinating with the ConMed facilities Department prior to performing lockout/tagout activities.
- Providing their own lockout/tagout equipment that meet OSHA standards.
- Performing lockout/tagout activities in accordance with OSHA standards.

• Knowing that copies of the ConMed program are available through the Project Manager
• Following special procedures for jobs requiring multiple lockout devices and those involving shift or personnel changes.

REGULATIONS
OSHA 29 CFR 1910.147, The Control of Hazardous Energy;
OSHA 29 CFR 1926.417, Locking and tagging of circuits;
and any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.6 FALL PROTECTION

PURPOSE
To inform contractors of their responsibilities when performing work at elevated locations at ConMed

ACTIVITIES
Contractors working at unguarded locations above six feet must provide their employees with fall protection. Potential activities requiring fall protection may include working on:
• Portable and fixed ladders
• Aerial lifts
• Scaffolds
• Roofs
• Elevated work locations and platforms

RESPONSIBILITIES
Contractors have the responsibility to:
• Reduce the hazards associated with falls.
• Control fall hazards first through engineering controls.
• Institute personal fall arrest systems, administrative controls and training when engineering controls are not feasible.
• Have a formal fall protection program in accordance with OSHA requirements.
• Have the necessary fall protection equipment to safely perform the job.
• Have workers properly trained in the use of fall protection equipment.
• Have supervisors (or competent personnel) who ensure the use of fall protection equipment as required.

REGULATIONS
The contractor's fall protection program shall include, but not be limited to the regulations below:
Fall Protection OSHA 29 CFR 1926 Subpart M;
Walking and Working Surfaces OSHA 29 CFR 1910 Subpart D;
Powered Platforms, Manlifts, Vehicle-Mounted Platforms OSHA 29 CFR 1910 Subpart F;
Scaffolds OSHA 29 CFR 1926 Subpart L;
Vehicle-Mounted Elevating and Rotating Work Platforms OSHA 29 CFR 1910.67;
Aerial Lifts OSHA 29 CFR 1926.453;
and any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.7 HOT WORK PERMIT

PURPOSE
To inform contractors of their responsibilities when performing hot work activities at ConMed. The hot work permit is designed to reduce the potential of an uncontrolled ignition of materials in a hot work area.

ACTIVITIES
Hot work is any activity that creates heat, flame, sparks, or smoke. Examples of hot work include but are not limited to:
Brazing Cutting Grinding
Soldering Gas or Arc welding Torch-applied roofing
Hot work permits are not required during the construction of new facilities or renovations of unoccupied existing facilities.

RESPONSIBILITIES
The contractor is responsible for the following at ConMed:
• Understanding and complying with the ConMed hot work permit program.
• Having trained employees and approved fire prevention equipment on site prior to performing work.
• Obtaining a hot work permit from the ConMed Facilities Department and/or ConMed Project Manager prior to the hot work activity.
• Acquiring a hot work permit prior to performing hot work within:
• Occupied existing facilities,
• 40 feet of a building or potential hazard such as a fuel storage tank, and
• Confined spaces regardless of location.
• Coordinating with the ConMed Facilities Department the temporary shutdown of localized fire systems to prevent possible fire alarm activation and disruption of normal business operations.
• Posting the hot work permit at the job site in an accessible and conspicuous location.
• Submitting the hot work permit to the ConMed facilities Department at the completion of the activity.
• Conducting their hot work activities in a sound fire safe manner and following the precautions outlined on the hot work permit.
• Assuring that a firewatcher remains on the job for 60 minutes after the completion of the hot work activity.

REGULATIONS
OSHA 29 CFR 1926 Subpart J, Welding and Cutting;
OSHA 29 CRF 1910 Subpart Q, Welding, Cutting, and Brazing; and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.8 MOLD

PURPOSE
To inform contractors of their responsibilities to control mold if encountered at ConMed.

MOLD
Fungi are present almost everywhere in indoor and outdoor environments. Certain types of mold can produce toxins, which can cause allergic reactions and produce flu-like symptoms.
Mold may be found, among other places, in the following building components or furnishings:
• Drywall
• Insulation
• Carpeting
• Flooring

RESPONSIBILITIES
Before undertaking any projects of repair, renovation or construction that may impact mold, contractors shall:
• Request from the ConMed Project Manager the location of mold in the work area.
• Stop work if mold is encountered and notify the ConMed Project Manager.
• Make certain that their employees and subcontractors have had the appropriate level of mold awareness training.
• Contact the ConMed Project Manager with any questions regarding mold.

REGULATIONS
Currently, there are no federal, state, or local regulations for evaluating potential health effects of fungal contamination and remediation.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.9 SCAFFOLDING

PURPOSE
To inform contractors of their responsibilities, while performing work at ConMed, in the use and/or erection of scaffolding.

RESPONSIBILITIES
Before undertaking any projects of repair, renovation or construction, that may require the use of scaffolding, contractors shall:
• Understand and comply with the ConMed Contractor Safety Program.
• Ensure all employees have received training in compliance with federal and local regulations.
• Contact the ConMed Project Manager with questions regarding scaffolding safety and required precautions.

- The contractor shall ensure that the scaffolding be:
  - Erected and dismantled by competent workers, under the supervision of knowledgeable and experienced supervisors.
  - Erected on sound and rigid footing, capable of carrying the maximum intended load without settling or displacement.
  - Securely fastened with all braces, pins, screw jacks, base plates and other fittings installed as required by the manufacturer.
  - Limited to authorized personnel only, especially after working hours.
  - Equipped with standard guardrails and toeboards on all open sides and ends of platforms four (4) to ten (10) feet in height.
  - Provided with a screen with maximum ½ inch openings between the toeboard and the guardrail, where persons are required to work or pass under the scaffold.
  - Replaced or repaired immediately if scaffolding and accessories have any defective parts.
  - Provided with an access ladder or equivalent safe access.
- The contractor shall ensure that the planking be:
  - Scaffold grade or equivalent.
  - Overlapped a minimum of 12 inches or secured from movement.
  - Extended over their end supports not less than 6 inches or more than 12 inches.

REGULATIONS
OSHA 29 CFR 1926, Subpart L, Scaffolding;
OSHA 29 CFR 1910.28, Safety requirements for scaffolding; and
any other applicable regulations.

ACCOUNTIBILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.10 UNIVERSAL WASTE DISPOSAL

PURPOSE
To inform contractors of their responsibilities for the proper disposal of Universal Waste from ConMed property.

GENERAL
Universal waste present limited hazard and are generated in smaller quantities. Universal Waste can not be placed in the regular trash but must be managed separately. Examples of Universal waste include:

- Used fluorescent light bulbs
- Batteries of any size
- Any specialized lighting devices
- Mercury containing devices

RESPONSIBILITIES
Before undertaking any projects of repair, renovation or construction, that may require the disposal or recycling of any component that is considered Universal Waste contractors shall:

• Read and understand the ConMed guidelines.
• Notify the ConMed Project Manager and the EHS Department of the project nature and duration prior to the start of the planned work activity.
• Plan to detach ballasts from lamp fixtures and strip all wiring.
• Plan to collect and segregate Universal Waste for disposal/recycling purposes.
• If ballasts/capacitors are leaking, immediately contact ConMed Project Manager or the EHS Department. .
• Coordinate with the ConMed Project Manager or the EHS Department for the disposal/recycling of the Universal Waste.
• If not handled through the ConMed Hazardous Waste handler, waste must be sent to a ConMed approved facility and copies of all disposal/recycling records including, but not limited to, waste manifests, Department of Transportation (DOT) shipping records, and recycling or disposal certificates must be forwarded to ConMed Project Manager or the EHS Department, no more than 30 days following the transportation, disposal, or recycling activity.

REGULATIONS
EPA 40 CFR 761, Toxic Substances Control Act (TSCA);
ConMed Waste Management procedure UNYE 011 and
any other applicable regulations.

ACCOUNTIBILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.11 PERSONAL PROTECTIVE EQUIPMENT

PURPOSE
To inform contractors of their responsibilities under OSHA's personal protective equipment standard while performing work at ConMed.

RESPONSIBILITIES
Contractors shall provide their employees with personal protective equipment including:
• General Requirements. (OSHA 1910.132) Protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be used wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.
• Eye and Face Protection. (OSHA 1910.133) Each affected employee shall use appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.
• Respiratory Protection. (OSHA 1910.134) Each affected employee shall use appropriate respiratory protection when potentially exposed air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors and when such hazards cannot be reduced or eliminated by effective engineering controls.
• Head Protection. (OSHA 1910.135) Each affected employee shall wear protective helmets when working in areas where there is a potential for injury to the head from falling objects. Protective helmets shall also be worn to reduce electrical shock hazards when near expose electrical conductors which could contact the head.
• Foot Protection. (OSHA 1910.136) Each affected employee shall wear protective footwear when working in areas where there is a danger of foot injuries due to falling and rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards.
• Hearing Protection. (OSHA 1910.95(K)(1)-(3)) Each affected employee shall wear protective ear wear whenever noise exposures equal or exceed an 8-hour time-weighted
average sound level (TWA) of 85 decibels and when engineering controls cannot reduce or eliminate the hazard.
• Hand Protection. (OSHA 1910.138) Each affected employee shall wear protective gloves when working in areas where hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.
• Provide training to each employee who is required to use PPE.
- Each affected employee must show understanding of training to their specific PPE. Contractors shall provide this training and upon completion, each employee shall be tested, and certified in writing by the trainer. If at any time the trained employee changes work activities requiring different PPE, or exhibits lack of understanding of the required PPE, the employee shall be retrained and re-certified.

REGULATIONS
OSHA 29 CFR 1910 Subpart I, Personal Protective Equipment; OSHA 1910.95(K)(1)-(3), Occupational Noise Exposure;
OSHA 29 CFR 1926.52, Occupational Noise Exposure; OSHA 29 CFR 1926 Subpart E, Personal Protective and Life Saving Equipment; and
any other applicable regulations.

ACCOUNTIBILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.12 HAZARD COMMUNICATION

PURPOSE
To inform contractors of their responsibilities under the hazard communication policy regarding potentially hazardous materials present at ConMed.

NOTIFICATION
ConMed is responsible for disclosing site-specific hazards to the contractor. Site-specific hazards may include the presence of chemical, l or biological materials. Disclosure of any site-specific hazards should occur prior to the solicitation process so any precautions to address the identified hazards can be taken into account.

RESPONSIBILITIES
Contractor shall:
• Maintain and have accessible copies of Material Safety Data Sheets (MSDSs) for hazardous chemicals brought onto ConMed property.
• Before use, forward MSDSs of hazardous materials (that produce strong odors) to the ConMed Project Manager or the EHS Department for review.
• Maintain an effective hazard communication program.
• Use and store all hazardous or flammable chemicals, liquids, or gases brought onto the project site in approved containers conforming to applicable federal and local codes.
• Secure permits, if applicable, for the temporary storage of hazardous materials on the project site.
• Ensure that spills of hazardous materials are contained and cleaned-up immediately and that all necessary means and materials are maintained at the work site to accomplish this task.
• Notify the ConMed Project Manager immediately of a hazardous material spill.
• In the event the contractor encounters a hazardous material on the project site (i.e., asbestos, lead, PCBs), which has not been rendered harmless, the contractor shall report the condition to the ConMed Project Manager or the EHS Department.

ACCESS TO MSDS'S
ConMed will provide MSDS copies of all hazardous chemicals on site that may be in or near the contractor work area.

REGULATIONS
OSHA 29 CFR 1910.1200, Hazard Communication;
OSHA 29 CFR 1926.59, Hazard Communication; and
any other applicable regulations.

ACCOUNTIBILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.13 TRENCHING/EXCAVATION

PURPOSE
To inform contractors of their responsibilities while performing trenching and excavation operations ConMed.

GENERAL
Excavations include, but are not limited to, operations such as drilling, digging and trenching.

RESPONSIBILITIES
Contractors shall apply the following safety controls:
• Before any excavation work begins, underground utilities shall be identified and the location marked of underground pipes, electrical conductors, gas lines or other structures.
• Evaluation is required of the trenching site by a "competent person" who knows and is trained to identify soil types, proper protective systems and hazardous conditions.
• Conduct a daily inspection of the excavation and the adjacent areas prior to work and as needed during the workday. If there are any unsafe conditions, work shall stop in the excavation and personnel removed until the problems are corrected.
• Monitor and recognize hazardous atmospheres and conditions such as vibration, external loads, weather conditions, ground water conditions and confined spaces.
• Check all protective material or equipment for any damage.
• When excavations are deeper than 4 four feet, ladders or steps shall be located so that a worker does not need to travel more than 25 feet in the excavation before being able to exit. See (OSHA) confined space standard 29 CFR- 1910.148 for testing before employees enter excavations greater than 4 feet in depth.
• Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with OSHA Standard 1926, Subpart P.
• Examination of the ground by a competent person for excavations less than five (5) feet in depth must present no indication of a potential cave-in hazard. If a cave-in hazard exists, protective systems are required.
• When excavations are deeper than five (5) feet, the sides shall be provided with a protective system (shored, braced or sloped sufficiently) to protect against hazardous ground movement.
• When heavy equipment will be operated nearby, the shoring or bracing shall be able to withstand this extra load regardless of the depth of the excavation. For any excavation that a person will enter, all dirt, debris and excavation material shall be effectively stored or retained at least two (2) feet from the edge of the excavation.
• Adequate protection from hazards associated with water accumulation should be in place before working in excavations.
• Signs and Barricades shall be displayed at all excavation/trenching sites.
• All excavations into which a person could fall or trip shall be guarded. While work is being performed in or near the opening, the guards surrounding the area shall be maintained.
• Barricades at least 3 to 5 feet high shall be spaced no further than ten (10) feet apart and yellow and black "Caution, Do Not Enter" construction tape shall be stretched securely between the barricades.
• A registered professional engineer shall design excavations more than twenty feet deep.
• Excavations should be covered and not left open overnight, whenever possible.

REGULATIONS
OSHA 29 CFR 1926, Subpart P, Trenching and Excavations;
OSHA 29 CFR 1926.650-652, Excavation Requirements; and
any other applicable regulations.

3.14 FIRE SUPPRESSION/SPRINKLER SYSTEM

PURPOSE
To inform contractors of their responsibilities should a fire suppression system or sprinkler need to be shut down..

GENERAL
Projects of repair, renovation or construction often require the disabling or alteration of automatic sprinkler and other fire safety systems. Work on any such systems must be preapproved by the ConMed Facilities Department. Pre-approval is designed as a method of managing life safety (i.e. sprinkler system) impairments in University buildings in the event the systems must be temporarily taken out of service for repairs or replacement.

RESPONSIBILITIES
Before undertaking any projects of repair, renovation or construction, that may require the disabling or altercation of a sprinkler system at ConMed, contractors shall:
• Plan to utilize temporary protection (i.e. fire extinguishers or charged lines).
• Restrict all Hot Work in the affected area.
• The Contractor shall immediately notify ConMed Project Manager or EHS Department in advance.
• The ConMed facilities Department will place the fire protection system "FIRE PROTECTION OUT OF SERVICE" and follow notification and fire watch procedures.
• ConMed facilities Department will ;
    - Promptly restore fire protection equipment to automatic service following completion of work.
    - Conduct any tests to ensure the system has been fully recharged.
    - Lock the system back open.
    - Reset any notification systems (i.e. alarm systems).

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.15 POWER TOOL SAFETY

PURPOSE
To inform contractors of their responsibilities for Power Tool Safety to ensure the safe working condition of tools and equipment.

ACTIVITIES
Each contractor shall be responsible for the safe working condition of tools and equipment used by its employees, which may include but are not limited to hand and portable power tools and other hand-held equipment.

RESPONSIBILITIES
Prior to performing activities related to repair, renovation, or construction projects, contractors shall eliminate or minimize any potential unsafe tools or equipment by implementing the following procedures:
• Each employer shall be responsible for the safe condition of tools and equipment used by its employees.
• Tools shall be inspected at regular intervals and shall be repaired in accordance with the manufacturers' specification.
• Before using a tool, the operator shall inspect it to determine that all operating moving parts operate and that it is clean.
• Power tools shall be maintained in accordance with the manufacturer's specifications.
• Appropriate personal protective equipment should be worn due to hazards that may be encountered while using portable power tools and hand tools.
• Tools should only be used for their intended purposes.
• All employees should receive instruction on regulations and the safe use of each power tool.
• Owners' manuals including manufacturer's specifications and suggested work practices should be kept on-file and made available upon request to all employees required to use the equipment.

REGULATIONS
OSHA 29 CFR 1910.242 - Hand and Portable Powered Tools and Equipment;
OSHA 29 CFR 1910.243 – Guarding of Portable Powered Tools;
OSHA 29 CFR 1910.244 - Other Portable Tools and Equipment;
OSHA 29 CFR 1926.302 - Power-operated hand tools; and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.16 HAZARDOUS WASTE MANAGEMENT

PURPOSE
To inform contractors of their responsibilities under the ConMed Hazardous Waste Management Program (HWMP) when handling, storing, transporting, and disposing of hazardous wastes generated at the ConMed.

GENERAL
The Environmental Protection Agency (EPA) and the local jurisdictions have developed regulations for compliance with RCRA. Responsibility for compliance with hazardous waste regulations begins with the person generating the waste material and follows through to disposal. Examples of hazardous wastes associated with the construction industry include, but are not limited to: adhesives, lubricants, spill residues, used oil, cleaning supplies, solvents, paints, paint thinners, and empty cylinders.

RESPONSIBILITIES
Prior to performing activities related to repair, renovation, or construction projects potentially impacting or generating hazardous waste, contractors shall:
• Identify any potential hazardous wastes associated with the planned work activity.
• Implement their own Hazardous Waste Program, compliant with ConMed policy.
• Implement their own employee training program for the specific materials identified in compliance with local and federal regulations.
• Contact the ConMed Project Manager or EHS Department regarding the transportation, handling, storage, and disposal of all solid and hazardous wastes potentially generated as part of the proposed work activities.
• Ensure no wastes are abandoned in place.
• Notify the ConMed Project Manager or EHS Department prior to the transportation, handling, storage and disposal of all solid and hazardous wastes potentially generated as part of the proposed work activities.
• Comply with all local and federal regulations and the ConMed Waste Management Program.
• Confirm that all wastes removed from ConMed owned properties are transported to and disposed of or recycled at ConMed approved facilities.
• Prior to transportation and disposal, waste manifests for materials meeting the definition of a hazardous waste, as defined by RCRA, must be signed by an approved representative of ConMed.
• Forward copies of all transportation, handling, storage, and disposal records including but not limited to Hazardous Waste Manifests, DOT Permits, and Disposal or Recycling certificates to the ConMed Project Manager or EHS Department.

REGUALTIONS
EPA 40 CFR 260-273, Standards for Universal Waste Management;
Local Flow Control Laws
Hazardous Waste Regulations for the State of New York; and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.17 ELECTRICAL SYSTEMS

PURPOSE
To inform contractors of their responsibilities when performing work activities that may impact electrical systems on ConMed property.

ACTIVITIES
Construction activities frequently impact electrical systems as part of the planned work activity. Such activities include, but are not limited to:
• Installation of electrical systems, components, machinery, and equipment.
• Alterations of electrical systems, components, machinery, and equipment.
• Maintenance of existing systems and equipment.

RESPONSIBILITIES
Prior to performing activities related to repair, renovation, or construction projects potentially impacting electrical system components and energized or non-energized machinery, equipment, parts, or systems, contractors shall:
• Identify any potential sources of electrical energy likely to cause death, injury, or serious physical harm.
• Notify the ConMed Project Manager of impact activities prior to the start of work.
• Coordinate planned outages with the ConMed Facilities Department through the ConMed Project Manager.
• Ensure all employees performing impact activities have received sufficient training in compliance with federal and local regulations.
• Ensure all employees are provided adequate personal protective equipment as required by regulations.
• Ensure all work is performed in accordance with the guidelines of federal and local regulations listed below.
• Ensure all ConMed is notified through the ConMed Project Manager prior to impacting building electrical systems.
• Follow Lock-Out/Tag-Out procedures for the Control of Hazardous Energy as specified in the OSHA 29 CFR 1910.147 Standard, and in the ConMed Contractor Safety Program.

REGUALTIONS
OSHA 29 CFR 1910.301-.399, Electrical Standard;
OSHA 29 CFR 1926, Subpart K, Electrical;
OSHA 29 CFR 1910.137, Electrical Protective Devices;
OSHA 29 CFR 1910. Subpart I, Revised PPE Standards; and
National Fire Protection Association 70E Electrical Hazards in the Workplace – ARC Flash requirements'
ConMed Electrical Safety Procedure UNYS 015
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.18 BLOODBORNE PATHOGENS

PURPOSE
To inform contractors of their responsibilities regarding employee exposure to Bloodborne Pathogens (BBP).

ACTIVITIES
The Occupational Safety and Health Administration (OSHA) defines work related exposure to potential Bloodborne Pathogens as reasonably anticipated skin, eye, mucous membrane, or potential contact with blood or other potentially infectious materials that may result from the performance of an employee's duties. Construction related work activities such as repair work and renovation projects create an environment where serious injuries are likely to occur, and thus the exposure to BBP.

RESPONSIBILITIES
Prior to allowing employees access to job sites where work activities related to repair, renovation, or construction projects are completed, contractors shall:

- Identify any potential work activities likely to cause injury, or serious physical harm.
- Universal precautions shall be observed to prevent contact with blood or other potentially infectious materials. Under circumstances in which differentiation between body fluid types is difficult or impossible, all body fluids shall be considered potentially infectious materials.
- Engineering and work practice controls shall be used to eliminate or minimize employee exposure. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be used.
- Ensure all employees have received sufficient training in compliance with federal and local regulations.
- Ensure all employees are provided with adequate personal protective equipment as required by regulations.
  - Inform the ConMed Project Manager or EHS Department should there be any BBP exposure.
  - All waste bio-waste will be disposed of according to ConMed waste disposal procedures.

REGUALTIONS
OSHA 29 CFR 1910.1030, Bloodborne Pathogens Standard; and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.19 INDUSTRIAL FORK LIFT

PURPOSE
To inform contractors of their responsibilities involving the operation and maintenance of applicable vehicles.

ACTIVITIES
Powered Industrial Lift Trucks include but are not limited to: fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines.

RESPONSIBILITIES
Prior to allowing employees access to job sites where industrial lift trucks are used, contractors shall ensure:
• Vehicles are inspected daily.
• Employees obey all safe operating procedures.
• Any power-operated industrial truck not in safe operating condition shall be removed from service.
• All repairs shall be made by authorized personnel.
• All parts of any such industrial truck requiring replacement shall be replaced only by parts equivalent to those used in the original design.
• No person shall be allowed to stand or pass under the elevated portion of any truck, whether loaded or empty.
• Unauthorized personnel shall not be permitted to ride on powered industrial trucks.
• Operators will sound the horn and use extreme caution when meeting pedestrians, making turns, and traveling through doors.
• When loading trailers, dock plates will be used. Operators will assure dock plates are in good condition and will store on edge when not in use.
• Operators are instructed to report all accidents, regardless of fault and severity.
• All employees are trained in the operation and handling in accordance with federal and local regulations.

REGUALTIONS
OSHA 29 CFR 1910.178, Powered Industrial Trucks; and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.20 FUEL BURNING EQUIPMENT

PURPOSE
To inform contractors of their responsibilities when they work on any fuel-burning equipment at ConMed. To ensure that ConMed remains in compliance with applicable environmental regulations.

ACTIVITIES
The installation, replacement, or removal of a piece of fuel-burning equipment (i.e., boilers, chillers, emergency generators, water heaters, or dryers burning gasoline, oil, or natural gas) at ConMed must be reported to Facilities Department.

RESPONSIBILITIES
• All projects involving any aspect of fuel-burning equipment as listed above must be approved by the ConMed Facilities Department prior to the start date.
• Contractors will be held responsible for obtaining any required permits. ConMed will not permit the project to proceed until any such permits are obtained.
• The contractor shall provide a description of the equipment including the unit's make, model, serial number (if known), fuel burned, fuel burn rate, and known exhaust characteristics as required by the permit application.
• The contractor, in coordination with the project engineers, construction managers, and/or manufacturers of the unit must provide a manufacturer's "cut-sheet" documenting this information before a unit is placed into service.
• In the event a piece of equipment is installed under emergency conditions, the information listed above must be provided no more than 15 calendar days after the installation.
• Contractors should provide the information listed above to the ConMed Project Manager, who in turn will forward it to the correct internal department.

REGULATIONS
EPA 40 CFR 70; and
New York State regulations,
Local Codes and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.21 REFRIGERANTS

PURPOSE
To inform contractors of their responsibilities when they work with any equipment containing refrigerants at ConMed to ensure that ConMed remains in compliance with applicable environmental regulations.

ACTIVITIES
The installation, maintenance, service, repair, or disposal of equipment containing more than 50 pounds of refrigerant by a contractor must be reported to Facilities Department. The U.S. Environmental Protection Agency (EPA) requires that ConMed maintain an accurate inventory of all such equipment, including the date it went into or out of service, the type and amount of refrigerant it contains, and the rate at which refrigerant may leak from the equipment.

RESPONSIBILITIES

- All projects involving any aspect of equipment containing refrigerants as listed above must be approved by the ConMed Project Manager or EHS Department
- Contractors must provide the location and description of the equipment worked on including the unit's make, model, serial number, refrigerant type, amount of refrigerant added or removed, nature of their work, date their work was performed.
- All work must be performed by certified technicians who hold applicable, up-to-date certification cards.
- Contractors must provide a copy of the refrigerant certification cards for the technicians who performed the work.
- Each contractor must provide this information to the ConMed Project Manager prior to the start of any scheduled work activity, who in turn will forward this information to EHS Department.
- Any referent removed must be done following approved EPA methods including recycling and disposal.
- Any records must be given to the ConMed Project Manager.

REGULATIONS
EPA 40 CFR 82; and
ConMed Refrigerant procedure UNYE 003 and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.22 OIL CONTAINING EQUIPMENT

PURPOSE
To inform contractors of their responsibilities when they install, remove, or work with any equipment containing oil at ConMed to ensure compliance with applicable environmental regulations.

ACTIVITIES
Installation or removal of oil-containing equipment by a contractor must be reported to the ConMed Facilities Department and the Project Manager. Oil includes fuel oil used in generators; heating oil used in boilers; hydraulic oil used in elevators, compactors, and wheel chair or dock lifts; and oil and grease waste from kitchens

RESPONSIBILITIES
• All projects involving oil-containing equipment as listed above must be reported to the Facilities Department.
• Contractors must provide the location and description of the equipment installed or removed the nature of their work, and the date their work was performed.
• Each contractor must provide this information to the ConMed Project Manager prior to the start of any scheduled work activity, who in turn will forward this information to the EHS Department.
• Refer to ConMed Waste Management Procedure for more information on the transportation, handling, and disposal of any waste.
• Prior to transportation and disposal, waste manifests for materials meeting the definition of a hazardous waste, as defined by RCRA, must be signed by an approved representative of ConMed.

REGULATIONS
EPA 40 CFR 112 and 40 CFR 280-281;
ConMed Spill Prevention Control and Countermeasure Plan UNYE 002 and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.23 NOISE

PURPOSE
To inform contractors of their responsibilities regarding noise to ensure that ConMed remains in compliance with applicable regulations.

ACTIVITIES
OSHA noise standards require a hearing conservation program must be implemented when employees are exposed to 85 dB or more in an 8- hour day. There are a number of other requirements under the OSHA standard.

RESPONSIBILITIES
- Contractors must protect their own workers in accordance with OSHA regulations.
- Contractor shall inform the ConMed Project Manager of equipment that will generate noise in excess of 85 dBA.

REGULATIONS
OSHA 29 CFR 1910.15 and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.24 CUTTING, WELDING & BRAZING

PURPOSE
To inform contractors of their responsibilities regarding cutting, welding and brazing to ensure that ConMed remains in compliance with applicable regulations.

ACTIVITIES
OSHA standards for cutting, welding or brazing contain detailed rules for fire protection and prevention during any of the processes.

RESPONSIBILITIES
- There shall be no open flame burning until a “Hot Work” permit is obtained from the Facilities Manager.
- The contractor shall obtain a “Hot Work” permit for each occasion that such a welding and/or flame cutting is anticipated.
- The ConMed Project Manager shall make certain the area sprinklers are in service and fire extinguishers are available and in good working condition.
- The contractor shall sweep, vacuum, or otherwise clean floors in the area and clear all combustible debris.
- If welding or cutting over combustible flooring or wall covering, they must be covered with non-combustible protection or wet down.
- Combustible materials must be moved to a safe distance from the work area.
    - Arrangements on how to handle ConMed materials may be made through the project manager.
- After completion of actual welding or cutting, the area shall be kept under surveillance by the contractor for a minimum of one-half (1/2) hour for any potential smoldering fires.
- Welding and flame cutting equipment shall not be used near flammable liquids or on closed containers that have held flammable liquids.
- The contractor shall remove inside deposits before working on ducts.

REGULATIONS
OSHA 29 CFR Subpart Q, 1910.251 to .255 and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.25 STORING and HANDLING COMPRESSED GAS

PURPOSE
To inform contractors of their responsibilities regarding the storing and handling of compressed gases to ensure that ConMed remains in compliance with applicable regulations.

ACTIVITIES
OSHA standards for the storing and handling of compressed gases define general and specific requirements for acetylene, hydrogen, oxygen and liquefied petroleum gas.

RESPONSIBILITIES

- Contractors must protect their own workers in accordance with OSHA regulations.
- LP gas cylinders shall not be stored in any portion of the building unless it is part of a gas fueled vehicle and has the container shutoff valve closed.
- Cylinders for gases which support combustion, such as oxygen, compressed air, etc. must be segregated and at a minimum distance of 20 feet from combustible or flammable gases such as acetylene, propane, LP gas, etc.
- Empty cylinders must be segregated from full cylinders and appropriately and clearly marked as empty.
- All cylinders must be clearly labeled, giving the name of the gas and whether it is flammable, toxic, or an oxidizer material and must be securely fastened in an upright position to prevent it from falling over.
- All cylinders must be stored in a dry, well-ventilated location.
    - Not subjected to heat above 125° F.
    - They should be a minimum of 25 feet from electric wires or equipment, flames, or other sources of ignition.
- Cylinders must not be allowed to drop, fall over, strike together, or be used as rollers for moving objects.
- When transporting gas cylinders, a standard truck, carriage, or rack securely blocked with cylinders chained in an upright position must be used.
    - Valve protection caps must be properly in place and valves closed securely when cylinders are not in actual use.
- Leaking gas cylinders must be removed to a secured area, notify the ConMed Project Manger or the Facilities or EHS Department as soon as possible.

REGULATIONS
OSHA 29 CFR, Subpart H, 1910.101 - .104 – Compressed gases, Acetylene, Hydrogen and Oxygen,
OSHA 29 CFR Subpart H, 1910.110 Liquefied petroleum gases, and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.26 FLAMMABLE MATERIALS

PURPOSE
To inform contractors of their responsibilities regarding handling and use of flammable materials to ensure that ConMed remains in compliance with applicable regulations.

ACTIVITIES
OSHA primary hazards apply to the handling, storage and use of combustible liquids with a flash point below 200^{O}F.

RESPONSIBILITIES
- Contractors must protect their own workers in accordance with OSHA regulations.
- All flammable liquids brought onto ConMed property must be properly stored outside of the buildings in areas approved by the ConMed EHS Department, in approved containers equipped with safety vents and grounding as necessary.
- It is the contractors' responsibility to keep materials in order and to avoid creating a fire hazard.
- The ConMed Project Manager will make the necessary arrangements for allocating adequate storage space for the contractor.
- Flammable liquids may be dispensed for use only from approved safety container, and the containers must be properly bonded and grounded.
- The ConMed Project Manager must be notified in advance of any anticipated use of flammable materials within ConMed buildings or grounds.
- Fuel tanks of powered industrial equipment, containing flammable liquids, must be filled outside of the building and must be equipped with flame arrestors.
- Paints, thinners, lacquers, etc., stored in closed containers and in ventilated metal cabinets in occupied buildings must be kept to a minimum.

REGULATIONS
OSHA 29 CFR 1910.106 Flammable and combustible liquids and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.27 EXPLOSIVES

PURPOSE
To inform contractors of their responsibilities regarding the use of any explosive compound to ensure that ConMed remains in compliance with applicable regulations.

ACTIVITIES
OSHA standards define the safe use, storage, and handling of explosive compounds.

RESPONSIBILITIES
- Contractors must protect their own workers in accordance with OSHA regulations.
- The use of powder-actuated tools and/or explosives of any nature is expressly forbidden except with written approval of the ConMed Environmental Health and Safety Manager, Facilities and Maintenance Manager, and the site area manager (if appropriate).
- Use of such materials may take place only during the dates and times designated in the written approval.

REGULATIONS
OSHA 29 CFR 1910.109 and
any other applicable regulations.

ACCOUNTABILITY
Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.28 PLANT TRAFFIC RULES

PURPOSE

To inform contractors of their responsibilities regarding vehicle traffic on ConMed property.

RESPONSIBILITIES

- Contractors must protect their own workers in accordance with OSHA regulations.
- Contractors' vehicles must observe the site parking lot speed limit, or any other posted traffic related signs.
- All vehicles must yield the right of way to pedestrians.
- Vehicles may be parked only as per ConMed regulations, except when unloading for a very short period of time (not to exceed 15 minutes).

REGULATIONS

ConMed safety requirements.

ACCOUNTABILITY

Contractors will be responsible for complying with the above guidelines and for communicating the information to their employees and subcontractors. This includes the implementation of policies and procedures. All work shall be performed in accordance with all applicable laws and regulations.

3.29 EMERGECIES

PURPOSE
To inform contractors of their responsibilities regarding emergency response while on ConMed property.

ACTIVITIES
The ConMed Emergency Management Program (EMP) describes the responsive action that must be taken by ConMed Corporation located at 525 French Road, Utica, NY, personnel in the event of any emergency. The EMP is designed to minimize hazards to human health or the environment and loss of property involving security, fire, an explosion or accidental release of hazardous materials and/or their constituents, into the air, soil or surface water.

RESPONSIBILITIES

- Contractors must protect their own workers in accordance with OSHA regulations and ConMed procedures.
- **EVACUATION:**
  - All employees should be familiar with the location of emergency exits and routes, manual pull stations, fire extinguishers in their work area.
    - Evacuation routes are posted near entrances in each building and in the work areas.
  - *If you discover a fire:*
    - Begin evacuation of the building by activating a manual pull station located at any of the emergency exits. The fire department will be automatically notified. You can also call 911 and notify Emergency Services, but you still must activate the alarm to evacuate the building. (You may need to dial 9 to access an outside line prior to dialing 911.)
  - *If you hear the fire alarm or see the strobe lights flashing:*
    - Turn off machines or equipment that may be dangerous or cause problems if left unattended, such as forklifts or power tools. Shutoff equipment only if it is safe to do so.
    - Evacuate quickly in an orderly manner through the nearest emergency exit and go to your assigned assembly area.
    - Do not waste time going to desks, lockers or refrigerators for purses, cigarettes or other items.
    - Do not stand near the building (within 50 feet) or sit on anyone's vehicle.
    - Be sure to stand out of the way of vehicular traffic especially where emergency vehicles may be entering or leaving the parking lot area.
- **MEDICAL EMERGENCY:**
  - Call 911 should there be a medical emergency.
- In all emergency instances Contact the ConMed Project Manager, EHS or Facilities Manager immediately.

REGULATIONS
ConMed procedure UNYS 003-1 Workplace Medical Response
ConMed procedure UNUS 002 Emergency Management Program
New York State 6 NYCRR § 373-2.4 and 373-3.2,
EPA 40 CFR 265.30, SARA; Title III Emergency Procedures,
29 CFR Occupational Safety & Health Administration, and
any other applicable regulations.

Bibliography

Office of Risk Management, *"Contractor Environmental Health & Safety Program"* last updated 12-13-2006, The George Washington University, 2025 F Street, NW Suite 101, Washington DC 20052

CONTRACTOR SAFETY PROGRAM REVIEW ACKNOWLEDGEMENT

Rev. A **FORM # UNYS 022 A**

Project Title and/or P.O. No. : _____

Contractor Company Name: _____

Contractor Representative Name: _____

ConMed Project Manager Name: _____

I (contractor name) _____ am an authorized contractor for ConMed Corporation French Road Facility located in Utica, NY. I have received environment, health and safety training on issues as they pertain to the facility located at 525 French Road, Utica, New York. By signing this document I acknowledge that I have received a copy of and will abide by the requirements of the ConMed, Contractor Safety Program, UNYS 022.

Contractor Representative Print Name	Contractor Sign Name	Date

ConMed project Manager Print Name	Trainer Sign Name	Date

Contractor Employee(s) Signature:

Contractor Employee Print Name	Contractor Employee Sign Name	Date
Contractor Employee Print Name	Contractor Employee Sign Name	Date
Contractor Employee Print Name	Contractor Employee Sign Name	Date
Contractor Employee Print Name	Contractor Employee Sign Name	Date
Contractor Employee Print Name	Contractor Employee Sign Name	Date
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Contractor Employee Print Name	Contractor Employee Sign Name	Date
Contractor Employee Print Name	Contractor Employee Sign Name	Date

Lockheed Martin List of Exceptions:
ConMed Contractor Safety Program Handbook UNYS 022-G Rev: B 8-12-11
January 2014
Changes by ConMed before being accepted 1-20-14
Additional changes by Lockheed Martin on 1/27/14

General Comments:

Lockheed Martin will provide its contractor(s) with a copy of the ConMed Contractor Safety Program Handbook (Handbook) for informational purposes. However, Lockheed Martin's contractor(s) is required under applicable laws and regulations to prepare its own Health and Safety Plan (HASP) for the work it will perform at the ConMed facility, provide HASP training to its employees and ensure compliance with the HASP. We expect the HASP to be consistent with the Handbook with regard to OSHA requirements. Lockheed Martin will provide ConMed a copy of its contractor's HASP.

For purposes of clarity, Lockheed Martin has prepared the following list of exceptions to the identified sections of the Handbook. The list addresses Handbook requirements that are inconsistent with Lockheed Martin policies and requirements. Lockheed Martin will attach this list of exceptions to the Handbook before providing copies to its contractor(s). Lockheed Martin and its contractors will conduct remediation work at the facility consistent with these exceptions. Lockheed Martin and its contractors will conduct investigation and remediation work at the facility in accordance with all applicable laws and regulations.

Section 3.1 Asbestos

ConMed's preferred asbestos contractor is Midlantic. Lockheed Martin may choose to retain Midlantic's services for future asbestos work, as it has in the past, or Lockheed Martin may choose to retain one of its approved asbestos contractors. If Lockheed Martin chooses to retain one of its approved contractors, Lockheed Martin will (i) provide notice to ConMed, (ii) provide documentation of applicable licenses, certifications and copies of all permits issued for asbestos-related work, and (iii) require its contractor to name ConMed as an additional insured on general and contractor pollution liability insurance policies and to provide corresponding certificates of insurance noting same. After an asbestos-related activity is completed, Lockheed Martin will provide a letter to ConMed documenting the activity.

Section 3.3 Confined Space

Lockheed Martin (or contractor) will notify ConMed in advance of any confined space entry (CSE) activity and will communicate the CSE procedures to be followed. CSE will be performed in compliance with Lockheed Martin policies and OSHA standards. Lockheed Martin will not provide ConMed with signed documentation, but rather will retain its signed documentation in its records. Lockheed Martin will be responsible for clearly labeling and managing entry into all confined spaces that are associated with the site remediation activities.

Section 3.4 Indoor Environmental Quality

With respect to indoor environmental quality, Lockheed Martin and its contractor(s) will conduct work in accordance with ConMed's *Criteria for Remediation System Site Work at Former Lockheed Martin French Road Facility Utica, NY*.

Section 3.5 Lockout/Tagout

If ConMed energies will be impacted by Lockheed Martin's remediation work, Lockheed Martin will coordinate any lockout/tagout (LO/TO) activities with ConMed. Lockheed Martin will not notify ConMed of minor remediation system LO/TO activities.

Section 3.7 Hot Work Permit

Lockheed Martin will coordinate all hot work activities with ConMed's Facilities Department. Hot work performed by Lockheed Martin's contractors will comply with Lockheed Martin policies and OSHA standards. Lockheed Martin will issue permits to its contractors that are consistent with its own hot work program.

Section 3.8 Mold

Lockheed Martin's only responsibility with respect to mold is to notify ConMed if mold is encountered.

Section 3.9 Scaffolding

In the event a Lockheed Martin contractor performs an activity that requires scaffolding, the contractor will comply with Lockheed Martin policies and OSHA standards.

Section 3.10 Universal Waste Disposal

Lockheed Martin is the RCRA generator of record for all wastes generated in connection with investigation and remediation activities at the ConMed facility. Lockheed Martin will have sole responsibility for the management of any wastes it generates and Lockheed Martin will use only its approved vendors for waste transport and disposal.

Section 3.13 Trenching/Excavation

For any trenching/excavation on site, Lockheed Martin and its contractors will comply with Lockheed Martin policies, OSHA standards, applicable NYSDEC and NYSDOH regulations, policies and guidelines, and applicable requirements in the RCRA Order on Consent issued by NYSDEC to Lockheed Martin.

Section 3.16 Hazardous Waste Management

Lockheed Martin and its contractors are solely responsible for the management of any hazardous wastes generated during investigative and remediation activities, including the transport and disposal of such wastes.

Section 3.17 Electrical Systems

Both the Groundwater Collection and Treatment System (GCTS) and the Sub-slab Depressurization System (SSDS) are powered by the ConMed electrical system, although both systems have their own fused electrical disconnects, which can be used to isolate Lockheed Martin's equipment from ConMed's electrical system. Non-routine electrical repairs will be performed by an electrical contractor retained by Lockheed Martin and Lockheed Martin will provide notice to ConMed of such repairs prior to the commencement of the repair work.

Section 3.18 Bloodborne Pathogens

Lockheed Martin's contractor(s) and its employees will comply with the contractor's exposure control plan for bloodborne pathogens, and will not inform ConMed if a contractor employee is exposed to blood. However, if there is the potential for ConMed employees, vendors or contractors to also be exposed to that blood, Lockheed Martin's contractor will notify ConMed immediately.

Section 3.20 Fuel Burning Equipment

Lockheed Martin may bring generators on site during construction activities with at least 90 days notification and approval from ConMed. Lockheed Martin may use generators to operate its remediation systems if responding to an emergency situation where the electric utility cannot deliver electricity to the facility, in which case Lockheed Martin will provide notice to ConMed as soon as practicable. Lockheed Martin may use generators outside of the ConMed building for purposes of performing groundwater sampling after providing ConMed advance notice of this use as part of an annual schedule of activities. ConMed will need to assess the potential impact of generator operations to its State Facility Air Permit. Lockheed Martin's contractors may use personnel lifts to access overhead SSDS piping; however, no indoor propane-powered lifts are allowed as these will impact white room air quality standards. Lockheed Martin will not be required to obtain approval from ConMed for this equipment, but will inform ConMed and coordinate the access route and location of the equipment prior to the equipment being brought on site.

Section 3.22 Oil Containing Equipment

For any chemicals brought on site, Lockheed Martin and its contractor(s) will supply ConMed with a copy of Material Safety Data Sheets in accordance with ConMed's *Criteria for Remediation System Site Work at Former Lockheed Martin French Road Facility Utica, NY*. Waste disposal is solely the responsibility of Lockheed Martin (see exceptions in Sections 3.10 and 3.16 above).

Section 3.24 Cutting, Welding & Brazing

For any activities involving cutting, welding and/or brazing, Lockheed Martin's contractor(s) will comply with Lockheed Martin policies and OSHA standards. ConMed will be informed of the planned location of any cutting, welding and/or brazing and the potential for generation of vapors or gases in the vicinity of the activities.

APPENDIX B

JOB SAFETY ANALYSES

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 1. Driving To/On/From Site

Created by: ***R. Mahoney***	***Date:*** ***Feb. 8, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Driving To Site	a. Typical Roadway & Traffic Hazards	a. Inspect vehicle for: Current Inspection; Properly-inflated tires; Sufficient fuel; Washer fluid, working headlights, tail lights and brake lights. Allow for ample travel time to preclude need for haste.
	b. Breakdown Potential	b. Confirm Safety/Emergency kit is present in vehicles (first aid kit, flares or reflective cones, fire extinguisher, flashlight; etc). have Emergency Contact Numbers (Stantec Office and Roadside Assistance) in vehicle. Also have sufficient warm clothing and a blanket in winter months.
	c. Safe Load (If using a truck or van with an equipment/materials load)	c. No hazardous materials are to be transported; Any fluids are in a proper/sealed container; equipment and materials are secured to truck bed or van floor/seats; Materials are not stacked in a way that would allow them to shift under rapid braking or collision; Equipment carried on the roof of a truck cap must be securely attached to a properly-installed roof rack. Inspect load after driving a short distance to insure shifting is not occurring.
2. Driving On Site	a. Entering Site Safely	a. Be aware of potential truck traffic and yield to other vehicles. Sign in at office building.
	b. Collision with other vehicles	b. DRIVE SLOWLY. Be aware of icy conditions.
	c. Vehicle Control in Reverse	c. Whenever possible, park in a manner that allows immediate forward egress when leaving. If backing up is necessary: View the roadway directly for clear access before backing; when backing, proceed SLOWLY, use both side view mirrors and rearview mirror; Honk horn occasionally to alert possible pedestrians.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 1. Driving To/On/From Site

Created by: ***R. Mahoney***	***Date:*** ***Feb. 8, 2014***	***Revision Date:***

Task Element	Hazard(s)	Controls
3. Driving From Site	a. Leaving Site Safely b. Breakdown Potential c. Safe Load (If using a truck or van with an equipment/materials load)	a. Sign out at Office Building. b. Confirm Safety/Emergency kit is present in vehicles (first aid kit, flares or reflective cones, fire extinguisher, flashlight; etc). have Emergency Contact Numbers (Stantec Office and Roadside Assistance) in vehicle. Also have sufficient warm clothing and a blanket in winter months. c. No hazardous materials are to be transported; Any fluids are in a proper/sealed container; equipment and materials are secured to truck bed or van floor/seats; Materials are not stacked in a way that would allow them to shift under rapid braking or collision; Equipment carried on the roof of a truck cap must be securely attached to a properly-installed roof rack. Inspect load after driving a short distance to insure shifting is not occurring.

Training Requirements:	**Personal Protective Equipment (PPE) Requirements:**
HAZWOPER 40-hr and 8-Hr Refresher	Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks.

Remarks:

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 2. Routine O&M Activities

Created by: ***R. Mahoney***	***Date:*** ***Feb. 8, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Mobilization	a. Driving Hazards b. Notifications c. Lifting Hazards d. Slip/Trip/Fall	a. Follow JSA for Driving To/On/From Site b. Sign out at office; sign in at front desk. c. Minimize weight of any single lift; use two people where necessary; lift with legs and not with back. d. Assess ground conditions at each system site (inside and outside); take measures to eliminate objects; Clear walking paths; Wear boots with proper treads; remove ice on pavement, if possible, or use salt/sand for traction.
2. System Checking	a. Visibility b. Vapor Exposure c. Electric Shock	a. Wear Reflective Vest b. Open and vent system enclosure building , read VOC levels with PID, and visually assess building for spills or leaks before entering. c. Do not touch or disassemble electrically-charged equipment without de-energizing first (if appropriate, perform Lock-out/Tag-out in accordance with **Section 7.3.8 of the HASP).**
3. Use of Step Ladder	a. Potential Fall From Height	a. Use ladder in accordance with **Section 7.3.9 of the HASP.**
4. Filter Bag Change-out (Canal GWTS)	a. Exposure to petroleum-contaminated sediment and fluids. b. Pinch point when disassembling/reassembling pumps and piping.	a. Monitor breathing zone continuously with PID during work; Wear proper gloves and splash goggles or face shield; have absorbent pads available to catch “drippage”; have heavy-duty trash bag ready to contain and dispose spent filter. b. Be aware of pinch points associated with connecting and disconnecting water hoses (cam locks); and equipment disassembly/reassembly. Use appropriate tools and wear impact-resistant gloves and safety glasses.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 2. Routine O&M Activities

Created by: ***R. Mahoney***	***Date:*** ***Feb. 8, 2014***	***Revision Date:***

Task Element	Hazard(s)	Controls
5. Well Gauging	a. Struck by vehicle (if in traffic area) b. Pinch Point when opening well cover c. Exposure to vapors. d. Splash potential for groundwater or NAPL.	a. Wear reflective vest; Establish work area and mark with cones and flagging; position field vehicle to block work area. b. Be aware of pinch points associated with removal/ replacement of the well lid/vault cover. Wear sturdy leather or equivalent gloves. Use appropriate tool to remove well lid cover. c. Monitor breathing zone continuously with PID; Be aware of action levels set forth in **Section 3.4 of HASP.** Upgrade to Level C if action levels of VOCs are exceeded and sustained. d. Wear proper protective gloves. Use slow and controlled motion when inserting and removing well probe from well or decontamination bucket. Place decon bucket on firm, level surface.

Training Requirements:	**Personal Protective Equipment (PPE) Requirements:**
HAZWOPER 40-hr and 8-Hr Refresher; Lock-out Tag-out Procedures.	Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks

Remarks:

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 3. Groundwater Monitoring Well Gauging and Sampling

***Created by:* R. Mahoney**	***Date:* Jan. 21, 2014**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Mobilization	a. Driving hazards b. Notifications c. Lifting hazards d. Slip/Trip/Fall	a. Follow Precautions outlined in JSA for Task 1 – ***Driving To/From/On Site***. b. Sign out at office; sign in at Terminal Office c. Minimize weight of any single lift; use two people where necessary; lift with legs and not with back. d. Assess ground conditions at each well site; take measures to eliminate objects; Clear walking paths in areas of vegetative growth; Wear boots with proper treads; remove ice on pavement, if possible, or use salt/sand for traction.
2. Opening Well / Gauging	a. Struck by vehicle (if in traffic area) b. Pinch Point when opening well cover c. Exposure to vapors d. Splash potential for groundwater or NAPL	a. Wear reflective vest; Establish work area and mark with cones and flagging; position field vehicle to block work area. b. Be aware of pinch points associated with **removal and replacement** of the well lid/vault cover. Be aware of body position; wear sturdy leather or impact-resistant gloves. Use appropriate tool to remove well lid cover. This includes a handle appropriately designed for the type and weight of cover to be removed, and should allow lifting the cover from an upright position. c. Monitor breathing zone continuously with PID; be aware of action levels set forth in **Section 3.4 of HASP.** Upgrade to Level C (Full-face respirator with P-100 combo cartridges) if action levels of VOCs are exceeded and sustained. d. Wear latex gloves (minimum protection) and neoprene gloves (preferred). Use slow and controlled motion when inserting and removing well probe from well or decontamination bucket. Place decon bucket on firm, level surface.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 3. Groundwater Monitoring Well Gauging and Sampling

Created by: ***R. Mahoney***	***Date:*** ***Jan. 21, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
3. Opening Well / Sampling	a. Struck by vehicle (if in traffic area)	a. Wear reflective vest; Establish work area and mark with cones and flagging; position field vehicle to block work area.
	b. Pinch Point when opening well cover	b. Be aware of pinch points associated with removal and replacement of the well lid/vault cover. Be aware of body position; wear sturdy leather or impact-resistant gloves. Use appropriate tool to remove well lid cover. This includes a handle appropriately designed for the type and weight of cover to be removed, and should allow lifting the cover from an upright position.
	c. Exposure to vapors	c. Monitor breathing zone continuously with PID; Be aware of action levels set forth in **Section 3.4 of HASP.** Upgrade to Level C (Full-face respirator with P-100 combo cartridges) if action levels of VOCs are exceeded and sustained.
	d. Splash potential for groundwater or NAPL	d. Wear latex gloves (minimum protection) and neoprene gloves (preferred). Use slow and controlled motion when inserting and removing bailer from well and when pouring contents into measuring bucket or carbon bucket. Place all buckets on firm, level surface.
	e. Handling glass sample containers	e. Use bubble wrap to cushion containers in cooler.
4. Decontamination (equipment)	a. Splash Potential	a. Perform decon in a controlled environment with proper containers and potable water supply; Wear gloves and safety glasses; wear a Face Shield if necessary. Containerize decon water in covered buckets for transport to GCTS treatment bldg.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 3. Groundwater Monitoring Well Gauging and Sampling

Created by: ***R. Mahoney***	***Date:*** ***Jan. 21, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
5. Decontamination (personal)	a. Exposure to contaminated liquids (splash potential) and solids.	a. If necessary, perform dry decon on boots with stiff-bristled brush to remove soil, onto a poly-covered surface; Wear gloves and safety glasses; wear a Face Shield if necessary; Contain wash and rinse fluids in appropriate containers.
Training Requirements: **HAZWOPER 40-hr and 8-Hr Refresher**	**Personal Protective Equipment (PPE) Requirements:** Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks.	

Remarks: For wells located in areas of heavy brush or trees – visually inspect area for poison ivy before proceeding with work. If present, take measures to eliminate threat (remove, or cover with plastic sheeting, etc). For removal, wear Tyvek suit and gloves – cover all exposed skin.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 4. Portable Electric Compressor Use (*does not apply to gasoline-powered units*)

Created by: ***R. Mahoney***	***Date:*** ***Feb. 8, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Handling / Transporting Compressor	a. Lifting/dropping hazard	a. Perform lifting in accordance with **Section 7.3.12 of HASP.** Minimize weight of any single lift; use two people where necessary; use proper positioning, lift together, lift with legs and not with back. Use ramp where possible to load onto and off of truck or van.
	b. Injury during transport	b. Secure unit in truck bed or van with ropes, strap or bungee cords.
2. Energizing unit for use	a. Electrical shock	a. Communication between employees, if more than one. Use only a proper-amperage electrical circuit, with a breaker. Use only heavy-gauge extension cords, if required. Do not use 2-prong adaptors. Be careful of placement of cord, and keep plug off the ground. Be aware of standing water. Do not use in rainy conditions.
	b. Inadvertent/premature startup of unit	b. Confirm that unit on/off switch is in off position and tank pressure has been bled prior to plugging unit in.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 4. Portable Electric Compressor Use (*does not apply to gasoline-powered units*)

Created by: ***R. Mahoney***	***Date:*** ***Feb. 8, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
3. Unit Operation	a. Excessive Noise	a. Wear hearing protection
	b. Injury from moving parts	b. Make sure guards are in place for moving parts (If present) such as belts, pulleys. Wear eye protection and heavy gloves.
	c. Potential for explosion	c. Do not use near open flame, welding or other "hot work" equipment.
	d. High velocity air flow from residual air pressure-blowing debris, dust, etc.	d. Wear safety glasses, hard hat, long sleeves
	e. Tripping hazard from cord and hoses	e. Place cord and hoses out of traffic area to the extent possible; step carefully and deliberately.
	f. Impact from loose hose "whip" action	f. Check hose and fitting connections before and during use.

Training Requirements:	**Personal Protective Equipment (PPE) Requirements:**
HAZWOPER 40-hr and 8-Hr Refresher	Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks.

Remarks:

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 5. Plumbing and Piping Work *(for PVC piping only)*

***Created by:* R. Mahoney**	***Date:* Feb 8, 2014**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Mobilization	a. Driving Hazards b. Notifications c. Lifting Hazards d. Slip/Trip/Fall	a. Follow JSA for Driving To/On/From Site b. Sign out at office; sign in at Main Entrance c. Minimize weight of any single lift; use two people where necessary; lift with legs and not with back. d. Assess ground conditions at each system site (inside and outside); take measures to eliminate objects; Clear walking paths; Wear boots with proper treads; remove ice on pavement, if possible, or use salt/sand for traction.
2. System Checking	a. Visibility b. Vapor Exposure c. Electric Shock	a. Wear Reflective Vest b. Open and vent system enclosure building , read VOC levels with PID, and visually assess building for spills or leaks before entering. c. Do not touch or disassemble electrically-charged equipment without de-energizing first (if appropriate, perform Lock-out/Tag-out in accordance with **Section 7.3.8 of the HASP).**
3. Use of Step Ladder	a. Potential Fall From Height	a. Use ladder in accordance with **Section 7.3.9 of the HASP.**
4. Draining Fluid from Piping	a. Exposure to petroleum-contaminated water b. Exposure to vapors from contaminated water	a. Drain slowly from a controlled location; direct effluent system building sump. - Wear nitrile gloves, safety goggles or face shield. - Use absorbent pads to minimize fluids on floor and working surfaces b. Vent building; perform breathing zone air monitoring with PID; take protective actions in accordance with **Section 3.4 of HASP.**
5. Handling Piping	a. Strain from Lifting Pipe Lengths b. Striking other Workers with Pipe	a. Use two people for all heavy loads; Perform lifting in accordance with **Section 7.3.12 of HASP**; b. Use caution when handling longer lengths of pipe to avoid striking other workers; be aware of their location at all times.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 5. Plumbing and Piping Work *(for PVC piping only)*

***Created by:* R. Mahoney**	***Date:* Feb 8, 2014**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
6. Pipe Cutting	a. Laceration and trauma to hands or other body parts	a. - Use only hand saws, with sharp blades - Secure pipe in a pipe vice or other mechanical clamping mechanism to prevent movement - Wear heavy-duty, impact-resistant protective gloves - Two hands on the saw - immediately de-burr the piping with sandpaper or file - Store saw in an out-of-the way location to avoid inadvertent contact with the blade.
7. Pipe welding (gluing)	a. Exposure to chemical adhesive (vapors)	a. - Use "Low-VOC" glue product. - Follow manufacturer's directions for use. - Vent building; perform breathing zone air monitoring with PID; take protective actions in accordance with **Section 3.4 of HASP.** - Keep container closed and sealed when not in use
	b. Exposure to chemical adhesive (skin/eye contact)	b. - Have eyewash ready in work area - Wear protective gloves, long sleeves, safety glasses or face shield. - Work over absorbent pad to collect any dripped adhesive material. - Keep container closed and sealed when not in use
	c. Exposure to flammable material	c. No smoking, open flame, sparks or other ignition sources in work area.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 5. Plumbing and Piping Work *(for PVC piping only)*

***Created by:* R. Mahoney**	***Date:* Feb 8, 2014**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
8. Using Threaded Connections	a. Injury to hands or other body parts from hand tools	a. - Use properly-sized chain- or strap-type pipe wrench - Be mindful of positions of tools and yourself, especially in tight spaces. Control your body weight when forcing a wrench. - Do not use "cheater" pipes to extend a wrench handle length for additional leverage. - Wear heavy-duty, impact-resistant protective gloves.
Training Requirements: **HAZWOPER 40-hr and 8-Hr Refresher**	**Personal Protective Equipment (PPE) Requirements:** Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks.	
Remarks:		

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 6. Sequestering Agent Drum Handling

Note: Delivery of new drums and removal of empty drums of sequestering agent will be performed by vendor and overseen by Stantec employee.

Created by: ***L. Best/ R. Mahoney***	***Date:*** ***Feb. 10, 2014***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Mobilization – Assemble all necessary tools equipment and PPE required to complete the task. Schedule Subcontractor services.	a. Driving hazards b. Lifting hazards c. Slip/Trip/Fall	a. Follow Precautions outlined in JSA for Task 1 – ***Driving To/From/On Site***. b. Minimize weight of any single lift; use two people where necessary; lift with legs and not with back. c. Assess ground conditions in and around GW Treatment System building; take measures to eliminate or mark objects; Wear boots with proper treads; Remove ice on pavement, if applicable, or use salt/sand for traction.
2. Opening and Closing Drums	a. Contact with acid b. Muscle Strain and impact injury c. Potential for drum tipping	a. Wear face shield, safety glasses and nitrile gloves. Use caution when removing tubing from empty drum to insure all fluid has been drained from tubing back into drum. Wipe excess fluid carefully from tubing. Insert tubing into new, full drum with caution. b. Wear impact-resistant gloves and use proper bung wrench to open and seal bungs. c. Strap drums to containment basin.
5. Decontamination (equipment)	a. Exposure to VOC-contaminated liquids (splash potential).	a. If necessary, perform decon in a controlled environment with proper containers and potable water supply; Wear gloves and safety glasses; wear a Face Shield if necessary.

Training Requirements:	**Personal Protective Equipment (PPE) Requirements:**
HAZWOPER 40-hr and 8-Hr Refresher; Lock-out Tag-out Procedures.	Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 7. Working from Height Using An Aerial Lift

Note: This JSA applies to interior work using a scissor-style lift only.

Created by: ***L. Best***	***Date:*** ***Jan. 31, 2014***	***Revision Date:***

Task Element	Hazard(s)	Controls
1. Training and Preparation	a. Injury due to improper preparation, equipment, or site knowledge. b. Injury due to improper operation c. Injury due to improper PPE.	a. Read, understand and acknowledge project HASP, and Client and Site requirements b. Lift Operators must receive proper training and demonstrate skills necessary to operate the unit safely. Training must be documented. c. Insure that hard hat, steel toe boots, safety glasses are used at all times.
2. Mobilization	a. Driving Hazards b. Notifications	a. Follow JSA for Driving To/On/From Site b. Sign out at office; sign in at Site
3. Work Area Control	a. Injury to users or others in the vicinity of the work area.	a. Mark work area with orange cones or caution tape to prevent unwanted foot traffic below or near lift. b. Be aware of surroundings while on lift, and maintain communication with personnel in the area of the lift. c. Operate lift only on level, stable floor surfaces capable of supporting the weight of the unit. Inspect area for objects that might impede the vehicle. d. Be aware of suspended structures, piping, electrical wires or other objects that potentially impinge on work areas.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 7. Working from Height Using An Aerial Lift

Note: This JSA applies to interior work using a scissor-style lift only.

Created by: ***L. Best***	***Date:*** ***Jan. 31, 2014***	***Revision Date:***

Task Element	Hazard(s)	Controls
4. Lift Operation	a. Injury due to faulty equipment	a. Inspect all aspects of vehicle and lift before each use in accordance with manufacturer's recommendations. Confirm that required annual inspection is documented.
	b. Injury from improper operation	b. Stay clear of scissor structure during up/down adjustments. Do not move vehicle while in lift except as allowed by manufacturer's instructions.
	c. Injury from unit "rollover."	c. If the unit has stabilizers make sure they are set properly, on a solid level surface .
	d. Injury from impacting overhead objects during vehicle movement or lift operation.	d. Operator cannot move lift until area surrounding lift has been observed for potential conflicts. Be certain surrounding area is completely visible before moving.
	e. Injury from electrocution	e. Maintain a minimum of 10 ft from any electrical wires.
5. Working From Heights	a. Injury due to fall	a. Lift users must wear appropriately-sized harness at all times while working at heights; assess footing conditions; take measures to eliminate objects; wear boots with proper treads; do not lean over lift railings.
	b. Injury to others from dropping objects	b. No personnel positioned beneath the lift. Tie-off heavy equipment if possible. Wear hard hats at all times.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 7. Working from Height Using An Aerial Lift

Note: This JSA applies to interior work using a scissor-style lift only.

Created by: L. Best	*Date:* Jan. 31, 2014	*Revision Date:*
Task Element	**Hazard(s)**	**Controls**
Training Requirements: **HAZWOPER 40-hr and 8-Hr Refresher**	**Personal Protective Equipment (PPE) Requirements:** Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety glasses required for **ALL** tasks. Also required for this JSA: Body harness with attached lanyard rated appropriately for worker weight.	

Remarks: Operation of lift can be performed by a subcontractor, provided subcontractor personnel have proper training and documentation.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 8. Excavation Activities

Created by: ***L. Best***	***Date:*** ***Jan. 22, 2015***	***Revision Date:***

Task Element	Hazard(s)	Controls
1. Pre-Clearance Activities & Utility Locates	a. Damage to utilities or injuries arising from struck utilities	a. Any work constituting ground disturbance must include pre-clearance activities in accordance with "Lockheed Martin Minimum Requirements for Intrusive Fieldwork Work Plans". See Appendix A of Lockheed Martin – "Remediation Contractor's ESH Handbook". Pre-clearance activities include completion and sign off on the Dig Permit and Risk Handling Checklist that are included within the above referenced document. Utility locates must be conducted by a subcontractor per Lockheed Martin Corporation requirements prior to any ground-intrusive work to prevent damage to existing infrastructure and to prevent injuries which may arise from striking a utility; if any part of the crew is unsure of the mark out, work must stop until the problem is resolved; the Project Manager should be consulted if pipes or other indications of underground infrastructure are encountered; remember that all workers have Stop Work Authority if proceeding with the work places themselves, others, and/or the environment at risk.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 8. Excavation Activities

Created by: ***L. Best***	***Date:*** ***Jan. 22, 2015***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
2. Mobilization	a. Driving Hazards b. Notifications c. Slip/Trip/Fall d. Kickoff and Tailgate Meetings	a. Follow precautions outlined in JSA for **Task 1 – Driving To/From/On Site**. b. Sign out at office; sign in at Site c. Assess ground conditions when accessing the work area; take measure to eliminate objects; clear walking paths in areas of vegetative growth; wear boots with proper treads; remove ice on pavement, if possible, or use salt/sand for traction. d. Conduct initial safety meeting as kickoff to the field work and review HASP. Conduct daily tailgate meetings to review tasks for the day and identify hazards/changed conditions.
3. Work Area Control	a. Injury to others in the vicinity of the work area	a. Mark work area with orange cones or caution tape to prevent unwanted foot traffic in close proximity to excavation area and operating machinery; be aware of surroundings and maintain communication with personnel in the excavation vicinity.

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PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 8. Excavation Activities

Created by: ***L. Best***	***Date:*** ***Jan. 22, 2015***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
4. Oversee excavation	a. Exposure to vapors	a. Monitor breathing zone continuously with PID; be aware of action levels set forth in **Section 3.4 of the HASP**; upgrade to Level C (full-face respirator with P-100 combo cartridges) if action levels of VOCs are exceeded and sustained.
	b. Exposure to impacted soil/groundwater	b. Wear nitrile gloves and safety glasses in case of dermal contact with excavated soil and/or encountered groundwater; move slowly if standing water accumulates and presents splash potential; containerized water/liquids should be covered and placed on firm, solid ground.
	c. Struck by operating equipment	c. Stand on opposite side of excavation across from the operating equipment; maintain eye contact and open communication with the operator; do not stand where the operator cannot see you; maintain adequate distance from the machinery when in use, particularly the moving parts; appropriate standing locations and communication should be discussed at the health and safety meeting prior to work start; be aware of other activities in the area and periodically confirm the work area is controlled.
	d. Fall in excavation (slip/trip/fall) e. Handling glass sample containers (if collecting waste characterization samples)	d. Maintain an adequate distance from walls of excavation; stay alert for signs of wall collapse (sliding, toppling, bulging); do not enter excavations greater than 4 feet deep; excavations deeper than 10 feet should have fall prevention systems in place. e. Use bubble wrap to cushion containers in cooler.
5. Decontamination (equipment)	a. Splash Potential	a. Perform decontamination in a controlled environment with proper containers and water supply; wear gloves and safety glasses; wear a face shield if necessary; containerize decontamination water.

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PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 8. Excavation Activities

Created by: ***L. Best***	***Date:*** ***Jan. 22, 2015***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
6. Decontamination (personal)	a. Exposure to contaminated liquids (splash potential) and solids)	a. If necessary, perform dry decontamination on boots with stiff-bristled brush to remove soil, onto a poly-covered surface; wear gloves and safety glasses; wear a face shield if necessary; containerize wash and rinse fluids.

Training Requirements: **HAZWOPER 40-hr and 8-Hr Refresher**	**Personal Protective Equipment (PPE) Requirements:** Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety vest; Hand protection (chemical resistant and/or impact resistant); Safety glasses required for **ALL** tasks.
Remarks:	

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 9. Oversight of GW Well and Vapor Point Maintenance/Repair/Abandonment Activities

***Created by:* L. Best**	***Date:* Jan. 23, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Pre-Clearance Activities & Utility Locates	a. Damage to utilities or injuries arising for struck utilities	a. Any work constituting ground disturbance must include pre-clearance activities in accordance with "Lockheed Martin Minimum Requirements for Intrusive Fieldwork Work Plans". See Appendix A of Lockheed Martin – "Remediation Contractor's ESH Handbook". Pre-clearance activities include completion and sign off on the Dig Permit and Risk Handling Checklist that are included within the above referenced document. Utility locates must be conducted by a subcontractor per Lockheed Martin Corporation requirements prior to any ground-intrusive work to prevent damage to existing infrastructure and to prevent injuries which may arise from striking a utility; if any part of the crew is unsure of the mark out, work must stop until the problem is resolved; the Project Manager should be consulted if pipes or other indications of underground infrastructure are encountered; remember that all workers have Stop Work Authority if proceeding with the work places themselves, others, and/or the environment at risk; overhead barriers must also be considered (height of mast vs. height of overhead lines or other overhead features which may be an obstacle to movement of the drill rig).

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 9. Oversight of GW Well and Vapor Point Maintenance/Repair/Abandonment Activities

***Created by:* L. Best**	***Date:* Jan. 23, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
2. Mobilization	a. Driving Hazards b. Notifications c. Slip/Trip/Fall d. Kickoff and Tailgate Meetings	a. Follow precautions outlined in JSA for **Task 1 – Driving To/From/On Site**. b. Sign out at office; sign in at Site c. Assess ground conditions when accessing the work area(s); take measure to eliminate objects; clear walking paths in areas of vegetative growth; wear boots with proper treads; remove ice on pavement, if possible, or use salt/sand for traction. d. Conduct initial safety meeting as kickoff to the field work and review HASP. Conduct daily tailgate meetings to review tasks for the day and identify hazards/changed conditions.
3. Work Area Control	a. Injury to others in the vicinity of the work area (struck by machinery or moving parts) b. Struck by vehicle (if near roadway)	a. Mark work area with orange cones or caution tape to prevent unwanted foot traffic in close proximity to drilling locations and operating machinery; be aware of surroundings and maintain communication with personnel in the work area; all field personnel should know where the kill switch is for the drill rig or other power equipment. b. Use cones and/or caution tape to clearly mark work area. Wear appropriate PPE including reflective safety vest.

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PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 9. Oversight of GW Well and Vapor Point Maintenance/Repair/Abandonment Activities

***Created by:* L. Best**	***Date:* Jan. 23, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
4. Activities Oversight	a. Exposure to vapors	a. Monitor breathing zone continuously with PID; be aware of action levels set forth in **Section 3.4 of the HASP**; upgrade to Level C (full-face respirator with P-100 combo cartridges) if action levels of VOCs are exceeded and sustained.
	b. Exposure to impacted soil/groundwater	b. Wear nitrile gloves and safety glasses in case of dermal contact with excavated soil and/or encountered groundwater; move slowly if standing water accumulates and presents splash potential; containerized water/liquids should be covered and placed on firm, solid ground.
	c. Struck by operating equipment	c. Maintain an adequate distance from moving parts during drilling and always stand where the operator can see you; maintain eye contact and open communication with operator; appropriate standing locations and communication should be discussed at the health and safety meeting prior to work start; be aware of other activities in the area and periodically confirm the work area is controlled.
	d. Slip/trip/fall	d. Be aware of the possibility of slip/trip/fall hazards associated with the borehole; if the test boring will be converted to a monitoring well, place a cone (or similar cover) over the opening until the well is installed and the curb box/stick up casing has been set; if not, fill in borehole or place a cone (or similar cover) over the opening until the hole has been filled.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 9. Oversight of GW Well and Vapor Point Maintenance/Repair/Abandonment Activities

***Created by:* L. Best**	***Date:* Jan. 23, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
5. Soil characterization/subsurface soil sampling	a. Sharp tools and pinch points	a. Sample sleeves should be opened with care; use proper tools for cutting sleeve and wear appropriate hand protection (work gloves/impact-resistant gloves); always cut away from yourself and others.
	b. Exposure to contaminants and impacted materials (vapors, soil, groundwater)	b. Continue monitoring the breathing zone PID; be aware of action levels set forth in **Section 3.4 of the HASP**; upgrade to Level C (full-face respirator with P-100 combo cartridges) if action levels of VOCs are exceeded and sustained; wear nitrile gloves and safety glasses in case of dermal contact with soil and/or encountered groundwater; containerized water/liquids should be covered and placed on firm, solid ground.
	c. Handling glass sample containers	c. Use bubble wrap to cushion containers in cooler.
	d. Handling bottleware with acid preservatives	d. Wear nitrile gloves and safety glasses to avoid dermal contact and splash potential when handling bottleware; check custody seals on bottles.
6. Soil (and groundwater) handling and storage	a. Spill potential/dermal contact with impacted materials	a. All containerized materials should be covered and placed on firm, solid ground and should remain covered to avoid spills while being moved; nitrile gloves and safety glasses must be worn to avoid dermal contact and splash potential (contact with soil, contact with groundwater, spill and splash while pouring or transferring contents); materials should be stored in closed, accurately labelled containers suitable for the material type; the staging area should be out of the way of pedestrians and vehicles; the staged containers should be as secure as possible (locked drum lids, fenced off area).
	b. Pinch points	b. Wear appropriate hand protection and use appropriate tools for opening and closing drums.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 9. Oversight of GW Well and Vapor Point Maintenance/Repair/Abandonment Activities

***Created by:* L. Best**	***Date:* Jan. 23, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
7. Decontamination (equipment)	a. Splash Potential	a. Perform decontamination in a controlled environment with proper containers and water supply; wear gloves and safety glasses; wear a face shield if necessary; containerize decontamination water.
8. Decontamination (personal)	a. Exposure to contaminated liquids (splash potential) and solids)	a. If necessary, perform dry decontamination on boots with stiff-bristled brush to remove soil, onto a poly-covered surface; wear gloves and safety glasses; wear a face shield if necessary; containerize wash and rinse fluids.

Training Requirements:	**Personal Protective Equipment (PPE) Requirements:**
HAZWOPER 40-hr and 8-Hr Refresher	Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety vest; Hand protection (chemical resistant and/or impact resistant); Safety glasses required for **ALL** tasks.

Remarks:

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 10. Geoprobe Drilling Activities

Created by: ***L. Best***	***Date:*** ***Jul. 21, 2015***	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
1. Pre-Clearance Activities & Utility Locates	a. Damage to utilities or injuries arising from struck utilities	a. Any work constituting ground disturbance must include pre-clearance activities in accordance with "Lockheed Martin Minimum Requirements for Intrusive Fieldwork Work Plans". See Appendix A of Lockheed Martin – "Remediation Contractor's ESH Handbook." Pre-clearance activities include completion and sign off on the Dig Permit and Risk Handling Checklist that are included within the above referenced document. Utility location surveys (including GPR & RD surveys) must be conducted by a subcontractor per Lockheed Martin Corporation requirements prior to any ground-intrusive work to prevent damage to existing infrastructure and to prevent injuries which may arise from striking a utility; if any part of the crew is unsure of the mark out, work must stop until the problem is resolved; the Project Manager should be consulted if pipes or other indications of underground infrastructure are encountered; remember that all workers have Stop Work Authority if proceeding with the work places themselves, others, and/or the environment at risk.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 10. Geoprobe Drilling Activities

***Created by:* L. Best**	***Date:* Jul. 21, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
2. Mobilization	a. Driving Hazards b. Notifications c. Slip/Trip/Fall d. Kickoff and Tailgate Meetings	a. Follow precautions outlined in JSA for **Task 1 – Driving To/From/On Site**. b. Sign out at office; sign in at Site c. Assess ground conditions when accessing the work area; take measure to eliminate objects; clear walking paths in areas of vegetative growth; wear boots with proper treads; remove ice on pavement, if possible, or use salt/sand for traction. d. Conduct initial safety meeting as kickoff to the field work and review HASP. Conduct daily tailgate meetings to review tasks for the day, identify hazards/changed conditions, and reiterate "Stop Work" authority for all workers.
3. Work Area Control	a. Injury to others in the vicinity of the work area	a. Mark work areas with orange cones or caution tape to prevent unwanted foot traffic in close proximity to drilling areas and operating machinery; be aware of surroundings and maintain communication with personnel in the vicinity of drilling activities.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 10. Geoprobe Drilling Activities

***Created by:* L. Best**	***Date:* Jul. 21, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
4. Oversee Drilling Activities and Collect Soil Samples	a. Exposure to vapors	a. Monitor breathing zone continuously with PID; be aware of action levels set forth in **Section 3.4 of the HASP**; upgrade to Level C (full-face respirator with P-100 combo cartridges) if action levels of VOCs are exceeded and sustained.
	b. Exposure to impacted soil/groundwater	b. Wear nitrile gloves and safety glasses in case of dermal contact with soil boring and/or encountered groundwater; move slowly if standing water accumulates and presents splash potential; containerized water/liquids should be covered and placed on firm, solid ground.
	c. Struck by operating equipment/pinch points	c. Maintain an observer's position where eye contact and open communication with the operator are possible; do not stand where the operator cannot see you; maintain adequate distance from the machinery when in use, particularly the moving parts; appropriate standing locations and communication should be discussed at the health and safety meeting prior to work start; be aware of other activities in the area and periodically confirm the work area is controlled.
	d. Noise	d. Use hearing protection as specified in **Section 7.3.4 of the HASP**.
	e. Handling glass sample containers	e. Use bubble wrap to cushion containers in cooler.
5. Decontamination (equipment)	a. Splash Potential	a. Perform decontamination in a controlled environment with proper containers and water supply; wear gloves and safety glasses; wear a face shield if necessary; containerize decontamination water.

JOB SAFETY ANALYSIS

PROJECT: Lockheed Martin – Site Activities for Utica Remediation Site - 525 French Road

TASK: 10. Geoprobe Drilling Activities

***Created by:* L. Best**	***Date:* Jul. 21, 2015**	***Revision Date:***
Task Element	**Hazard(s)**	**Controls**
6. Decontamination (personal)	a. Exposure to contaminated liquids (splash potential) and solids.	a. If necessary, perform dry decontamination on boots with stiff-bristled brush to remove soil, onto a poly-covered surface; wear gloves and safety glasses; wear a face shield if necessary; containerize wash and rinse fluids.

Training Requirements:	**Personal Protective Equipment (PPE) Requirements:**
HAZWOPER 40-hr and 8-Hr Refresher	Wear minimum PPE level appropriate for task. Steel toed, ankle-height boots; Hard hat; Safety vest; Hand protection (chemical resistant and/or impact resistant); Safety glasses required for **ALL** tasks.

Remarks: note that although drilling is likely to involve a direct-push Geoprobe rig, the hazards and controls for given task elements are likely applicable to other drilling programs.

APPENDIX C

SAFETY FORMS

Stantec

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 1 DAY – RMS 2

Project: _____ Project No: _____

Client: _____

Location: _____

Start Date: _____

Work Description

Provide a general description of the work to be conducted.

Documentation and Procedure Review

1.	Risk Management Strategy (RMS1) form and/or Site Specific Health and Safety Plan signed and reviewed?	☐ Yes ☐ **No***
2.	Emergency Response Plan reviewed?	☐ Yes ☐ **No*** ☐ N/A
3.	Tested two-way communications (cell phone, satellite phone) and security measures?	☐ Yes ☐ **No***
4.	Attended Client Site Health and Safety meeting?	☐ Yes ☐ **No*** ☐ N/A
5.	Conducted Stantec site safety meeting with all workforces?	☐ Yes ☐ **No*** ☐ N/A
6.	Are there any new or unexpected hazards not identified in the RMS1/HASP? *If yes, include in the Job Safety Analysis (JSA).*	☐ Yes ☐ No
7.	Working alone or remote work? *If yes, complete call in/out process – Safe Work form must be completed.*	☐ Yes ☐ No

Notifications and Permits

8.	Are work permits required for this site? *If yes, have they been completed and submitted as required?*	☐ Yes ☐ No ☐ Yes ☐ **No***
9.	Are utility locates required for this site? *If yes, have they been completed and reviewed?*	☐ Yes ☐ No ☐ Yes ☐ **No***
10.	Does the Client require any notification prior to starting the work? *If yes, has the notification been provided?*	☐ Yes ☐ No ☐ Yes ☐ **No***

***Contact your Project Manager immediately.**

Personal Protective Equipment

List specific PPE as needed. Verify type and inspect condition.

☐ Head Protection Type: _____	☐ Hearing Protection: _____	☐ Gloves Type: _____
☐ Foot Protection Type: _____	☐ Respiratory Protection: _____	☐ Water Safety Gear: _____
☐ Eye Protection Type: _____	☐ Fire Retardant Coveralls: _____	☐ _____
☐ High Visibility Vest: _____	☐ Fall Protection: _____	☐ _____

Tools and Equipment

List specific equipment to be used. Verify type and inspect condition.

☐	☐	☐
☐	☐	☐

Stantec

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 1 DAY – RMS 2

Daily Tailgate Discussions/Subcontractor Input

Start	Time:	Weather:
Mid-Day	Time:	Weather:
Post-Day	Time:	Weather:

I know the hazards:

By signing here, you are stating the following:

1. I have been involved in the Job Safety Analysis and understand the hazards and risk control actions associated with each task I am about to perform.
2. I understand the permit to work requirements applicable to the work I am about to perform (if it includes permitted activities).
3. I am aware that no jobs or work (that is not risk-assessed) is to be performed.
4. I am aware of my obligation to "**Stop Work**" (*See Stop Work Section).*

I arrived and departed fit for duty:

5. I am physically and mentally fit for duty.
6. I am not under the influence of any type of medication, drugs or alcohol that could affect my ability to work safely.
7. I am aware of my responsibility to bring any illness, injury (regardless of where or when it occurred) or fatigue issue I may have to the attention of the Crew Lead.
8. I signed out uninjured unless I have otherwise informed the Crew Lead.

Insert fitness level under corresponding time column: Fit for Duty = F Alternate Plan = AP
Team Lead to contact Project Manager for any personnel identified as AP

Individual Name/Company Name/Signature	Time:	Time:	Time:

I will STOP the job any time anyone is concerned or uncertain about safety.

I will STOP the job if anyone identifies a hazard or additional mitigation not recorded.

I will be alert to any changes in personnel or their fitness level (AP), conditions at the work site or hazards.

If it is necessary to **STOP THE JOB**, I will reassess the task, hazards and mitigations; and then proceed only when safe to do so.

Remember to
1. Stop and think
2. Look around
3. Assess risk
4. Control risks
5. Begin/resume work

Conclusion of day: I certify that the planned work activities are completed for the day and all injuries and first aids have been reported via RMS3.

Signature of Crew Lead: _____ **Date:** _____

Stantec

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 1 DAY – RMS 2

Job Safety Analysis (JSA) **Must be completed for all field activities.**

Basic Job Steps	Potential Hazards	Controls to Reduce or Eliminate Hazard	Person Responsible

Review the hazard categories below and check the mitigation measures applicable to the identified scope of work.

Environmental Hazards

1. Work area clean ☐
2. Material storage identified ☐
3. Dust/Mist/Fume ☐
4. Noise in area ☐
5. Extreme temperatures ☐
6. Spill potential ☐
7. Waste containers needed ☐
8. Waste properly disposed ☐
9. Waste plan identified ☐
10. Excavation permit required ☐
11. Other workers in area ☐
12. Weather conditions ☐
13. MSDS reviewed ☐

Ergonomic Hazards

14. Awkward body position ☐
15. Over extension ☐
16. Prolonged twisting/bending motion ☐
17. Working in a tight area ☐
18. Lift too heavy/awkward to lift ☐
19. Parts of body in line of fire ☐
20. Repetitive motion ☐
21. Hands not in line of sight ☐
22. Working above your head ☐

Access/Egress Hazards

23. Aerial life/Man basket (inspected & tagged) ☐
24. Scaffold (inspected & tagged) ☐
25. Ladders (tied off) ☐
26. Slips & trips ☐
27. Hoisting (tools, equipment) ☐
28. Evacuation (alarms, routes, ph. #) ☐
29. Confined space entry permit required ☐

Overhead Hazards

30. Barricades & signs in place ☐
31. Hole coverings identified ☐
32. Harness/lanyard inspected ☐
33. 100% Tie-off with harness ☐
34. Tie off points identified ☐
35. Falling items ☐
36. Foreign bodies in eyes ☐
37. Hoisting or moving loads overhead ☐

Rigging & Hoisting Hazards

38. Lift study required ☐
39. Proper tools used ☐
40. Tools inspected ☐
41. Equipment inspected ☐
42. Slings inspected ☐
43. Others working overhead/below ☐
44. Critical lift permit ☐

Electrical Hazards

45. GFI test ☐
46. Lighting levels too low ☐
47. Working on/near energized equipment ☐
48. Electrical cords condition ☐
49. Electrical tools condition ☐
50. Fire extinguisher ☐
51. Hot work or electrical permit required ☐

Personal Limitations/Hazards

52. Procedure not available for task ☐
53. Confusing instructions ☐
54. No training for task or tools to be used ☐
55. First time performing the task ☐
56. Micro break (stretching/flexing) ☐
57. Report **all injuries** to your supervisor ☐

It is important that all relevant hazards have plans in place to reduce risk.
Be sure that all associated permits are closed off at the end of the job.

Remember: Stop and Think

Reviewed by Name and Signature: _____

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 1 DAY – RMS 2

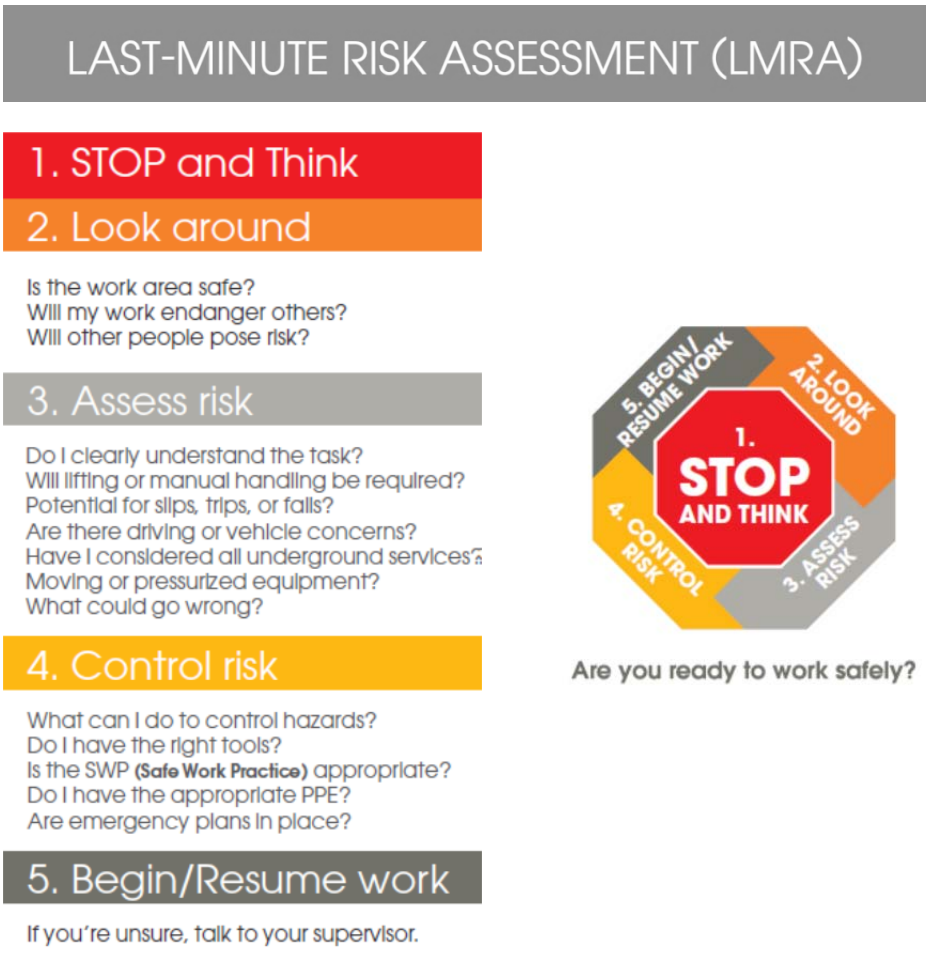
Fit for Duty

Safety is influenced by many factors, but the most important is the health and well-being of Stantec's employees and partners. Physical and mental health are just as important as good tools, good practices, and good job planning.

This card is designed to help you do a quick self-assessment of your physical and mental health. Any concerns resulting from your assessment regarding your ability to carry out your job responsibilities safely and in good health need to be discussed with your supervisor before starting work.

- Am I feeling good today and ready to work at my typical level of physical activity and responsibility?
- Do I have any sprains/strains, areas of weakness or soreness?
- Am I managing multiple sources of stress?
- Am I well hydrated?
- Any physically-demanding activities recently (chores, sports, hobbies)?
- Am I well-rested with a good energy level? When did I eat last?
- Am I taking any medications that can make me drowsy or adversely affect my safe performance?
- Any cuts/scrapes are clean and bandaged?
- Did I remember to bring with me my health maintenance medications (blood pressure, diabetes, cholesterol, heart, etc.)?

If your answers to any of the questions above indicate that you may not be ready to work, contact your supervisor immediately to discuss a plan of action.



Stantec

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 5 DAY – RMS 2

Project: _____ Project No: _____

Client: _____

Location: _____

Start Date: _____

Documentation and Procedure Review

1.	Risk Management Strategy (RMS1) form and/or Site Specific Health and Safety Plan signed and reviewed?	☐ Yes ☐ **No***
2.	Emergency Response Plan reviewed?	☐ Yes ☐ **No*** ☐ N/A
3.	Tested two-way communications (cell phone, satellite phone) and security measures?	☐ Yes ☐ **No***
4.	Attended Client Site Health and Safety meeting?	☐ Yes ☐ **No*** ☐ N/A
5.	Conducted Stantec site safety meeting with all workforces?	☐ Yes ☐ **No*** ☐ N/A
6.	Are there any new or unexpected hazards not identified in the RMS1/HASP? *If yes, include in the Job Safety Analysis (JSA).*	☐ Yes ☐ No
7.	Working alone or remote work? *If yes, complete call in/out process – Safe Work form must be completed.*	☐ Yes ☐ No

Notifications and Permits

8.	Are work permits required for this site? *If yes, have they been completed and submitted as required?*	☐ Yes ☐ No ☐ Yes ☐ **No***
9.	Are utility locates required for this site? *If yes, have they been completed and reviewed?*	☐ Yes ☐ No ☐ Yes ☐ **No***
10.	Does the Client require any notification prior to starting the work? *If yes, has the notification been provided?*	☐ Yes ☐ No ☐ Yes ☐ **No***

***Contact your Project Manager immediately.**

Work Description

Provide a general description of the work to be conducted.

Personal Protective Equipment

List specific PPE as needed. Verify type and inspect condition.

☐ Head Protection Type: _____	☐ Hearing Protection: _____	☐ Gloves Type: _____
☐ Foot Protection Type: _____	☐ Respiratory Protection: _____	☐ Water Safety Gear: _____
☐ Eye Protection Type: _____	☐ Fire Retardant Coveralls: _____	☐ _____
☐ High Visibility Vest: _____	☐ Fall Protection: _____	☐ _____

Tools and Equipment

List specific equipment to be used. Verify type and inspect condition.

☐	☐	☐
☐	☐	☐

Daily Tailgate Discussions/Subcontractor Input

Date:	**Time:**	**Weather:**
Start		
Mid-Day		
Post-Day		
Date:	**Time:**	**Weather:**
Start		
Mid-Day		
Post-Day		
Date:	**Time:**	**Weather:**
Start		
Mid-Day		
Post-Day		
Date:	**Time:**	**Weather:**
Start		
Mid-Day		
Post-Day		
Date:	**Time:**	**Weather:**
Start		
Mid-Day		
Post-Day		

Stantec

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 5 DAY – RMS 2

I know the hazards:

By signing here, you are stating the following:

1. I have been involved in the Job Safety Analysis (JSA) and understand the hazards and risk control actions associated with each task I am about to perform.
2. I understand the permit to work requirements applicable to the work I am about to perform (if it includes permitted activities).
3. I am aware that work that has not been risk–assessed must not be performed.
4. I am aware of my ability and obligation to **Stop Work** (*See below).*

I arrived and departed fit for duty (see Fit for Duty card for further information):

5. I am physically and mentally fit for duty.
6. I am not under the influence of any type of medication, drugs or alcohol that could affect my ability to work safely.
7. I am aware of my responsibility to bring any illness, injury (regardless of where or when it occurred), symptoms of soreness or discomfort, or fatigue issue I may have to the attention of the Crew Lead or Supervisor.
8. I sign out uninjured unless I have otherwise informed the Crew Lead or Supervisor.

Insert fitness level under corresponding time column: Fit for Duty = F Alternate Plan = AP
Team Lead to contact Project Manager for any personnel identified as AP

Individual Name/Company Name/Signature	Date:			Date:			Date:			Date:			Date:		
	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:

I will STOP WORK any time anyone is concerned or uncertain about safety. **I will STOP WORK** if anyone identifies a hazard or additional mitigation not recorded. **I will** be alert to any changes in personnel or their fitness level (AP), conditions at the work site or hazards. If it is necessary to **STOP WORK**, I will reassess the task, hazards and mitigations; and then proceed only when safe to do so.

Conclusion of day: I certify that the planned work activities are completed for the day and all injuries and first aids have been reported via RMS3.

Signature of Crew Lead: _____ **Date:** _____

Signature of Crew Lead: _____ **Date:** _____

Signature of Crew Lead: _____ **Date:** _____

Signature of Crew Lead: _____ **Date:** _____

Signature of Crew Lead: _____ **Date:** _____

Are you ready to work safely?

Remember to
1. Stop and think
2. Look around
3. Assess risk
4. Control risks
5. Begin/resume work

Stantec

FIELD LEVEL RISK ASSESSMENT (FIT FOR DUTY), 5 DAY – RMS 2

Job Safety Analysis (JSA) **Must be completed for all field activities.**

Basic Job Steps	Potential Hazards	Controls to Reduce or Eliminate Hazard	Person Responsible

Review the hazard categories below and check the mitigation measures applicable to the identified scope of work.

Environmental Hazards

1. Work area clean ☐
2. Material storage identified ☐
3. Dust/Mist/Fume ☐
4. Noise in area ☐
5. Extreme temperatures ☐
6. Spill potential ☐
7. Waste containers needed ☐
8. Waste properly disposed ☐
9. Waste plan identified ☐
10. Excavation permit required ☐
11. Other workers in area ☐
12. Weather conditions ☐
13. MSDS reviewed ☐

Ergonomic Hazards

14. Awkward body position ☐
15. Over extension ☐
16. Prolonged twisting/bending motion ☐
17. Working in a tight area ☐
18. Lift too heavy/awkward to lift ☐
19. Parts of body in line of fire ☐
20. Repetitive motion ☐
21. Hands not in line of sight ☐
22. Working above your head ☐

Access/Egress Hazards

23. Aerial life/Man basket (inspected & tagged) ☐
24. Scaffold (inspected & tagged) ☐
25. Ladders (tied off) ☐
26. Slips & trips ☐
27. Hoisting (tools, equipment) ☐
28. Evacuation (alarms, routes, ph. #) ☐
29. Confined space entry permit required ☐

Remember to
1. Stop and think
2. Look around
3. Assess risk
4. Control risks
5. Begin/resume work

Overhead Hazards

30. Barricades & signs in place ☐
31. Hole coverings identified ☐
32. Harness/lanyard inspected ☐
33. 100% Tie-off with harness ☐
34. Tie off points identified ☐
35. Falling items ☐
36. Foreign bodies in eyes ☐
37. Hoisting or moving loads overhead ☐

Rigging & Hoisting Hazards

38. Lift study required ☐
39. Proper tools used ☐
40. Tools inspected ☐
41. Equipment inspected ☐
42. Slings inspected ☐
43. Others working overhead/below ☐
44. Critical lift permit ☐

Electrical Hazards

45. GFI test ☐
46. Lighting levels too low ☐
47. Working on/near energized equipment ☐
48. Electrical cords condition ☐
49. Electrical tools condition ☐
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51. Hot work or electrical permit required ☐

Personal Limitations/Hazards

52. Procedure not available for task ☐
53. Confusing instructions ☐
54. No training for task or tools to be used ☐
55. First time performing the task ☐
56. Micro break (stretching/flexing) ☐
57. Report **all injuries** to your supervisor ☐

It is important that all relevant hazards have plans in place to reduce risk.
Be sure that all associated permits are closed off at the end of the job.

Remember: Stop and Think

Reviewed by Name and Signature: _____

Incidents involving injury, potential injury, or report of pain, soreness, or discomfort must be reported immediately (within one hour) to a supervisor. Supervisors will then immediately contact their HSE representative to develop a plan for assessment and care. This form must be completed and **submitted within 24 hours** of any incident. Do not delay submission waiting for signatures. **Email to hse@stantec.com or fax unsigned report to (780) 969-2030** and file locally in compliance with the corporate records retention policy and practices once all signatures have been obtained.

This document contains privileged and confidential information prepared at the request of Stantec's Legal Counsel. The contents of this report are restricted to HR personnel, Risk Management Representatives, Project Manager and PC Leader, and Stantec's Insurer, Adjuster and Legal Counsel. Information collected will be used solely for the purpose of meeting the requirements of Stantec's HSE and insurance programs, complying with applicable legislation, and will be used in accordance with any governing privacy legislation. The information collected will be maintained electronically and may be included in required reports.

SECTION 1: GENERAL INFORMATION			
Office location:		PC number:	
Location of incident:			
Incident date and time:		Date and time reported:	
Project name:		Project number:	
Client Name:			
Person in charge:		Person in Charge Phone:	

SECTION 2: STANTEC EMPLOYEE INFORMATION (if more than one identify extras in incident details below)			
Name:		Phone:	
Job position:		Group name:	
Time employee began work:		Job Experience (in years)	
Type of employment:	Full Time ☐ ; Visitor ☐ ; Contract ☐ ; Volunteer ☐ ; Seasonal ☐		
Supervisor:		Supervisor Phone:	

SECTION 3: INCIDENT DETAILS

Type of Incident: *incident types marked with an asterisk, please complete pages 1 and 4 only

See StanNet for a list of Incident Type Definitions

☐ **Report Only*	☐ ***Hazard Identification**	☐ ***Near Miss**
☐ First Aid	☐ Motor Vehicle Incident	☐ 3rd Party Incident (i.e., Public)
☐ Medical Aid – No Lost Time	☐ Property Damage - Vehicle	☐ Spill or Release
☐ Restricted Work	☐ Property Damage - Other	☐ Utility Strike
☐ Lost Time	☐ Theft	☐ Fire/Explosion/Flood
☐ Fatality	☐ Contractor Recordable Incident	☐ Stop Work Authority
☐ Violence or Harassment	☐ Non-compliance	☐ Other (specify details below)

Describe incident in detail: (include any issues related to people, equipment, materials, environment, and processes)

Immediate corrective actions taken:

CE (Atlantic) – Neil Clements (506-639-2961); CE (Ontario/Quebec) – Jim Elkins (613-404-8508);
CW (AB ECR/BC) – Yvonne Beattie (780-616-8909); CW (AB South, North & Central/SK/MB) – Shawna Robichaud (587-894-2635);
International – Kev Metcalfe (780-231-2185); US East (New England, Tri-State & Mid-Atlantic) – Fred Miller (610-235-7315);
US East (Great Lakes, South & Southeast) - Keith Kuhlmann (740-816-6170); US West – Fred Miller and Keith Kuhlmann

SECTION 4: MEDICAL INFORMATION

Name of first aid attendant:	Injury recorded in first aid log? Yes ☐ No ☐ N/A ☐
Description of first aid or medical treatment administered:	
Clinic/hospital sent to:	
Attending physician/paramedic (if known):	

Area of Injury – Please check all that apply:

☐ Head	☐ Teeth	☐ Upper back		Left	Right		Left	Right		Left	Right		Left	Right					
☐ Face	☐ Neck	☐ Lower back		☐ Shoulder	☐		☐ Wrist	☐		☐ Hip	☐		☐ Ankle	☐					
☐ Eye(s)	☐ Chest	☐ Abdomen		☐ Arm	☐		☐ Hand	☐		☐ Thigh	☐		☐ Foot	☐					
☐ Ear(s)		☐ Pelvis		☐ Elbow	☐		☐ Finger(s)	☐		☐ Knee	☐		☐ Toe(s)	☐					
☐ Other	Specify			☐ Forearm	☐					☐ Lower Leg	☐								

Has the injured employee had a previous similar injury or disability?	Yes ☐	No ☐

SECTION 5: PROPERTY OR VEHICLE DAMAGE: STANTEC

Ownership Details (choose one):	☐ Rented (attach rental agreement)		☐ Stantec Owned		☐ Personal (employee vehicle)		
Year, Make, and Model of Vehicle:			Vehicle ID # (VIN)				
Nature of damage:			Estimated cost of damage:	$			
Description of damaged property:							
Attending police officer (if known):			Badge #:				
Copy of police report received	Yes ☐ No ☐ If yes, file number:		(attach copy of police report)				

PROPERTY OR VEHICLE DAMAGE: 3RD PARTY

Name of owner and contact number:			
Year, Make, and Model of Vehicle:		License Plate Number:	
Insurer and Policy Number:			
Injured parties? Yes ☐ No ☐	If yes, describe Injuries:		
Diagram or photographs attached?	Yes ☐ No ☐		

WITNESS INFORMATION - #1

Name:		Phone Number:	
Witness statement provided?	Yes (attached) ☐	No ☐	

WITNESS INFORMATION - #2

Name:		Phone Number:	
Witness statement provided?	Yes (attached) ☐	No ☐	

SECTION 6: SPILL OR RELEASE

Substance:			
Quantity:		Employee(s) exposed via:	☐ Inhalation ☐ Contact ☐ Ingestion ☐ n/a
Off-site impacts observed or anticipated?		Yes ☐ No ☐ If yes, describe:	
Name of regulatory agencies contacted:			
Contact name, number, date and time of call:			

CE (Atlantic) – Neil Clements (506-639-2961); CE (Ontario/Quebec) – Jim Elkins (613-404-8508);
CW (AB ECR/BC) – Yvonne Beattie (780-616-8909); CW (AB South, North & Central/SK/MB) – Shawna Robichaud (587-894-2635);
International – Kev Metcalfe (780-231-2185); US East (New England, Tri-State & Mid-Atlantic) – Fred Miller (610-235-7315);
US East (Great Lakes, South & Southeast) - Keith Kuhlmann (740-816-6170); US West – Fred Miller and Keith Kuhlmann

SECTION 7: ANALYSIS

IMMEDIATE/DIRECT CAUSES

A. **UNSAFE ACTIONS** (check off as many as necessary)

- ☐ Operating equipment without authority
- ☐ Failure to warn
- ☐ Failure to secure
- ☐ Operating at improper speed
- ☐ Making safety devices inoperative
- ☐ Removing safety devices
- ☐ Using defective/improper equipment
- ☐ Using equipment improperly
- ☐ Failing to use personal protective equipment properly
- ☐ Improper loading
- ☐ Improper placement
- ☐ Improper lifting or handling
- ☐ Improper position for a task
- ☐ Servicing equipment in operation
- ☐ Horseplay
- ☐ Failure to follow procedure, policy or practice
- ☐ Failure to identify hazard or risk
- ☐ Inattention
- ☐ Failure to communicate
- ☐ Other: Specify

B. **UNSAFE CONDITIONS** (check off as many as necessary)

- ☐ Inadequate guards/barriers
- ☐ Improper/inadequate PPE
- ☐ Defective tools or equipment
- ☐ Congested work area
- ☐ Inadequate warning system
- ☐ Fire and explosion hazards
- ☐ Poor housekeeping; disorder
- ☐ Noise exposure
- ☐ Radiation exposure
- ☐ High or low temperature exposures
- ☐ Inadequate or excess illumination
- ☐ Inadequate ventilation
- ☐ Presence of harmful materials
- ☐ Inadequate instructions/procedures
- ☐ Hazardous environmental conditions; gases, dusts, smokes, fumes, vapours
- ☐ Inadequate information/data
- ☐ Inadequate preparation/planning
- ☐ Inadequate support/assistance
- ☐ Road conditions
- ☐ Weather conditions
- ☐ Other: Specify

BASIC/ROOT CAUSES

C. PERSONAL FACTORS (check off as many as necessary)

- ☐ Inadequate physical capability
- ☐ Physical stress
- ☐ Mental stress
- ☐ Lack of skill
- ☐ Lack of knowledge
- ☐ Other: Specify

D. JOB FACTORS (check off as many as necessary)

- ☐ Inadequate leadership or supervision
- ☐ Inadequate engineering
- ☐ Inadequate purchasing
- ☐ Abuse or misuse
- ☐ Inadequate maintenance (scheduled or preventative)
- ☐ Inadequate tools or equipment
- ☐ Inadequate work standards
- ☐ Other: Specify
- ☐ Excessive wear and tear
- ☐ Inadequate communications
- ☐ Improper motivation

SECTION 8: FOLLOW-UP

Short-term:	Corrective Action	Assigned To	Target Date	Completion Date

Long-term:	Corrective Action	Assigned To	Target Date	Completion Date

CE (Atlantic) – Neil Clements (506-639-2961); CE (Ontario/Quebec) – Jim Elkins (613-404-8508);
CW (AB ECR/BC) – Yvonne Beattie (780-616-8909); CW (AB South, North & Central/SK/MB) – Shawna Robichaud (587-894-2635);
International – Kev Metcalfe (780-231-2185); US East (New England, Tri-State & Mid-Atlantic) – Fred Miller (610-235-7315);
US East (Great Lakes, South & Southeast) - Keith Kuhlmann (740-816-6170); US West – Fred Miller and Keith Kuhlmann

REVIEW COMMENTS		
Involved Employee Comments:		
Signature: Job Title:	Print Name:	Date:
Lead Investigator Comments:		
Signature: Job Title:	Print Name:	Date:
Supervisor/Project Manager:		
Signature: Job Title:	Print Name:	Date:
HSE Representative (OSEC/JH&S Committee/RSEC/HSE Manager):		
Signature: Job Title:	Print Name:	Date:
Management Review:		
Signature: Job Title:	Print Name:	Date:
Client Review (if required):		
Signature: Job Title:	Print Name:	Date:
Additional Comments:		

SAFE WORK PRACTICE - WORKING ALONE - FIELD
SWP-118

1 PURPOSE

The Working Alone Safe Work Practice (SWP) is intended to mitigate risks to employees when they are working alone. Project managers shall apply all reasonable measures to protect employees who are performing their duties in areas or under conditions where they are required to be on their own.

2 SCOPE

This practice applies to all Stantec employees who are required to work alone. This SWP will be reviewed and revised not less than every three years or sooner if circumstances at a workplace change in a way that poses a risk to the safety or health of a worker working alone or in isolation.

3 RESPONSIBILITIES

Project Manager Responsibilities:

- Identify risks or hazards associated with the work to be performed or the environment where the work is to be done.
- Conduct and document a risk/hazard assessment for each different (specific) type of work or work location that can be deemed to be a working alone situation.
- Utilizing the RMS1 form, communicate the results of the risk assessment to all affected workers and others conducting similar work.
- Provide written working alone procedures in their area of responsibility in order to eliminate or minimize identified risks.
- Verify quality of cell coverage for where the work is to be done utilizing provider's service maps, and in remote areas, by directly contacting service providers.
- Develop effective methods of communication for those who may require emergency assistance, depending on the specific work, location of the work, and nature of the work. (For example: cell phones, radio, and pager). When electronic devices are not feasible, an effective contact system must be established (For example: check-in procedures and periodic site visits requiring employees to check in after the completion of specific tasks). The length of time an employee may be out of contact with a supervisor (the frequency of regular communications) must be based on the result from the risk assessment.
- Using Form SWP-118a, the Working Alone Checklist, document and communicate when working alone is permitted and/or prohibited.
- Schedule potentially hazardous work for times when supervisors and appropriate help will be available.
- Provide adequate staffing (for example: buddy system) for hazardous tasks performed at off-hours or remote locations.

Employee responsibilities:

- Participate in the working alone risk assessment and risk management decisions with project managers.
- Read and understand this safe work practice.

- Maintain regular communication as outlined in RMS1 form.

Health, Safety and Environmental responsibilities:

- Monitor applicable legislation to ensure the Working Alone SWP is up to date and incorporates any new or revised regulatory requirements.
- Provide consultation to staff in the development of departmental and site-specific working alone plans.
- Audit to determine the effectiveness of the Working Alone SWP.

4 HAZARDS

High risk activities are activities where the potential for the occurrence of accidents or injuries is deemed to be highly likely and where the severity of the injury or accident will bring serious consequences. High risk activities include the following (not all-inclusive):

- working from heights
- working in confined spaces (employees are not permitted to work alone in a confined space)
- lock out/tag out
- working with electricity
- working with hazardous substances or materials
- working with material under high pressure
- working where there is a possible threat of violence
- working in isolation from first aid services or immediate/emergency assistance

Low Risk activities are activities where the potential for the occurrence of accidents and injuries is deemed to be highly unlikely and where the severity of an accident or injury is generally thought not to have serious consequences.

5 CONTROLS

Working Alone Prohibited

Working alone will be prohibited under the following circumstances:

- At no time will an employee be permitted to work in a confined space alone.
  - Tunnels and manholes are considered confined spaces, and as such, employees are not permitted to enter them alone.
- Work shall not be done on an energized electrical conductor or equipment that has a voltage of more than 750 volts unless 2 or more workers are present while the work is being performed.
- Use of a vehicle, crane, or similar equipment near a live power line where it is possible for any part or the equipment or its load to make contact with the live power line.
- Operating a vehicle, crane, mobile equipment, or similar material handling equipment where the operator does not have full view of the intended path of travel.
- If the task requires the use of fall arrest equipment and scaffolds.

- When using quick-acting, acutely toxic material as described by the Material Safety Data Sheet.
- When using of supplied air respiratory equipment or self-contained breathing apparatus.
- Where there exists the risk of drowning.
- During welding operations where a fire watcher is required.
- While performing tasks which, based on the risk assessment conducted by leadership in consultation with the employee and Health, Safety and Environmental, are deemed to require more than one person.

Communication:

Consideration shall be given to the most practical and effective means of communication:

- Portable or cell telephone,
- Walkie-talkie,
- Personal alarm or pager,
- Buddy system,
- Check-in system and requirement for updating an individual's status while working alone, or
- Any other method that may be considered most effective.

Each working alone scenario will use these communication options, either singularly or in combination in the development of the RMS1 form.

When Working Alone requires work in remote areas where cell phone coverage is limited, Project Manager's shall with the approval of the appropriate PC and/or RL, provide the employee with a SPOT Satellite device.

Guidelines for Conducting Working Alone Risk Assessments

It is mandatory that the working conditions or circumstances that present high safety risks be assessed so the probability of accident or injury can be minimized. The RMS1 form is the tool that should be used to document this process. Project managers and employees will evaluate working alone assignments on a case-by-case basis and will consider the following risk factors:

- Tasks and hazards involved in the work to be performed.
- Consequences resulting from a "worst case" scenario. This will be accomplished by asking the question, "What if?"
- Likelihood for other persons to be in the area.
- Possibility that a critical injury or incident could prevent the employee from calling for help or leaving the workplace.
- Emergency response time.
- Employee's training and experience.
- Employee's physical handicaps or any pre-existing medical conditions.
- Frequency of supervision, if at all.
- The time or shift when the work is to be completed.

- Whether the individual is accustomed to working alone.

Project managers shall include written working alone safety plans on the RMS1 form. Safety plans shall include:

- Identification of the risks or hazards associated with the work to be performed or the environment where the work is to be done;
- Procedures to eliminate or minimize the identified risks (e.g., buddy systems);
- Methods of communication by which the workers can secure emergency assistance and how emergency assistance will be provided in the event of incidents or accidents.
- The length of time an employee may be out of contact with a supervisor (i.e., the frequency of regular communications); and
- Confirmation where and when working alone is permitted.

Project managers must review the working alone section of the RMS1 form with affected employees with particular emphasis on safe work procedures and the provision of assistance to employees at risk due to infrequent supervision, intermittent communication, or physical isolation.

6 TRAINING

Employees who, due to assigned duties, are required to work alone shall receive on-the-job training in the requirements for this procedure.

All employees required to work alone must have valid first aid training.

7 OUTSIDE AUTHORITIES TO BE CONTACTED

Not applicable

8 RESOURCES

RMS1 Form
SWP-118a – Working Alone Checklist

9 DEFINITIONS

Risk Assessment: a thorough examination of an operation for the purpose of identifying what actual and potential hazards exist

Working alone: individuals are considered to be working alone when they are working by themselves without close or direct supervision. Assistance, in the event of an injury, illness, or emergency, is not readily available to the individual.

Emergency Assistance: a means of communication to gain assistance in the event of an emergency involving an accident or serious injury, illness, or threat of violence.

After Hours: the period of time when “normal” weekday or shift operations cease.

Field Work: Field work consists of work activities that are being performed outside an office environment

10 DOCUMENTATION SUMMARY

A. File these records in the Office Safety File:
    a. Not applicable
B. File these records in the Project Health & Safety File:
    a. RMS1
    b. Working Alone Checklist

10.1 Revision History

Date	Change	Acknowledgments
01/21/10	Initial posting to StanNet	KDR
2010/02/22	Change from HSE to SWP in header; modified references in body from HSE-118a to SWP-118a; corrected RMS-1 to RMS1	GD

APPENDIX D

SAFETY DATA SHEETS

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Ethyl chloride

Synonyms & Trade Names Chloroethane, Hydrochloric ether, Monochloroethane, Muriatic ether

CAS No. 75-00-3	**RTECS No.** KH7525000	**DOT ID & Guide** 1037 115
Formula CH_3CH_2Cl	**Conversion** 1 ppm = 2.64 mg/m³	**IDLH** 3800 ppm [10%LEL] See: 75003
Exposure Limits **NIOSH REL** : Handle with caution in the workplace. See Appendix C (Chloroethanes) **OSHA PEL** : TWA 1000 ppm (2600 mg/m³)		**Measurement Methods** **NIOSH** 2519 See: NMAM or OSHA Methods

Physical Description Colorless gas or liquid (below 54°F) with a pungent, ether-like odor. [Note: Shipped as a liquefied compressed gas.]

MW: 64.5	**BP:** 54°F	**FRZ:** -218°F	**Sol:** 0.6%	**VP:** 1000 mmHg	**IP:** 10.97 eV
Sp.Gr: 0.92 (Liquid at 32°F)	**Fl.P:** NA (Gas) - 58°F (Liquid)	**UEL:** 15.4%	**LEL:** 3.8%	**RGasD:** 2.23	

Flammable Gas

Incompatibilities & Reactivities Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium; oxidizers; water or steam [Note: Reacts with water to form hydrochloric acid.]

Exposure Routes inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact

Symptoms incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage

Target Organs Liver, kidneys, respiratory system, cardiovascular system, central nervous system

Personal Protection/Sanitation (See protection codes) **Skin:** Prevent skin contact (liquid) **Eyes:** Prevent eye contact (liquid) **Wash skin:** No recommendation **Remove:** When wet (flammable)	**First Aid** (See procedures) **Eye:** Irrigate immediately (liquid) **Skin:** Water flush promptly (liquid)

Change: No recommendation	**Breathing:** Respiratory support **Swallow:** Medical attention immediately (liquid)

Respirator Recommendations
OSHA

Up to 3800 ppm:
(APF = 10) Any supplied-air respirator*
(APF = 50) Any self-contained breathing apparatus with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0132

Page last reviewed: April 4, 2011
Page last updated: November 18, 2010
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1,1-Dichloroethane

Synonyms & Trade Names Asymmetrical dichloroethane; Ethylidene chloride; 1,1-Ethylidene dichloride		
CAS No. 75-34-3	**RTECS No.** KI0175000	**DOT ID & Guide** 2362 130
Formula $CHCl_2CH_3$	**Conversion** 1 ppm = 4.05 mg/m³	**IDLH** 3000 ppm See: 75343
Exposure Limits **NIOSH REL** : TWA 100 ppm (400 mg/m³) See Appendix C (Chloroethanes) **OSHA PEL** : TWA 100 ppm (400 mg/m³)		**Measurement Methods** **NIOSH** 1003 ; **OSHA** 7 See: NMAM or OSHA Methods
Physical Description Colorless, oily liquid with a chloroform-like odor.		

MW: 99.0	**BP:** 135°F	**FRZ:** -143°F	**Sol:** 0.6%	**VP:** 182 mmHg	**IP:** 11.06 eV
Sp.Gr: 1.18	**Fl.P:** 2°F	**UEL:** 11.4%	**LEL:** 5.4%		

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.
Incompatibilities & Reactivities Strong oxidizers, strong caustics
Exposure Routes inhalation, ingestion, skin and/or eye contact
Symptoms irritation skin; central nervous system depression; liver, kidney, lung damage
Target Organs Skin, liver, kidneys, lungs, central nervous system

Personal Protection/Sanitation (See protection codes) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact	**First Aid** (See procedures) **Eye:** Irrigate immediately **Skin:** Soap flush promptly

Wash skin: When contaminated **Remove:** When wet (flammable) **Change:** No recommendation	**Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH/OSHA

Up to 1000 ppm:
(APF = 10) Any supplied-air respirator

Up to 2500 ppm:
(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

Up to 3000 ppm:
(APF = 50) Any self-contained breathing apparatus with a full facepiece
(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0249

Page last reviewed: February 3, 2009
Page last updated: February 3, 2009
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Vinylidene chloride

Synonyms & Trade Names 1,1-DCE; 1,1-Dichloroethene; 1,1-Dichloroethylene; VDC; Vinylidene chloride monomer; Vinylidene dichloride

CAS No. 75-35-4	**RTECS No.** KV9275000	**DOT ID & Guide** 1303 130P (inhibited)
Formula $CH_2=CCl_2$	**Conversion**	**IDLH** Ca [N.D.] See: IDLH INDEX
Exposure Limits **NIOSH REL** : Ca See Appendix A **OSHA PEL** †: none		**Measurement Methods** **NIOSH** 1015 ; **OSHA** 19 See: NMAM or OSHA Methods

Physical Description Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor.

MW: 96.9	**BP:** 89°F	**FRZ:** -189°F	**Sol:** 0.04%	**VP:** 500 mmHg	**IP:** 10.00 eV
Sp.Gr: 1.21	**Fl.P:** -2°F	**UEL:** 15.5%	**LEL:** 6.5%		

Class IA Flammable Liquid: Fl.P. below 73°F and BP below 100°F.

Incompatibilities & Reactivities Aluminum, sunlight, air, copper, heat [Note: Polymerization may occur if exposed to oxidizers, chlorosulfonic acid, nitric acid, or oleum. Inhibitors such as the monomethyl ether of hydroquinone are added to prevent polymerization.]

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys

Cancer Site [in animals: liver & kidney tumors]

Personal Protection/Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap flush immediately

Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0083

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Page last updated: February 3, 2009
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1,2-Dichloroethylene

CAS

540-59-0

RTECS

KV9360000

DOT ID & Guide

1150 130P

CICH=CHCl

Synonyms & Trade Names

Acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene

Exposure Limits

NIOSH REL: TWA 200 ppm (790 mg/m^3)

OSHA PEL: TWA 200 ppm (790 mg/m^3)

IDLH

1000 ppm See: 540590

Conversion

1 ppm = 3.97 mg/m^3

Physical Description

Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.

MW: 97.0	BP: 118-140°F	FRZ: -57 to -115°F	Sol: 0.4%
VP: 180-265 mmHg	IP: 9.65 eV		Sp.Gr(77°F): 1.27
Fl.P: 36-39°F	UEL: 12.8%	LEL: 5.6%	

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities

Strong oxidizers, strong alkalis, potassium hydroxide, copper [Note: Usually contains inhibitors to prevent polymerization.]

Measurement Methods

NIOSH 1003; OSHA 7
See: NMAM or OSHA Methods

Personal Protection & Sanitation

(See protection)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid

(See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH/OSHA
Up to 2000 ppm:
(APF = 25) Any supplied-air respirator operated in a continuous-flow mode£
(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)£
(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
(APF = 50) Any self-contained breathing apparatus with a full facepiece
(APF = 50) Any supplied-air respirator with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes

inhalation, ingestion, skin and/or eye contact

Symptoms

Irritation eyes, respiratory system; central nervous system depression

Target Organs

Eyes, respiratory system, central nervous system

See also: INTRODUCTION See ICSC CARD: 0436

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Tetrachloroethylene

Synonyms & Trade Names Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

CAS No. 127-18-4	**RTECS No.** KX3850000	**DOT ID & Guide** 1897 160
Formula $Cl_2C=CCl_2$	**Conversion** 1 ppm = 6.78 mg/m^3	**IDLH** Ca [150 ppm] See: 127184
Exposure Limits **NIOSH REL** : Ca Minimize workplace exposure concentrations. See Appendix A **OSHA PEL** †: TWA 100 ppm C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm		**Measurement Methods** **NIOSH** 1003 ; **OSHA** 1001 See: NMAM or OSHA Methods

Physical Description Colorless liquid with a mild, chloroform-like odor.

MW: 165.8	**BP:** 250°F	**FRZ:** -2°F	**Sol:** 0.02%	**VP:** 14 mmHg	**IP:** 9.32 eV
Sp.Gr: 1.62	**Fl.P:** NA	**UEL:** NA	**LEL:** NA		

Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Incompatibilities & Reactivities Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, liver, kidneys, central nervous system

Cancer Site [in animals: liver tumors]

Personal Protection/Sanitation (See protection codes) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact	**First Aid** (See procedures) **Eye:** Irrigate immediately

Wash skin: When contaminated **Remove:** When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	**Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0076 See MEDICAL TESTS: 0179

Page last reviewed: April 4, 2011
Page last updated: November 18, 2010
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NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

Trichloroethylene

CAS

79-01-6

RTECS

KX4550000

DOT ID & Guide

1710 160

CICH=CCl$_2$

Synonyms & Trade Names

Ethylene trichloride, TCE, Trichloroethene, Trilene

Exposure Limits

NIOSH REL: Ca See Appendix A See Appendix C

OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)

IDLH

Ca [1000 ppm] See: 79016

Conversion

1 ppm = 5.37 mg/m^3

Physical Description

Colorless liquid (unless dyed blue) with a chloroform-like odor.

MW: 131.4	BP: 189°F	FRZ: -99°F	Sol(77°F): 0.1%
VP: 58 mmHg	IP: 9.45 eV		Sp.Gr: 1.46
Fl.P: ?	UEL(77°F): 10.5%	LEL(77°F): 8%	

Combustible Liquid, but burns with difficulty.

Incompatibilities & Reactivities

Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Measurement Methods

NIOSH 1022, 3800; OSHA 1001

See: NMAM or OSHA Methods

Personal Protection & Sanitation

(See protection)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid

(See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes

inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms

Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Target Organs

Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Cancer Site

[in animals: liver & kidney cancer]

See also: INTRODUCTION See ICSC CARD: 0081 See MEDICAL TESTS: 0236

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September 2005

NIOSH Publication Number 2005-149

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Methyl chloroform

Synonyms & Trade Names Chlorothene; 1,1,1-Trichloroethane; 1,1,1-Trichloroethane (stabilized)					
CAS No. 71-55-6	**RTECS No.** KJ2975000			**DOT ID & Guide** 2831 160	
Formula CH_3CCl_3	**Conversion** 1 ppm = 5.46 mg/m³			**IDLH** 700 ppm See: 71556	
Exposure Limits **NIOSH REL** : C 350 ppm (1900 mg/m³) [15-minute] See Appendix C (Chloroethanes) **OSHA PEL** †: TWA 350 ppm (1900 mg/m³)				**Measurement Methods** **NIOSH** 1003 See: NMAM or OSHA Methods	
Physical Description Colorless liquid with a mild, chloroform-like odor.					
MW: 133.4	**BP:** 165°F	**FRZ:** -23°F	**Sol:** 0.4%	**VP:** 100 mmHg	**IP:** 11.00 eV
Sp.Gr: 1.34	**Fl.P:** ?	**UEL:** 12.5%	**LEL:** 7.5%		
Combustible Liquid, but burns with difficulty.					
Incompatibilities & Reactivities Strong caustics; strong oxidizers; chemically-active metals such as zinc, aluminum, magnesium powders, sodium & potassium; water [Note: Reacts slowly with water to form hydrochloric acid.]					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage					
Target Organs Eyes, skin, central nervous system, cardiovascular system, liver					
Personal Protection/Sanitation (See protection codes) **Skin:** Prevent skin contact				**First Aid** (See procedures) **Eye:** Irrigate immediately	

Eyes: Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated **Change:** No recommendation	**Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH/OSHA

Up to 700 ppm:
(APF = 10) Any supplied-air respirator*
(APF = 50) Any self-contained breathing apparatus with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0079 See MEDICAL TESTS: 0141

Page last reviewed: February 3, 2009
Page last updated: February 3, 2009
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NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

Trichloroethylene

CAS

79-01-6

RTECS

KX4550000

DOT ID & Guide

1710 160

CICH=CCl$_2$

Synonyms & Trade Names

Ethylene trichloride, TCE, Trichloroethene, Trilene

Exposure Limits

NIOSH REL: Ca See Appendix A See Appendix C

OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)

IDLH

Ca [1000 ppm] See: 79016

Conversion

1 ppm = 5.37 mg/m^3

Physical Description

Colorless liquid (unless dyed blue) with a chloroform-like odor.

MW: 131.4	BP: 189°F	FRZ: -99°F	Sol(77°F): 0.1%
VP: 58 mmHg	IP: 9.45 eV		Sp.Gr: 1.46
Fl.P: ?	UEL(77°F): 10.5%	LEL(77°F): 8%	

Combustible Liquid, but burns with difficulty.

Incompatibilities & Reactivities

Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Measurement Methods

NIOSH 1022, 3800; OSHA 1001

See: NMAM or OSHA Methods

Personal Protection & Sanitation

(See protection)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid

(See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes

inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms

Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Target Organs

Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Cancer Site

[in animals: liver & kidney cancer]

See also: INTRODUCTION See ICSC CARD: 0081 See MEDICAL TESTS: 0236

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Vinyl chloride

Synonyms & Trade Names Chloroethene, Chloroethylene, Ethylene monochloride, Monochloroethene, Monochloroethylene, VC, Vinyl chloride monomer (VCM)

CAS No. 75-01-4	**RTECS No.** KU9625000	**DOT ID & Guide** 1086 116P (inhibited)
Formula CH_2=CHCl	**Conversion** 1 ppm = 2.56 mg/m^3	**IDLH** Ca [N.D.] See: IDLH INDEX
Exposure Limits **NIOSH REL** : Ca See Appendix A **OSHA PEL** : [1910.1017] TWA 1 ppm C 5 ppm [15-minute]		**Measurement Methods** **NIOSH** 1007 ; **OSHA** 4 , 75 See: NMAM or OSHA Methods

Physical Description Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations. [Note: Shipped as a liquefied compressed gas.]

MW: 62.5	**BP:** 7°F	**FRZ:** -256°F	Sol(77°F): 0.1%	**VP:** 3.3 atm	**IP:** 9.99 eV
	Fl.P: NA (Gas)	**UEL:** 33.0%	**LEL:** 3.6%	**RGasD:** 2.21	

Flammable Gas

Incompatibilities & Reactivities Copper, oxidizers, aluminum, peroxides, iron, steel [Note: Polymerizes in air, sunlight, or heat unless stabilized by inhibitors such as phenol. Attacks iron & steel in presence of moisture.]

Exposure Routes inhalation, skin and/or eye contact (liquid)

Symptoms lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]

Target Organs Liver, central nervous system, blood, respiratory system, lymphatic system

Cancer Site [liver cancer]

Personal Protection/Sanitation (See protection codes)
Skin: Frostbite
Eyes: Frostbite
Wash skin: No recommendation
Remove: When wet (flammable)
Change: No recommendation
Provide: Frostbite wash

First Aid (See procedures)
Eye: Frostbite
Skin: Frostbite
Breathing: Respiratory support

Respirator Recommendations
(See Appendix E)

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

See also: INTRODUCTION See ICSC CARD: 0082 See MEDICAL TESTS: 0241

Page last reviewed: April 4, 2011
Page last updated: November 18, 2010
Content source: National Institute for Occupational Safety and Health (NIOSH) Education and Information Division

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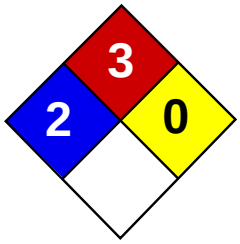

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S46- If swallowed, seek medical advice immediately and show this container or label. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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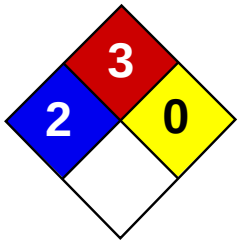

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C8H10

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD50): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer). CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:
CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001) CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001) CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States] TWA: 435 STEL: 545 from OSHA (PEL) [United States] TWA: 435 STEL: 545 (mg/m3) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States] TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)] TWA: 100 STEL: 125 (ppm) [Belgium] TWA: 100 STEL: 125 (ppm) [Finland] TWA: 50 (ppm) [Norway] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in diethyl ether. Very slightly soluble in cold water or practically insoluble in water. Soluble in all proportions in Ethyl alcohol. Soluble in Carbon tetrachloride, Benzene. Insoluble in Ammonia. Slightly soluble in Chloroform. Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:
Lethal Dose/Conc 50% Kill: LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg Lowest Published Lethal Dose/Conc: LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Can cause mild skin irritation. It can be absorbed through intact skin. Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm , it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS) Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include

headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and conciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987). Ingestion: Do not drink, pipet or siphon by mouth. May cause gastroinestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through)]. 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Ethylbenzene Illinois toxic substances disclosure to employee act: Ethylbenzene Illinois chemical safety act: Ethylbenzene New York release reporting list: Ethylbenzene Rhode Island RTK hazardous substances: Ethylbenzene Pennsylvania RTK: Ethylbenzene Minnesota: Ethylbenzene Massachusetts RTK: Ethylbenzene Massachusetts spill list: Ethylbenzene New Jersey: Ethylbenzene New Jersey spill list: Ethylbenzene Louisiana spill reporting: Ethylbenzene California Director's List of Hazardous Substances: Ethylbenzene TSCA 8(b) inventory: Ethylbenzene TSCA 4(a) proposed test rules: Ethylbenzene TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97 SARA 313 toxic chemical notification and release reporting: Ethylbenzene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Manufacturer's Material Safety Data Sheet. -Fire Protection Guide to Hazardous Materials, 13th ed., National Fire Protection Association (NFPA) -Registry of Toxic Effects of Chemical Substances (RTECS) -Chemical Hazard Response Information System (CHRIS) -Hazardous Substance Data Bank (HSDB) -New Jersey Hazardous Substance Fact Sheet -Ariel Global View -Reprotext System

Other Special Considerations: Not available.

Created: 10/09/2005 05:28 PM

Last Updated: 05/21/2013 12:00 PM

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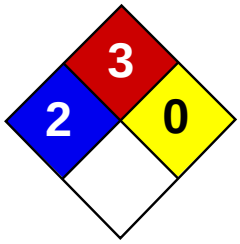

Material Safety Data Sheet
Xylenes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Xylenes

Catalog Codes: SLX1075, SLX1129, SLX1042, SLX1096

CAS#: 1330-20-7

RTECS: ZE2100000

TSCA: TSCA 8(b) inventory: Xylenes

CI#: Not available.

Synonym: Xylenes; Dimethylbenzene; xylol; methyltoluene

Chemical Name: Xylenes (o-, m-, p- isomers)

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Xylenes	1330-20-7	100

Toxicological Data on Ingredients: Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 24°C (75.2°F). (Tagliabue.) OPEN CUP: 37.8°C (100°F).

Flammable Limits: LOWER: 1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Vapors may travel to source of ignition and flash back.

Special Remarks on Explosion Hazards:
Vapors may form explosive mixtures with air. Containers may explode when heated. May polymerize explosively when heated. An attempt to chlorinate xylene with 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin) caused a violent explosion

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 (ppm) [Canada] TWA: 435 (mg/m3) [Canada] TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 138.5°C (281.3°F)

Melting Point: -47.4°C (-53.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.864 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 1 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water. Miscible with absolute alcohol, ether, and many other organic liquids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Store away from acetic acid, nitric acid, chlorine, bromine, and fluorine.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2119 mg/kg [Mouse]. Acute dermal toxicity (LD50): >1700 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5000 4 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:
Lowest Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Man] - Route: Oral; Dose: 10000 ppm/6H

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in animal. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects (male and femael fertility (spontaneous abortion and fetotoxicity)) and birth defects based animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Can be absorbed through skin. Eyes: Causes eye irritation. Inhalation: Vapor causes respiratory tract and mucous membrane irritation. May affect central nervous system and behavior (General anesthetic/CNS depressant with effects including headache, weakness, memory loss, irritability, dizziness, giddiness, loss of coordination and judgement, respiratory depression/arrest or difficulty breathing, loss of appetite, nausea, vomiting, shivering, and possible coma and death). May also affects blood, sense organs, liver, and peripheral nerves. Ingestion: May cause gastrointestinal irritation including abdominal pain, vomiting, and nausea. May also affect liver and urinary system/ kidneys. May cause effects similar to those of acute inhalation. Chronic Potential Health Effects: Chronic inhalation may affect the urinary system (kidneys) blood (anemia), bone marrow (hyperplasia of bone marrow) brain/behavior/Central Nervous system. Chronic inhalation may alsocause mucosal bleeding. Chronic ingestion may affect the liver and metabolism (loss of appetite) and may affect urinary system (kidney damage)

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylenes UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Xylenes Illinois chemical safety act: Xylenes New York acutely hazardous substances: Xylenes Rhode Island RTK hazardous substances: Xylenes Pennsylvania RTK: Xylenes Minnesota: Xylenes Michigan critical material: Xylenes Massachusetts RTK: Xylenes Massachusetts spill list: Xylenes New Jersey: Xylenes New Jersey spill list: Xylenes Louisiana spill reporting: Xylenes California Director's List of Hazardous Substances: Xylenes TSCA 8(b) inventory: Xylenes SARA 302/304/311/312 hazardous chemicals: Xylenes SARA 313 toxic chemical notification and release reporting: Xylenes CERCLA: Hazardous substances.: Xylenes: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R10- Flammable. R21- Harmful in contact with skin. R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 12:54 PM

Last Updated: 05/21/2013 12:00 PM

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ARIES CHEMICAL INCORPORATED

6604 DEPOT ST., P.O. BOX 519
BEAVER FALLS, NEW YORK 13305
315-346-1489 FAX: 315-346-1658

Origination Date: 06-09-00
Revision Date: 06-06-10

2908

SECTION I - GENERAL INFORMATION

TRADE NAME:
Aries 2908

EMERGENCY PHONE NO:
INFOTRAC (800) 535-5053

CHEMICAL NAME:
Sequestrant

DISTRIBUTOR'S D-U-N-S NO:
14-861-3045

HAZARDOUS MATERIAL DESCRIPTION: UN3265, Corrosive Liquid, acidic, organic, n.o.s., ((1-Hydroxyethylidene) diphosphonic acid), 8, III
EMERGENCY RESPONSE GUIDE#: 153
SHIPPING NUMBER: UN3265
REPORTABLE QUANTITY: NA

SYNONYMS:
N/A

FORMULA: Mixture

CHEMICAL FAMILY:
Sequestrant

MOLECULAR WEIGHT: N/A

SECTION 2 – HAZARDOUS INGREDIENTS

INGREDIENTS	% BY WT.	CAS NO.	TWA OSHA	TWA ACGIH
(1-Hydroxyethylidene) diphosphonic acid	8-10	2809-21-4	n/a	

HAZARD RATING	HEALTH	2	REACTIVITY	0
	FIRE	0	SPECIAL	H

SECTION 3 – PHYSICAL AND CHEMICAL PROPERTIES

SPECIFIC GRAVITY:
1.04 to 1.09

pH:
5 to 7

BOILING POINT:
> 212° F

SOLUBILITY IN WATER:
Complete

VAPOR PRESSURE:
N/T

PERCENT VOLATILE BY VOLUME:
N/A

EVAPORATION RATE:
Same as water

APPEARANCE AND ODOR: Clear, colorless, slight to no odor.

MATERIAL: Liquid

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:
> 212° F

FLAMMABLE LIMITS:
LEL: N/A UEL: N/A

AUTO IGNITION TEMPERATURE: N/A

EXTINGUISHING MEDIA: Water fog, carbon dioxide, foam, dry chemical.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus when fighting fire. Treat surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Thermal decomposition may release oxides of carbon & phosphorus.

SECTION 5 - HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE: Corrosive to eyes. Mild to severe irritation depending on the length of exposure, solution concentration and first aid measures. Irritant to skin and irritation may occur to mucous membranes and lungs. Exposed individuals should be monitored for respiratory distress, bronchitis or pneumonia.

INGESTION: DO NOT INDUCE VOMITING. Rinse with copious amounts of water first. Irrigate the esophagus and dilute stomach contents by slowly giving one to two glasses of water. If individual is unconscious, DO NOT GIVE FLUIDS BY MOUTH. Seek medical assistance immediately.

SKIN CONTACT: Wash exposed area with plenty of soap and water. Repeat washing. Remove contaminated clothing and wash thoroughly before reuse. If irritation persists, seek medical attention.

EYE CONTACT: In case of eye contact, flush eyes with water thoroughly for a minimum of 15 minutes. Seek medical attention.

INHALATION: Not expected route of entry. Remove to fresh air. Seek medical attention if individual experiences nausea, headache, dizziness, has difficulty in breathing or is cyanotic.

CARCINOGENICITY: Not a carcinogen.

SECTION 6 - REACTIVITY DATA

STABILITY:
Stable

HAZARDOUS POLYMERIZATION:
Will not occur.

CONDITIONS TO AVOID: Store away from sources of heat. Do not allow to freeze.

MATERIALS TO AVOID: Store away from strong alkali and oxidizers.

HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: Oxides of phosphorous and carbon.

SECTION 7 - SPILL OR LEAK PROCEDURE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Dike or dam spill to contain. Absorb onto inert media and allow material to dry. Pick up by scooping, sweeping or vacuum. Avoid raising dust clouds.

WASTE DISPOSAL METHODS: Non-biodegradable - use solid waste disposal common to landfill type operation or similar disposal in accordance with local, state and federal regulations to determine best disposal alternatives.

ENVIRONMENTAL TOXICITY DATA: Acute Oral LD50: 2,400.0 mg/kg. Acute dermal LD50: > 7,940.0 mg/kg.

HAZARDOUS WASTE 40CFR261: N/A

HAZARDOUS WASTE NO: N/A

CONTAINER DISPOSAL: Returnable

SECTION 8 – SPECIAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION: Wear NIOSH approved acid fume respirator if mists are present.

EYE PROTECTION: Use safety goggles.

PROTECTION CLOTHING: Long sleeve shirt, long pants and shoes.

VENTILATION: Good general ventilation.

OTHER: Emergency eyewash and safety shower should be located nearby.

SECTION 9 - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store away from strong alkali and oxidizers. Do not allow product to freeze.

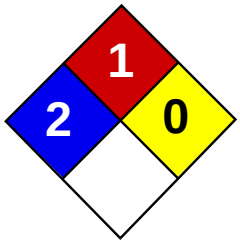
OTHER PRECAUTIONS: Emergency eyewash and safety shower should be located nearby.

SECTION 10 - REGULATORY INFORMATION

SECTION 313 - SUPPLIER NOTIFICATION

THIS PRODUCT DOES NOT CONTAIN ANY TOXIC CHEMICALS WHICH ARE REPORTABLE UNDER SECTION 313 OF THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT OF 1986 (40 CFR 372).

WHILE ARIES CHEMICAL INC. BELIEVES THE DATA SET FORTH HEREIN IS ACCURATE AS OF THE DATE HEREOF, ARIES CHEMICAL MAKES NO WARRANTY WITH RESPECT THERETO AND EXPRESSLY DISCLAIMS ALL LIABILITY FOR REFINANCE THEREON OF SUCH DATA, AND IS OFFERED SOLELY FOR YOUR CONSIDERATION, INVESTIGATION, AND VERIFICATION.



Material Safety Data Sheet
Silver MSDS

Section 1: Chemical Product and Company Identification

Product Name: Silver

Catalog Codes: SLS4222, SLS2005, SLS3427, SLS1210, SLS2632, SLS4054, SLS1837

CAS#: 7440-22-4

RTECS: VW3500000

TSCA: TSCA 8(b) inventory: Silver

CI#: Not applicable.

Synonym:

Chemical Formula: Ag

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Silver	7440-22-4	100

Toxicological Data on Ingredients: Silver: ORAL (LD50): Acute: 100 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of ingestion, of inhalation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact: No known effect on skin contact, rinse with water for a few minutes.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Splash goggles. Lab coat.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 (mg/m3) from OSHA (PEL) TWA: 0.01 (mg/m3) from OSHA NIOSH Australia: TWA: 0.1 (mg/m3)Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Solid metallic powder. Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 107.87 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 2212°C (4013.6°F)

Melting Point: 961°C (1761.8°F)

Critical Temperature: Not available.

Specific Gravity: 10.4 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Is not dispersed in cold water, hot water.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 100 mg/kg [Mouse].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Very hazardous in case of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification:

Identification:

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Rhode Island RTK hazardous substances: Silver Pennsylvania RTK: Silver Minnesota: Silver Massachusetts RTK: Silver New Jersey: Silver TSCA 8(b) inventory: Silver TSCA 8(a) PAIR: Silver TSCA 8(d) H and S data reporting: Silver SARA 313 toxic chemical notification and release reporting: Silver: 1% CERCLA: Hazardous substances.: Silver: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC): R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Not applicable. Lab coat. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:26 PM

Last Updated: 05/21/2013 12:00 PM

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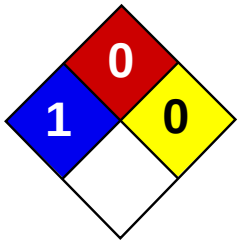

Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Lead MSDS

Section 1: Chemical Product and Company Identification

Product Name: Lead

Catalog Codes: SLL1291, SLL1669, SLL1081, SLL1459, SLL1834

CAS#: 7439-92-1

RTECS: OF7525000

TSCA: TSCA 8(b) inventory: Lead

CI#: Not available.

Synonym: Lead Metal, granular; Lead Metal, foil; Lead Metal, sheet; Lead Metal, shot

Chemical Name: Lead

Chemical Formula: Pb

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Lead	7439-92-1	100

Toxicological Data on Ingredients: Lead LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (permeator). CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Non-flammable in presence of open flames and sparks, of shocks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: When heated to decomposition it emits highly toxic fumes of lead.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable

protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.05 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.05 (mg/m3) from OSHA (PEL) [United States] TWA: 0.03 (mg/m3) from NIOSH [United States] TWA: 0.05 (mg/m3) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 207.21 g/mole

Color: Bluish-white. Silvery. Gray

pH (1% soln/water): Not applicable.

Boiling Point: 1740°C (3164°F)

Melting Point: 327.43°C (621.4°F)

Critical Temperature: Not available.

Specific Gravity: 11.3 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, excess heat

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Incompatible with sodium carbide, chlorine trifluoride, trioxane + hydrogen peroxide, ammonium nitrate, sodium azide, disodium acetylide, sodium acetylide, hot concentrated nitric acid, hot concentrated hydrochloric acid, hot concentrated sulfuric acid, zirconium.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC. May cause damage to the following organs: blood, kidneys, central nervous system (CNS).

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential: Skin: Lead metal granules or dust: May cause skin irritation by mechanical action. Lead metal foil, shot or sheets: Not likely to cause skin irritation Eyes: Lead metal granules or dust: Can irritate eyes by mechanical action. Lead metal foil, shot or sheets: No hazard. Will not cause eye irritation. Inhalation: In an industrial setting, exposure to lead mainly occurs from inhalation of dust or fumes. Lead dust or fumes: Can irritate the upper respiratory tract (nose, throat) as well as the bronchi and lungsby mechanical action. Lead dust can be absorbed through the respiratory system. However, inhaled lead does not accumulate in the lungs. All of an inhaled dose is eventually abssorbed or transferred to the gastrointestinal tract. Inhalation effects of exposure to fumes or dust of inorganic lead may not develop quickly. Symptoms may include metallic taste, chest pain, decreased physical fitness, fatigue, sleep disturbance, headache, irritability, reduces memory, mood and personality changes, aching bones and muscles, constipation, abdominal pains, decreasing appetite. Inhalation of large amounts may lead to ataxia, deliriuim, convulsions/seizures, coma, and death. Lead metal foil, shot, or sheets: Not an inhalation hazard unless metal is heated. If metal is heated, fumes will be released. Inhalation of these fumes may cause "fume metal fever", which is characterized by flu-like symptoms. Symptoms may include metallic taste, fever, nausea, vomiting, chills, cough, weakness, chest pain, generalized muscle pain/aches, and increased white blood cell count. Ingestion: Lead metal granules or dust: The symptoms of lead poisoning include abdominal pain or cramps (lead cholic), spasms, nausea, vomiting, headache, muscle weakness, hallucinations, distorted perceptions, "lead line" on the gums, metallic taste, loss of appetite, insomnia, dizziness and other symptoms similar to that of inhalation. Acute poisoning may result in high lead levels in the blood and urine, shock, coma and death in extreme cases. Lead metal foil, shot or sheets: Not an ingestion hazard for usual industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (female) which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Lead California prop. 65 (no significant risk level): Lead: 0.0005 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Lead Connecticut hazardous material survey.: Lead Illinois toxic substances disclosure to employee act: Lead Illinois chemical safety act: Lead New York release reporting list: Lead Rhode Island RTK hazardous substances: Lead Pennsylvania RTK: Lead

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R20/22- Harmful by inhalation and if swallowed. R33- Danger of cumulative effects. R61- May cause harm to the unborn child. R62- Possible risk of impaired fertility. S36/37- Wear suitable protective clothing and gloves. S44- If you feel unwell, seek medical advice (show the label when possible). S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:21 PM

Last Updated: 05/21/2013 12:00 PM

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MATERIAL SAFETY DATA SHEET
ERA A Waters Company

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

MANUFACTURER: ERA
ADDRESS: 16341 Table Mountain Parkway
Golden, CO, 80403 U.S.A.

BUSINESS PHONE: 303-431-8454
FAX: 303-421-0159 **EMAIL:** info@eraqc.com
CHEMICAL EMERGENCY PHONE: 352-535-5053 (INFOTRAC)

Product Name(s): Hexavalent Chromium 1000 mg/L
Catalog / Part Number(s): 019, 973, 186004178
MSDS Creation Date: November 22, 2005
Revision Date: July 18, 2012 **MSDS Reference Number:** 019

SECTION 2: HAZARDS IDENTIFICATION

Toxic. Harmful by inhalation. May cause cancer. Risk of cancer depends on duration and level of exposure. The matrix of each standard is a K2Cr2O7/water mixture listed below which is classified as dangerous by Directive 199/45/EC. Use only as directed and in accordance with good laboratory practices.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

				EXPOSURE LIMITS		EU LABEL
CHEMICAL INGREDIENT NAME	CAS NUMBER	EC NUMBER	% BY WT.	OSHA	ACGIH	HAZARD LABEL
Potassium dichromate	7778-50-9	231-906-6	≤0.1	0.1 mg/m3 PEL	0.05 mg/m3	

Notes: This standard is 125 mL of a mixture containing potassium dichromate salt with the balance being ≥99.9% water. Hexavalent chromium is a known human carcinogen. Exposure Limits are 8-Hour TWA (Time Weighted Average) unless designated C (Ceiling) or STEL (Short Term Exposure Limit). Other components considered Non-Hazardous under OSHA 1910.1200 (HazCom) as they are not present in concentrations exceeding 1% (or 0.1% if considered a known or potential carcinogen). Material Use: Analytical reagent or certified reference material used in laboratories. Uses also include research and development.

SECTION 4: FIRST-AID MEASURES

Inhalation: Remove to fresh air.
Skin Contact: Flush with water.
Eye Contact: Immediately flush with water for a minimum of 15 minutes.
Ingestion: Get medical attention
After following first aid measures, seek medical attention.

SECTION 5: FIRE-FIGHTING MEASURES

Flammable Properties: Not flammable.
Extinguishing Media: Dry chemical, carbon dioxide or appropriate foam.
Unique Aspects Contributing To a Fire: None.
Special Fire Fighting Procedures: None.
Note: As in any fire, wear self-contained breathing apparatus, and full protective gear.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Absorb liquid with spill pillow or other absorbent. Ventilate and wash spill site after material pick up is complete. Place wastes into closed containers for proper disposal.

SECTION 7: HANDLING AND STORAGE

Handle in accordance with good laboratory practices. Store in a dry well-ventilated place. This product is intended for use only by people trained in the safety and handling of chemicals and laboratory preparations.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Handle in accordance with good laboratory practices. Wash thoroughly after handling.
Respiratory Protection: Not normally needed. If exposure limits are exceeded, use approved respirator.
Eye Protection: Safety glasses with side shields or safety goggles
Skin Protection: Neoprene or other chemical resistant gloves.
Engineering Controls: Not normally needed. If exposure limits are exceeded, work in a fume hood.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

DATA FOR MATRIX:

Appearance:	**Clear to yellow**	**Specific Gravity:**	**NA**	**Melting Point:**	**NA**
Physical State:	**Liquid**	**Flash Point:**	**NA**	**Vapor Pressure:**	**NA**
Odor:	**NA**	**Explosion Limits:**	**NA**	**Vapor Density (air=1):**	**NA**
pH:	**NA**	**Boiling Point:**	**NA**	**Solubility in Water:**	**Soluble**

SECTION 10: STABILITY AND REACTIVITY

Hazardous Polymerization Will Not Occur __X__ May Occur____ Stability: Stable __X__ Unstable ____
Hazardous Decomposition/Combustion Products: NA
Conditions and Materials to Avoid: Oxidizing agents.

SECTION 11: TOXICOLOGICAL INFORMATION

Primary Route(s) of Exposure Under Normal Use: Skin contact: may cause skin irritation or be harmful if absorbed through skin. Eye contact: may cause eye irritation. Inhalation: hamful if inhaled, may be irritation to mucous membranes and upper respiratory tract. Ingestion: harmful if swallowed.

Target Organ(s): Lungs, kidneys, blood.

Acute Effects: Harmful by inhalation. May cause sensitization by inhalation and skin contact. Ingestion can cause vomiting.
Potassium dichromate: Oral, child: LDLO=26 mg/kg; Oral, man: LDLO=143 mg/kg; Oral, rat:LD50=25 mg/kg; Skin, rabbit:LD50=14 mg/kg.

Chronic Effects: Carcinogen; Teratogen; May cause heritable gentic damage. Reproductive hazard; May impair fertility. May cause harm to the unborn child.

Other Information: Chemical Ingredient(s) potassium dichromate is classified as carcinogen(s) by OSHA, IARC (Group 1), NTP, ACGIH (A1), or California. California Prop-65: This product is or contains chemicals known to the state of California to cause cancer.

SECTION 12: ECOLOGICAL INFORMATION

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Avoid release into the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

To determine proper disposal, consult applicable federal, state and local environmental control regulations.

SECTION 14: TRANSPORT INFORMATION

Shipment Name/Type: Non-hazardous for transport.
UN Number: NA Shipping/Hazardous Class: NA Packing Group: NA
Shipping regulations are based on combinations of criteria such as quantity, class and packaging according to DOT, IATA and (49) CFR.

SECTION 15: REGULATORY INFORMATION

EU Symbol of Danger: Toxic (T) concentration ≤0.1 C <0.2%
EU Risk Phrases: May cause cancer [R45]; May cause heritable genetic damage [R46]; Harmful by inhalation [R20].

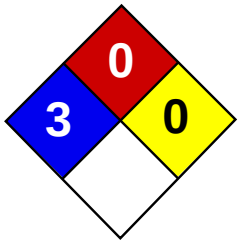
U.S. TSCA: Listed
Canada: This product has been classified according to the hazard criteria of the CPR and this MSDS contains all the information required by the CPR.

SECTION 16: OTHER INFORMATION

United States EPA Regulatory Information:		**NFPA Rating:**	**Health: 3**	**Flammability: 0**	**Reactivity: 0**
SARA 313:	**Yes (0.1% deminimis)**				
CERCLA RQ:	**10 lbs**	**HMIS Rating:**	**Health: 3**	**Flammability: 0**	**Physical Hazard: 0**

NOTE: NA = Data not available, not established, determined or not pertinent.

DISCLAIMER: The information contained herein has been compiled from data presented in various technical sources believed to be accurate. This information is intended to be used only as a guide and does not purport to be complete. ERA makes no warranties and assumes no liability in connection with the use of this information. It is the user's responsibility to determine the suitability of this information and to assure the adoption of necessary precautions.



Material Safety Data Sheet
Sodium Cyanide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Cyanide

Catalog Codes: SLS2314, SLS3736

CAS#: 143-33-9

RTECS: VZ7525000

TSCA: TSCA 8(b) inventory: Sodium Cyanide

CI#: Not available.

Synonym:

Chemical Name: Sodium Cyanide

Chemical Formula: NaCN

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium Cyanide	143-33-9	100

Toxicological Data on Ingredients: Sodium Cyanide: ORAL (LD50): Acute: 6.44 mg/kg [Rat]. DERMAL (LD50): Acute: 10.4 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator). Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to skin, eyes, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of acids, of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Dangerous on contact with acids, acid fumes, water or stream. It will produce toxic and flammable vapors of CN-H and sodium oxide. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas. When heated to decomposition it emits toxic fumes hydgrogen cyanide and oxides of nitrogen

Special Remarks on Explosion Hazards: Fusion mixtures of metal cyanides with metal chlorates, perchlorated or nitrates causes a violent explosion

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Poisonous solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
STEL: 5 (mg/m3) from ACGIH (TLV) [United States] SKIN CEIL: 4.7 from NIOSH CEIL: 5 (mg/m3) from NIOSHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Granular solid. Flakes solid.)

Odor:
Faint almond-like odor. Odorless when perfectly dry. Emits odor of hydrogen cyanide when damp.

Taste: Not available.

Molecular Weight: 49.01 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 1496°C (2724.8°F)

Melting Point: 563°C (1045.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.595 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Vapor Density of Hydrogen Cyanide gas: 0.941

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Soluble in cold water. Slightly soluble in Ethanol

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, moisture, incompatibles.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity:
Corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent reaction with fluorine gas, magnesium, nitrates, nitric acid. Dangerous on contact with acids, acid fumes, water or stream. It wil produce toxic and flammable vapors of CN-H and sodium oxide. Cyanide may react with CO2 in ordinary air to form toxic hydrogen cyanide gas. Strong oxidizers such as acids, acid salts, chlorates, and nitrates. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

Special Remarks on Corrosivity: Corrosive to aluminum

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 6.44 mg/kg [Rat]. Acute dermal toxicity (LD50): 10.4 mg/kg [Rabbit].

Chronic Effects on Humans: May cause damage to the following organs: skin, eyes, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects (maternal and paternal fertility) based on animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health effects: Skin: May cause itching and irritation. May be fatal if absorbed through injured skin with symtpoms similar to those noted for inhalation and ingestion. Eyes: May cause eye irritation and eye damage. Inhalation: May cause respiratory tract irritation. May be fatal if inhaled. The substance inhibits cellular respiration causing metabolic asphyxiation. May cause headache, weakness, dizziness, labored breathing, nausea, vomiting. May be followed by cardiovascular effects, unconciousness, convulsions, coma, and death Ingestion: May be fatal if swallowed. May cause

gastrointestinal tract irritation with nausea, vomiting. May affect behavior and nervous systems(seizures, convulsions, change in motor activity, headache, dizziness, confusion, weakness stupor, aniexity, agitation, tremors), cardiovascular system, respiration (hyperventilation, pulmonary edema, breathing difficulty, respiratory failure), cardiovascular system (palpitations, rapid heart beat, hypertension, hypotension). Massive doses by produce sudden loss of conciousness and prompt death from respiratory arrest. Smaller but still lethal doses on the breath or vomitus. Chronic Potential Health Effects: Central Nervous system effects (headaches, vertigo, insomnia, memory loss, tremors, fatigue), fatigue, metabolic effects (poor appetite), cardiovascular effects (chest discomfort, palpitations), nerve damage to the eyes, or dermatitis, respiratory tract irritation, eye irritation, or death can occur. may prolong the illness for 1 or more hours. A bitter almond odor may be noted

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Sodium cyanide UNNA: 1689 PG: I

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut carcinogen reporting list.: Sodium Cyanide Illinois chemical safety act: Sodium Cyanide New York release reporting list: Sodium Cyanide Rhode Island RTK hazardous substances: Sodium Cyanide Pennsylvania RTK: Sodium Cyanide Minnesota: Sodium Cyanide Massachusetts RTK: Sodium Cyanide Massachusetts spill list: Sodium Cyanide New Jersey: Sodium Cyanide New Jersey spill list: Sodium Cyanide Louisiana RTK reporting list: Sodium Cyanide Louisiana spill reporting: Sodium Cyanide California Director's List of Hazardous Substances: Sodium Cyanide TSCA 8(b) inventory: Sodium Cyanide TSCA 4(a) final test rules: Sodium Cyanide TSCA 8(a) PAIR: Sodium Cyanide TSCA 8(d) H and S data reporting: Sodium Cyanide TSCA 12(b) one time export: Sodium Cyanide SARA 302/304/311/312 extremely hazardous substances: Sodium Cyanide CERCLA: Hazardous substances.: Sodium Cyanide: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-6: Reactive and very flammable material. CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS E: Corrosive solid.

DSCL (EEC):
R27/28- Very toxic in contact with skin and if swallowed. R41- Risk of serious damage to eyes. S1/2- Keep locked up and out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S28- After contact with skin, wash immediately with plenty of water S36/37- Wear suitable protective clothing and gloves. S39- Wear eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 01:58 PM

Last Updated: 05/21/2013 12:00 PM

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acc. to ISO 11014

Printing date 06/19/2013 *Review date 06/19/2013*

1 Identification

· **Product identifier**

· **Trade name: STD Aroclor 1260**
· **Article number** N9331027
· **Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
· **Application of the substance / the preparation** Laboratory chemicals

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
PerkinElmer Life and Analytical Sciences
710 Bridgeport Avenue
Shelton, Connecticut 06484 USA
· **Emergency telephone number:**
CHEMTREC (within US) 800-424-9300
CHEMTREC (from outside US) +1 703-527-3887 (call collect)

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2 Hazard(s) identification

· **Classification of the substance or mixture**

GHS02 Flame

H225 Highly flammable liquid and vapour.

GHS08 Health hazard

H361 Suspected of damaging fertility or the unborn child.
H373 May cause damage to organs through prolonged or repeated exposure.

GHS09 Environment

H411 Toxic to aquatic life with long lasting effects.

GHS07

H315 Causes skin irritation.
H336 May cause drowsiness or dizziness.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms** GHS02, GHS07, GHS08, GHS09
· **Signal word** Danger

· **Hazard-determining components of labeling:**
n-hexane
· **Hazard statements**
H225 Highly flammable liquid and vapour.
H315 Causes skin irritation.
H361 Suspected of damaging fertility or the unborn child.
H336 May cause drowsiness or dizziness.

(Contd. on page 2)

Trade name: STD Aroclor 1260

(Contd. of page 1)

H373 May cause damage to organs through prolonged or repeated exposure.
H411 Toxic to aquatic life with long lasting effects.

· **Precautionary statements**

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P241	Use explosion-proof electrical/ventilating/lighting/equipment.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P303+P361+P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P321	Specific treatment (see on this label).
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Classification system:**
· **NFPA ratings (scale 0 - 4)**

Health = 2
Fire = 3
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = *2
Fire = 3
Reactivity = 0

· **Other hazards**
The product does not contain any organic halogen compounds (AOX), nitrates, heavy metal compounds or formaldehydes.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

*

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
110-54-3 n-hexane
· **Identification number(s)**
· **EC number:** 203-777-6
· **Index number:** 601-037-00-0
· **Chemical characterization: Mixtures**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Hazardous components:**

110-54-3	n-hexane	H225 H361; H373; H304 H411 H315; H336	75-100%

· **Additional Components**

11096-82-5	aroclor 1260	0.1-<1%

(Contd. on page 3)

Trade name: STD Aroclor 1260

(Contd. of page 2)

*
4 First-aid measures

· **Description of first aid measures**
· **General information:**
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:** In case of unconsciousness place patient stably in side position for transportation.
· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:** Rinse opened eye for several minutes under running water.
· **After swallowing:** If symptoms persist consult doctor.
· **Information for doctor:** Treat aggressively with 100% oxygen. Use nonrebreather mask.
· **Most important symptoms and effects, both acute and delayed** No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

*
5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:** CO2, sand, extinguishing powder. Do not use water.
· **For safety reasons unsuitable extinguishing agents:** Water with full jet
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

*
6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
Wear protective equipment. Keep unprotected persons away.
· **Environmental precautions:**
Do not allow product to reach sewage system or any water course.
Inform respective authorities in case of seepage into water course or sewage system.
Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
Do not flush with water or aqueous cleansing agents
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

*
7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Store in cool, dry place in tightly closed receptacles.
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of aerosols.
· **Information about protection against explosions and fires:**
Keep ignition sources away - Do not smoke.

(Contd. on page 4)

Trade name: STD Aroclor 1260

(Contd. of page 3)

Protect against electrostatic charges.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** Store in a cool location.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:**
Keep receptacle tightly sealed.
Store in cool, dry conditions in well sealed receptacles.
· **Specific end use(s)** No further relevant information available.

*

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.

· **Control parameters**

· **Components with limit values that require monitoring at the workplace:**	
110-54-3 n-hexane	
PEL	Long-term value: 1800 mg/m³, 500 ppm
REL	Long-term value: 180 mg/m³, 50 ppm
TLV	Long-term value: 176 mg/m³, 50 ppm Skin; BEI

· **Ingredients with biological limit values:**	
110-54-3 n-hexane	
BEI	0.4 mg/L Medium: urine Time: end of shift at end of workweek Parameter: 2.5-Hexanedione without hydrolysis

· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.
· **Breathing equipment:**
In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use respiratory protective device that is independent of circulating air.
· **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

(Contd. on page 5)

Trade name: STD Aroclor 1260

(Contd. of page 4)

· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break trough time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**

Tightly sealed goggles or safety glasses

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9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Liquid
Color:	Dark brown to black
· **Odor:**	Characteristic
· **Odour threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	-95 °C (-139 °F)
Boiling point/Boiling range:	69 °C (156 °F)
· **Flash point:**	-26 °C (-15 °F)
· **Flammability (solid, gaseous):**	Not applicable.
· **Ignition temperature:**	240 °C (464 °F)
· **Decomposition temperature:**	Not determined.
· **Auto igniting:**	Product is not selfigniting.
· **Danger of explosion:**	Product is not explosive. However, formation of explosive air/vapor mixtures are possible.
· **Explosion limits:**	
Lower:	1.2 Vol %
Upper:	7.4 Vol %
· **Vapor pressure at 20 °C (68 °F):**	160 hPa (120 mm Hg)
· **Density at 20 °C (68 °F):**	0.66 g/cm³ (5.508 lbs/gal)
· **Relative density**	Not determined.
· **Vapour density**	Not determined.
· **Evaporation rate**	Not determined.
· **Solubility in / Miscibility with**	
Water at 20 °C (68 °F):	0.1 g/l
· **Partition coefficient (n-octanol/water):**	Not determined.

(Contd. on page 6)

Trade name: STD Aroclor 1260

(Contd. of page 5)

· **Viscosity:**	
Dynamic:	Not determined.
Kinematic:	Not determined.
· **Solvent content:**	
Organic solvents:	100.0 %
VOC content:	100.0 %
· **Other information**	No further relevant information available.

10 Stability and reactivity

· **Reactivity**
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

*

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** No irritating effect.
· **Sensitization:** No sensitizing effects known.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **Persistence and degradability** No further relevant information available.
· **Behavior in environmental systems:**
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Ecotoxical effects:**
· **Remark:** Toxic for fish
· **Additional ecological information:**
· **General notes:**
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
Also poisonous for fish and plankton in water bodies.
Toxic for aquatic organisms
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

(Contd. on page 7)

Trade name: STD Aroclor 1260

(Contd. of page 6)

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

*

14 Transport information

· **UN-Number**	
· **DOT, ADR, IMDG, IATA**	UN1208
· **UN proper shipping name**	
· **DOT, ADR**	Hexanes, mixture
· **IMDG**	HEXANES, mixture, MARINE POLLUTANT
· **IATA**	HEXANES, mixture
· **Transport hazard class(es)**	
· **DOT**	
· **Class**	3
· **Label**	3
· **ADR, IMDG, IATA**	
· **Class**	3
· **Label**	3
· **Packing group**	
· **DOT, ADR, IMDG, IATA**	II
· **Environmental hazards:**	Product contains environmentally hazardous substances: n-hexane
· **Marine pollutant:**	Yes
· **Special precautions for user**	Warning: Flammable liquids
· **Danger code (Kemler):**	33
· **EMS Number:**	F-E,S-D
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	UN1208, Hexanes, mixture, 3, II

(Contd. on page 8)

(Contd. of page 7)

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15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**

110-54-3	n-hexane	H225 H361; H373; H304 H411 H315; H336	75-100%
11096-82-5	aroclor 1260		0.1-<1%

· **Sara**

· **Section 355 (extremely hazardous substances):**

None of the ingredients is listed.

· **Section 313 (Specific toxic chemical listings):**

110-54-3	n-hexane

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

110-54-3	n-hexane

· **Proposition 65**

· **Chemicals known to cause cancer:**

11096-82-5	aroclor 1260

· **Chemicals known to cause reproductive toxicity for females:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**

None of the ingredients is listed.

· **Cancerogenity categories**

· **EPA (Environmental Protection Agency)**

110-54-3	n-hexane	II

· **TLV (Threshold Limit Value established by ACGIH)**

None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms** GHS02, GHS07, GHS08, GHS09
· **Signal word** Danger

· **Hazard-determining components of labeling:**
n-hexane
· **Hazard statements**
H225 Highly flammable liquid and vapour.
H315 Causes skin irritation.
H361 Suspected of damaging fertility or the unborn child.
H336 May cause drowsiness or dizziness.
H373 May cause damage to organs through prolonged or repeated exposure.

(Contd. on page 9)

Trade name: STD Aroclor 1260

(Contd. of page 8)

H411 Toxic to aquatic life with long lasting effects.

· **Precautionary statements**

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P241	Use explosion-proof electrical/ventilating/lighting/equipment.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P303+P361+P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P321	Specific treatment (see on this label).
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

· **National regulations:**

· **Information about limitation of use:**
Workers are not allowed to be exposed to this hazardous material. Exceptions can be made by the authorities in certain cases.

· **Water hazard class:** Water hazard class 2 (Self-assessment): hazardous for water.
· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

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16 Other information

Disclaimer
The information provided in this Material Safety Data Sheet is based on our present knowledge, and believed to be correct at the date of publication. However, no representation is made concerning its accuracy and completeness. It is intended as guidance only, and is not to be considered a warranty or quality specification. All materials may present unknown hazards, and should be used with caution. Although certain hazards are described, we cannot guarantee that these are the only hazards which exist. PerkinElmer Life and Analytical Sciences shall not be held liable for any damage resulting from handling or from contact with the product.

· **Contact:**
With in the USA: 1-(800)-762-4000
Out side the USA: 1-(203)-712-8488

· **Abbreviations and acronyms:**
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
ICAO: International Civil Aviation Organization
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
VOC: Volatile Organic Compounds (USA, EU)

· *** Data compared to the previous version altered.**

Click **http://www.guidechem.com/cas-110/11097-69-1.html** for suppliers of this product

PCB 1254 (cas 11097-69-1) MSDS

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifiers

Product name : Aroclor 1254

Product Number : 48586
Brand : Supelco
CAS-No. : 11097-69-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [EU-GHS/CLP]
Specific target organ toxicity - repeated exposure (Category 2)
Acute aquatic toxicity (Category 1)
Chronic aquatic toxicity (Category 1)

Classification according to EU Directives 67/548/EEC or 1999/45/EC
Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Danger of cumulative effects.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008 [CLP]
Pictogram

Signal word Warning

Hazard statement(s)
H373 May cause damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P273 Avoid release to the environment.
P501 Dispose of contents/ container to an approved waste disposal plant.

Supplemental Hazard Statements none

According to European Directive 67/548/EEC as amended.
Hazard symbol(s)

R-phrase(s)
R33 Danger of cumulative effects.
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrase(s)
S35 This material and its container must be disposed of in a safe way.
S60 This material and its container must be disposed of as hazardous waste.
S61 Avoid release to the environment. Refer to special instructions/ Safety data sheets.

2.3 Other hazards - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Component		Concentration
Aroclor 1254		
CAS-No.	11097-69-1	-
Index-No.	602-039-00-4	

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

4.3 Indication of any immediate medical attention and special treatment needed
no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Nature of decomposition products not known.

5.3 Advice for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information
no data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Normal measures for preventive fire protection.

7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end uses
no data available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	no data available
f)	Initial boiling point and boiling range	no data available
g)	Flash point	no data available
h)	Evaporation rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	no data available
k)	Vapour pressure	no data available
l)	Vapour density	no data available
m)	Relative density	no data available
n)	Water solubility	no data available
o)	Partition coefficient: n-octanol/water	no data available
p)	Autoignition temperature	no data available
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information
no data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
no data available

10.2 Chemical stability
no data available

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid
no data available

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - rat - 1.010 mg/kg

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitization
no data available

Germ cell mutagenicity

Genotoxicity in vitro - rat - liver
Unscheduled DNA synthesis

Genotoxicity in vitro - rat - Liver
DNA damage

Genotoxicity in vitro - mouse - fibroblast
Morphological transformation.

Genotoxicity in vivo - rat - Oral
Morphological transformation.

Genotoxicity in vivo - rat - Intraperitoneal
DNA damage

Genotoxicity in vivo - rat - Oral
DNA damage

Carcinogenicity

Carcinogenicity - rat - Oral
Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Gastrointestinal:Tumors.

Carcinogenicity - rat - Oral
Tumorigenic:Carcinogenic by RTECS criteria. Liver:Tumors.

Carcinogenicity - mouse - Skin
Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Skin and Appendages: Other: Tumors.
Tumorigenic:Tumors at site or application.

Carcinogenicity - rat - Oral
Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Gastrointestinal:Tumors.

Carcinogenicity - mouse - Oral
Tumorigenic:Neoplastic by RTECS criteria. Liver:Tumors.

Carcinogenicity - mouse - Intraperitoneal
Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Tumorigenic Effects: Uterine tumors. Lungs, Thorax, or Respiration:Tumors.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

Reproductive toxicity - rabbit - Oral
Effects on Fertility: Post-implantation mortality (e.g., dead and/or resorbed implants per total number of implants). Effects on Fertility: Abortion. Effects on Embryo or Fetus: Fetal death.

Reproductive toxicity - rabbit - Oral
Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - rat - Oral

Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - rat - Oral
Effects on Newborn: Behavioral.

Reproductive toxicity - rat - Oral
Effects on Newborn: Delayed effects.

Reproductive toxicity - rat - Intraperitoneal
Maternal Effects: Other effects. Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - mouse - Oral

Effects on Newborn: Behavioral.

Reproductive toxicity - Mammal - Oral
Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated).

Developmental Toxicity - rat - Oral
Specific Developmental Abnormalities: Hepatobiliary system.

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Ingestion	Harmful if swallowed.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Signs and Symptoms of Exposure
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Additional Information
RTECS: Not available

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 0,22 µg/l - 96,0 h
Toxicity to algae	LC50 - Algae - 0,015 mg/l - 28 h

12.2 Persistence and degradability

12.3 Bioaccumulative potential

Bioaccumulation	Pimephales promelas (fathead minnow) - 8 Months -1,8 µg/l Bioconcentration factor (BCF): 238.000

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
no data available

12.6 Other adverse effects
Very toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID: 2315	IMDG: 2315	IATA: 2315

14.2 UN proper shipping name

ADR/RID:	POLYCHLORINATED BIPHENYLS, LIQUID
IMDG:	POLYCHLORINATED BIPHENYLS, LIQUID
IATA:	Polychlorinated biphenyls, liquid

14.3 Transport hazard class(es)

ADR/RID: 9	IMDG: 9	IATA: 9

14.4 Packaging group

ADR/RID: II	IMDG: II	IATA: II

14.5 Environmental hazards

ADR/RID: yes IMDG Marine pollutant: yes IATA: no

14.6 Special precautions for user
no data available

15. REGULATORY INFORMATION

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
no data available

15.2 Chemical Safety Assessment
no data available

16. OTHER INFORMATION

Further information
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information this document is based on the resent state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. guidechem shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

APPENDIX E

STANTEC HAZCOM PROGRAM (SWP-104)

SAFE WORK PRACTICE – HAZARD COMMUNICATION (HAZCOM) SWP-104

1 PURPOSE

This Safe Work Practice (SWP) is designed to provide a framework under which all Stantec US employees are adequately protected from the hazards of toxic, reactive, flammable or explosive chemical exposure. This program is written to meet the requirements of US hazard communication regulations; 29 CFR 1910.1200.

2 SCOPE

This SWP applies to all Stantec employees, office, and field operations performed in the United States.

3 RESPONSIBILITIES

3.1 Office Leaders

- Direct that an inventory of controlled products be maintained within the workplace.
- Inform employees regarding hazardous materials specific to their projects and/or work areas, and provide access to MSDS for the products to which they may be exposed.
- Discontinue use of product if it is not labeled properly.
- Maintain MSDS for all controlled products so they are current and readily available.
- Provide access to WHMIS training for employees.
- Do not accept materials without proper label and MSDS.
- Do not all materials to be transferred from its original container, unless the label and hazard information is transferred as well.

3.2 Office Safety and Environment Coordinator (OSEC):

- Ensure MSDS collections within the office are complete, up-to-date and readily available. The OSEC, or a member of the JHSC where applicable, will arrange to obtain a new MSDS from the supplier or manufacturer of the product. Stantec subscribes to a service called MSDSonline to assist in this task. Please contact your Regional Safety and Environment Coordinator (RSEC) for details.
- Make workplace label templates available within the office.
- Maintain an inventory of all chemical and biological controlled products within the office and/or lab. On a yearly basis, the inventory will be reviewed and less-hazardous replacement products of the products may be recommended.
- The OSEC will facilitate the implementation of the HAZCOM program through communication.

3.3 Employees:

- Affix workplace labels for products transferred to containers other than the original container from the supplier.
- Replace a label where supplier labels have become worn and illegible.
- Review MSDS when appropriate (e.g. prior to using a new product), report missing MSDS, and any other health and safety concerns.
- Employees must review MSDS at least annually.

- Participate in the Hazard Communication Program by completing initial training, refresher training, and retraining when new hazards or chemicals are introduced. Employees should be prepared to:

  - Read and interpret Hazard Communication labels and MSDS
  - Follow MSDS and employer work procedures
  - Use personal protective equipment as instructed
  - Protect themselves and others in the workplace

3.4 Venders and Subcontractors:

- Check in with the appropriate Stantec representative and provide them with a chemical inventory consisting of all hazardous materials being brought into the office or on-site and the corresponding MSDS.
- Ensure that all containers of hazardous materials being brought into an office or on-site are affixed with the appropriate warning labels.

4 HAZARDS

Hazards of controlled products/hazardous chemicals are described in detail in MSDS, and are shown on supplier labels and/or workplace labels.

Exposure to hazardous materials can cause or contribute to a variety of health effects such as irritation, burns, sensitization, heart ailments, kidney and lung damage and cancer. Some materials may also be a safety hazard and can contribute to fires, explosions and other accidents if not properly stored or handled.

4.1 Hazardous Chemicals On-site:

Stantec does not typically store large amounts of hazardous materials in its offices and labs, nor does Stantec transport bulk chemicals. Periodically, small quantities of hazardous materials are used to calibrate or fuel field instrumentation (e.g. PIDs, FIDs, field gas chromatographs, etc. These materials may include:

compressed isobutylene	compressed methane	tetrahydrofuran
compressed hydrogen	compressed nitrogen	trichloroethylene
compressed ultra-pure air	acetone	vinyl chloride
benzene	2-butanone	cleaning products
1,1-dichloroethane	1,2-dichlorethane	toluene
ethylbenzene	hexane	1,1,1-trichloroethane
hydrochloric acid	hydrogen peroxide	xylene

isopropyl alcohol	methanol	tetrachloroethene
methylene chloride	methyl ethyl ketone	1,1,2,2-tetrachloroethane
methyl isobutyl ketone	4-methyl-2-pentanone	sodium hydroxide
methyl tert butyl ether	nitric acid	sulfuric acid
pentane	propane	

- Each employee working with the compounds listed above will be given instruction that will allow safe use, handling, storage and disposal of the products. These compounds are used in very small quantities, often less than 1 ounce/50 mL each, and at any one time there may only be a few compounds present in the workplace.

- Stantec personnel may also be exposed to chemicals in the soil, water and air while working at HAZWOPER sites. The Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, 29 CFR 1910.120, includes the requirements for employees to work safely in those environments. Controlled products destined for disposal will be treated as hazardous waste. Appropriate labels must be maintained on the products. Transportation of Dangerous Goods requirements must be reviewed and implemented prior to shipment.

- Always consult the MSDS for potential health hazard exposures and follow the precautions noted on the MSDS. Where more detailed procedures or controls are required by the client or the contractor responsible for the work site, the Project Manager will coordinate with them and provide the necessary information, and if required training, to employees required to work there. This information will be used by the PM when the RMS1 form is completed.

5 CONTROLS

5.1 Hazard Recognition Assessment and Control (HRAC) Process

Stantec's Hazard Recognition, Assessment and Control Process utilizes a hierarchy of control to minimize employees' exposure to all hazards including hazardous substances/materials/wastes. The controls utilized are listed below in order of implementation.

- Elimination/Substitution

If a hazardous material's use or presence can be eliminated, then it should be. If a less hazardous material can be utilized to perform the same function of the more hazardous material, then the less hazardous material should be substituted in place of the more hazardous material.

- Engineering Controls

If a hazardous material cannot be eliminated through the use of the above control then engineering controls such as ventilation, blocking, air conditioning, etc. shall be utilized.

- Warnings

Where appropriate, storage areas should be labeled or placarded to indicate contents, and areas of use should have precautionary information posted.
Incompatible products must be segregated in accordance with legislation (e.g. flammable materials and oxidizers must be kept separate).
Label and decanted product requirements do not apply to controlled products contained in or transferred through piping or vessels (such as process vessels, reaction vessels, tank cars, or ore cars). Stantec employees should be aware that identification conventions can vary between worksites.

- Administrative Controls

Limiting the amount of time a person is exposed to a hazardous material or taking more breaks in the afternoon as it gets hotter are forms of administrative controls.

- Personal Protective Equipment (PPE)

PPE is the lowest level in the hierarchy of controls since PPE only places a barrier between the employee and the hazard. PPE is a last resort.
PPE requirements are described on individual MSDS, in addition to other reference materials, such as PPE compatibility charts, and the NIOSH handbook. Employees must properly use PPE as described in the MSDS and reference materials, as it relates to the product being used.
Refer to SWP-105 – Personal Protective Equipment.

5.2 Client Sites

- Where there is a concern for exposure to chemicals, the Project Manager will coordinate the required controls and procedures with the client or contractor responsible for the site or facility. Where required the client or contractor should provide all air samples or other tests performed according to an approved method. Where the possibility of an exposure above the permissible exposure limit exists, the Project Manager shall coordinate with the client or contractor, and inform all employees required to go to the site of the controls needed to limit the exposure, or provide the necessary PPE and/or procedures to protect employees. At no time will the concentration of a chemical be allowed to exceed the ceiling level for that specific chemical. Applicable Federal and State regulations for where the work is performed in shall be reviewed to identify the exposure limits that shall be used for the project.
- The MSDS will be consulted prior to any potential exposure, with precautions noted on the MSDS implemented to limit exposure. Where more detailed procedures or controls may be required by client or contractor, the Project Manager will coordinate and provide the necessary information and, if required, training.

5.3 Office Locations

- Each office will develop and maintain a list of all chemical and biological substances that are regularly handled, used, stored, produced or disposed of in the course of work processes and that may be hazardous to the health and safety of staff present. All chemical and biological substances that are controlled products must be identified on this list which will be readily available for reference at the office.

5.4 Storage of Hazardous Substances/Materials/Wastes

- Hazardous substances/materials/wastes shall be stored in a clean and organized manner paying attention to their characteristics (flammable, combustible, etc.) and compatibilities. Proper storage and good housekeeping is the best way to prevent the occurrence of spills.
- Hazardous substances/materials/wastes shall be stored in proper containers and in proper storage locations including the use of secondary containment to minimize the potential for spills, when appropriate.
- All hazardous substances/materials/wastes used or stored at a worksite must be clearly identified with proper labels and must be used and stored in such a way that the use or storage is not a hazard to workers.

5.5 Spill Prevention and Response

- In the event of an uncontrolled release, Stantec personnel and their Subcontractors shall follow the site specific (office, facility, field location) emergency response plan including communication with the appropriate Stantec and/or client personnel.
- An adequate number of spill kits must be available to handle the quantity of hazardous substances/materials/wastes that could potentially spill.
- The spill kits should be staged for immediate access without exposing the responder(s) to any hazards.
- The supplies, equipment and materials in the spill kit need to be compatible for the materials involved.
- Only those personnel who are trained in emergency spill response should attempt to contain or arrest the release.

6 TRAINING

- All employees in the United States will receive Hazard Communication training upon hire. Training may not be 'transferred' from a previous employer. The extent of training will vary by duties and/or need, and will include:
    - Program overview and legal requirements (including labeling systems, MSDS location, chemical hazards and appropriate protective measures)
    - Responsibilities and rights
    - Labels
    - Material Safety Data Sheets (MSDS), how to read and understand them
    - Hazards and safe work procedures for controlled products
    - How to recognize hazardous materials
    - Spill prevention, first aid, and emergency response procedures
    - Office personnel, including management and administrative personnel, will receive awareness and site-specific training;
    - Field/lab personnel may receive more extensive training, as needed.

- Hazard Communication Program training will be refreshed at least annually, or more frequently if exposure to controlled products is affected when:

    - Work conditions or locations change,
    - Work procedures change,
    - There is a change to a controlled product,
    - Updated hazard information becomes available, or if
    - There is a client-specific requirement.
    - The extent of the refresher may vary by duties and/or need.

Employees required to work on or around hazardous waste sites refer to SWP 108 - Bloodborne Pathogens, and SWP 314 – Working around Hazardous Waste and Wastewater

7 OUTSIDE AUTHORITIES TO BE CONTACTED

Products are not to be used until an MSDS is provided by the supplier and precautions have been reviewed

8 RESOURCES

- OSHA 29CFR1910.1200 Hazard Communication Standard
- OSHA 29CFR1910.120 Hazardous Waste Operations and Emergency Response
- SWP 105 – PPE
- SWP 108 – Bloodborne Pathogens
- SWP 314 – Working around Hazardous Waste and Wastewater

9 DEFINITIONS

Chemical - means any element, chemical compound or mixture of elements and/or compounds.

10 DOCUMENTATION SUMMARY

A. File these records in the Office Safety File:
    - Hazard Communication Training Records
    - Site Chemical Inventory
    - MSDS for all materials maintained in the office

B. File these records in the Project Health & Safety File:
    - Project Chemical Inventory
    - MSDS for all materials required on the project site

11 REVISION HISTORY

Date	Change	Acknowledgments
August 26, 2010	Initial submission to StanNet	K. Robinson
July 24, 2013	Revision for minor content and format.	C. Ferguson-Scott

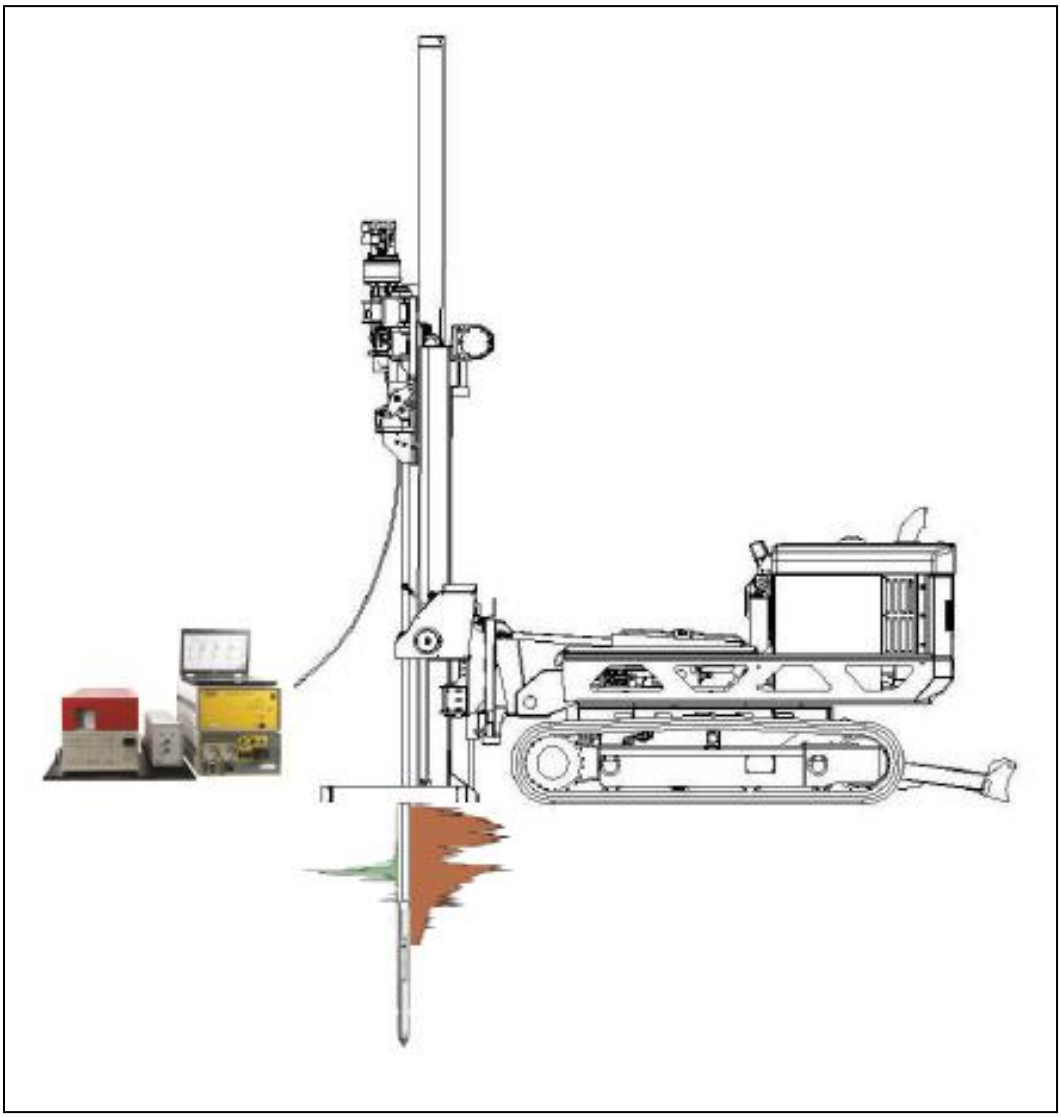
Appendix C
MIP Standard Operating Procedure

Stantec

Geoprobe® Membrane Interface Probe (MIP)

Standard Operating Procedure

Technical Bulletin No. MK3010
PREPARED: May, 2003
REVISED: January, 2015



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1.0 Objective

This document serves as the standard operating procedure for use of the Geoprobe Systems® Membrane Interface Probe (MIP) used to detect volatile organic compounds (VOCs) at depth in the subsurface.

2.0 Background

2.1 Definitions

Geoprobe®: A brand name of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, soil conductivity and contaminant logging, grouting, and materials injection.
**Geoprobe® is a registered trademark of Kejr, Inc., Salina, Kansas.*

Membrane Interface Probe (MIP): A system manufactured by Geoprobe Systems® for the detection and measurement of volatile organic compounds (VOCs) in the subsurface. A heated probe carrying a permeable membrane is advanced to depth in the soil. VOCs in the subsurface cross the membrane, enter into a carrier gas stream, and are swept to gas phase detectors at ground surface for measurement.

2.2 Discussion

The MIP is an interface between contaminates in the soil and the detectors at ground surface. It is a mapping tool used to find the depth at which the contamination is located, but is not used to determine concentration of the compound. Two advantages of using the MIP are that it detects contamination in situ and can be used in all types of soil conditions.

The MIP is a logging tool used to make continuous measurements of VOCs in soil. Volatile compounds outside the probe diffuse across a membrane and are swept from the probe to a gas phase detector at ground surface. A log is made of detector response versus probe depth. In order to speed diffusion, the probe membrane is heated to approximately 121°C. (Refer to Figure 2.1).

Along with the detection of VOCs in the soil, the MIP also measures the electrical conductivity of the soil to give a probable lithology of the subsurface. This is accomplished by using a dipole measurement arrangement at the end of the MIP probe so that both conductivity and detector readings may be taken simultaneously. A simultaneous log of soil electrical conductivity is recorded with the detector response.

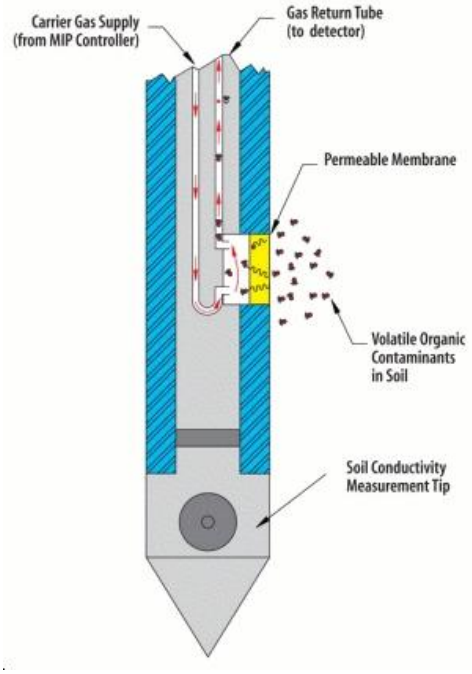

Figure 2.1: Diffusion across the membrane

Interpretation of electrical conductivity (EC) logs comes with field experience. It is very important that soil core samples are taken to confirm lithologic changes as each EC log is unique per site. As a generalization, a high conductivity reading indicates a smaller grain size and a low conductivity reading indicates a larger grain size (See Fig. 2.2).

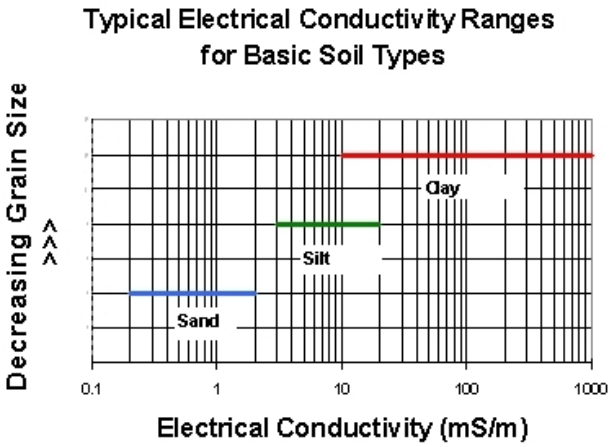

Figure 2.2: Generalized Electrical Conductivity Readings

3.0 MIP/EC Interferences

3.1 Detector saturation may require a short period of time for the detector to return to baseline after a log has been performed in higher concentrations. The MIP system can be used in free product environments with the operator monitoring and making the necessary adjustments to the detector and software gain/attenuation settings to account for the higher voltage readouts.

3.2 The MIP system can be operated in a wide range of contaminant concentrations from low dissolved phase to free phase materials. During a log and the removal of the tool string, contaminants can absorb onto the surface of the membrane and trunkline material causing elevated detector baseline signals. It is very important that the probe and trunkline system is clean enough to see the low concentrations typically used in the chemical response test. Not adequately decontaminating the probe prior to performing a response test can elevate the concentration of the standard causing an inaccurate high response to the specific concentration of standard that was prepared for the test.

3.3 Electrical conductivity can provide false positives or higher than expected readings when the soil is impacted by ionic plumes (chloride, nitrate) originating from, but not limited to: agriculture practices, seawater, salt storage, mining practices. Encountering metallic objects in the subsurface can also result in high EC readings.

3.4 Some silt and clay soils will not have the typical ionic composition that an operator may be used to for similar soils. This can result in lower than expected readings and perhaps cause misidentification of the associated soil zone based on typical response of a courser grain material. This can occasionally be found in clays that have had the minerals leached out or in intermixed silt-sand zones.

4.0 Tools and Equipment

The following equipment is needed to perform and record MIP logs. Basic MIP system components are listed in section 4.1 and shown in Figure 4.1. Additional equipment needed to run MiHPT logs is listed in section 4.2 with optional equipment listed in section 4.3. Refer to Appendix V for a detailed illustration of the GC1000 setup configuration. Appendix VI shows the common MIP probe tool string diagrams. There may be more required tools as determined by your specific model of Geoprobe® direct push machine.

4.1 Basic MIP System Components

Description	Quantity	Material Number
Field Instrument, 120V (Model FI6000)	-1-	213940
Field Instrument, 220V (Model FI6003)	*	213941
MIP Acquisition Software	-1-	214128
MIP Controller, 120V (Model MP6505)	-1-	214137
MIP Controller, 220V (Model MP6507)	*	214139
Gas Chromatograph, 120V with PID, FID and XSD	-1-	213946
Gas Chromatograph, 220V with PID, FID and XSD	*	213947
MIP Probe, 1.75 inch	-2-	214143
MIP/HPT Connection Tube	-2-	220912
MIP/HPT Drive Head 1.5in. rods	-2-	203794
Slotted 1.5” Drive Cap, Threadless	-2-	206609
MIP Probe, 2.25 inch	**	214152
2.25 Connection Tube	**	219455
2.25 Inch Water Seal Drive Head	**	212089
2.75 Inch Water Seal Drive Head	**	209796
Slotted 2.25” Drive Cap	**	211798
MIP Trunkline 100 ft.	(optional)	204077
MIP Trunkline 150 ft.	-2-	202570
MIP Trunkline 200 ft.	(optional)	204655
Agilent ADM 1000 Digital Flow Meter	-1-	600227
Hydrogen Gas Regulator	-1-	600137
Nitrogen Gas Regulator	-1-	600175
Vertical Gas Bottle Rack	-1-	214121
MIP Service Kit	-1-	214142
EC Bypass Cable	-1-	204025
Stringpot, 100-inch	-1-	214227
Stringpot Ground Plate	-1-	220775
Stringpot Cordset, 65-feet (19.8 m)	-1-	202884
Stringpot Mounting Bracket (6600/7700)	(optional)	202947
Stringpot Mounting Bracket (78 Series)	-1-	209511

Stringpot Foot Bracket (6600/7700)	(optional)	201816
Stringpot Foot Bracket (78 Series)	-1-	209533
Stringpot Piston Weight	-1-	214225
Drive Cushion (GH60)	-1-	204278
Rod Wiper, 1.25/1.5” Rods	-1-	600341
Rod Wiper Weldment	-1-	204387

4.2 Additional MiHPT System Components

Description	Quantity	Material Number
HPT Flow Module, 120V (Model K6300)	-1-	214091
HPT Flow Module, 220V (Model K6303)	*	214093
HPT Reference Tube 1.75 in HPT Probe	-1-	212689
HPT Reference Tube 2.25 in HPT Probe	**	211762
MiHPT Probe, 1.75 inch	-2-	219228
MiHPT Probe, 2.25 inch	**	214117
MiHPT Connection Tube	-2-	219594
MiHPT Drive Head for 1.5” rods	-2-	220545
MiHPT Trunkline 100 ft	(optional)	214113
MiHPT Trunkline 150 ft	-2-	214114
MiHPT Trunkline 200 ft	(optional)	214115
Coupling 1/8 to 1/8 Tube	-5-	107963
Coupling 0.135 to 0.150 Tube	-5-	220978
Oetiker Band Clamp 4.7mm x 5.7mm	-10-	220977
Oetiker Band Clamp #7	-10-	220976
HPT Sensor Module	-2-	210091
Heated Trunkline Seal Asm.	-4-	211768
HPT Test Load	-1-	206552
HPT Service Kit	-1-	205599

4.3 Optional Accessories

Description	Quantity	Material Number
Heated Trunkline Controller, 120V (Model MP7000)	-1-	214147
Heated Trunkline Controller, 220V (Model MP7003)	*	214148
MIP Heated Trunkline 100 ft.	(optional)	214150
MIP Heated Trunkline 150 ft.	-1-	214151
MIP Heated Transfer Line 8 ft.	-1-	214149
MIP Breakout Connection Panel.	-1-	211100
Roll-out Rod Rack (30-1.5in rods)	-1-	213627
Water Transport System.	-1-	203450

*Use in place of 120V components if desired.

**Use in place of 1.75 inch probe and components if desired.

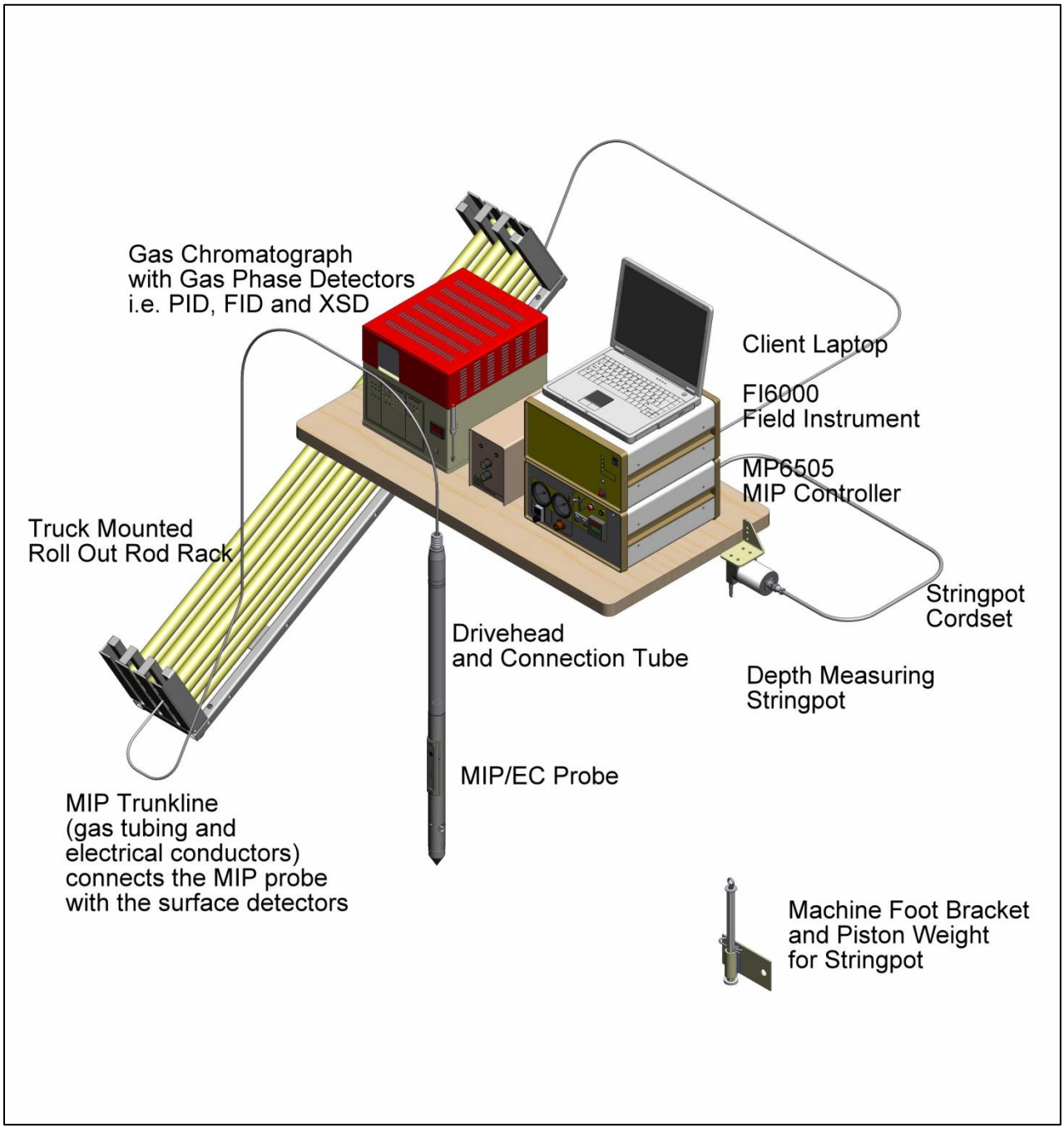

Figure 4.1: MIP System Components

5.0 Quality Assurance/Quality Control

Quality assurance (QA) testing of each of the sensors on the probe is too be performed before and after each log to validate that the equipment is capable of generating good data. The MIP tool includes chemical response tests (Section 5.1.3) which are performed to ensure that the probe membrane, trunkline and detectors are capable to providing ample signal over baseline noise to a known site contaminant at a given concentration. The electrical conductivity (EC) sensor is tested using an EC dipole test (Section 5.2) with low and high readings typical to EC values of the soil. The HPT sensor is included on the MiHPT probe and is tested using the HPT reference test (Section 5.3) which confirms the sensors ability to accurately measure a 6" column of water and provides an accurate measurement of atmospheric pressure.

Quality control (QC) is performed during and after each log is generated. Log QC will answer the following questions to ensure that the data is good and makes sense:

1. Does the log look correct? Does the elctrical conductivity appear to be in an acceptable range? Is there anything seen in the log that would make you suspect that the system wasn't working correctly, ie. a loss of temperature or gas pressure of the system.
2. Response consistency? As more logs are completed do they show general consistency of EC and contaminant response? Review a cross section of logs in the DI-Viewer (Appendix IV).
3. Repeatablity? Replicate logs may be run every 10 to 20 locations to verify repeatability.
4. Are my lithogy changes consistant with physical soil cores? Take continuous or discreet confirmation soil samples to confirm your lithogy changes in EC.
5. Do the MIP detector responses make sense for contaminant concentration. This must be verified by the collection of water or soil samples for lab analysis to confirm contaminants and their concentrations.

5.1 MIP Chemical Response Test:

Chemical response testing is an important quality assurance measure used to validate each log by proving that the integrity of the detector system is intact. With the chemical response test the operator introduces a working standard (known site contaminant of concern) at a known concentration to the membrane for a set time of 45 seconds which should match the residence or holding time at each sampling interval. Two acceptable methods of introducing the standard to the membrane are shown in Figures 5.4 and 5.5.

Typical site contaminant of concerns which are used in MIP chemical response tests include but are not limited to Benzene, Toluene, Trichloroethylene or Perchloroethylene. The stock standard should be made up from one of these or an appropriate mix of chemicals.

5.1.1 Preparation of the Stock Standard

Preparation of the stock standard is critical to the final outcome of the concentration to be placed into the testing cylinder. The following items are required for preparing the stock standard:

- Neat sample of the analyte of interest (i.e.: Benzene, Toluene, TCE, PCE, etc.) purchased from a chemical vendor
- Microliter syringes (recommended to have: 25μL, 100μL and a 500μL or 1,000μL syringes).
- 25-mL or 50-mL Graduated cylinder
- Several 40-mL VOC vials with labels
- 25mL Methanol

1. The total volume of methanol and the compound added should equal 25mL.
2. Pour methanol into graduated cylinder to the 23.5-24mL mark, the volume depends upon the compound density (Table 5.1).
3. Pour the methanol from the graduated cylinder into a 40mL VOC vial.
4. Add the appropriate volume of desired neat analyte into 40mL VOC vial containing methanol. The required volume of neat analyte for seven common compounds is listed in Column 3 of Table 5.2. The equation in table 5.1 shows how to calculate the appropriate neat analyte volume for other compounds of interest given the appropriate density.
5. Label the vial with the name of the stock standard (i.e. Benzene, Toluene, TCE, PCE), concentration (50mg/mL), date created, and created by (your name or initials).
6. Stock standards need to be kept cold in a refrigerator or freezer to ensure they can last up to one month otherwise they should be made up more frequently as often as every 3 days if there is not cooling during the summer months. The more volatile the compound the quicker it will lose its concentration.

Stock Standard Calculations
25mL (methanol) x 50mg/mL = 1250mg 1250mg x 1/density of analyte = amount of neat material to be placed with methanol to make up 25mL total volume *Example: Preparation of 50mg/mL Benzene standard.* *1250mg x 1/0.8765mg/μL = 1426μL* *Use 1426μL of neat Benzene in 23.5mL of Methanol to get a 50mg/mL stock standard.*

Table 5.1: Stock Standard Preparation Calculations

Compound	**Density (mg/μL)**	**Volume (μL) of Neat Standard Required to prepare Working Standard (0.5 L)**
Benzene	0.876	1426
Toluene	0.867	1442
Xylenes	0.860	1453
Methylene Chloride	1.335	936
Carbon Tetrachloride	1.594	784
Chloroform	1.480	845
Trichloroethylene	1.464	854
Perchloroethylene	1.623	770

Table 5.2: Density and required volumes of neat (pure ~100%) compounds used to make a 50mg/mL stock standard into 25 ml of methanol

5.1.2 Preparation of Working Standards

The following items are required to perform response testing:

- Microliter syringes (recommended to have: 10, 25, 100 & 500µL syringes).
- Freshly made 50ml/ml Stock standard
- Testing cylinder made from a nominal 2-in. PVC pipe with a length of 24 in. or 40ml vial
- 0.5 L plastic beaker or pitcher
- Supply of fresh water, 500mL needed per test
- Stopwatch

Volume of 50mg/ml Stock Standard (µL)		Final Concentration mg/L = ppm
10		1.0
100		10
1000		100

Table 5.3: Volumes of stock standard and final concentrations

Figure 5.1: Working standard

5.1.3 Performing the Chemical Response Test

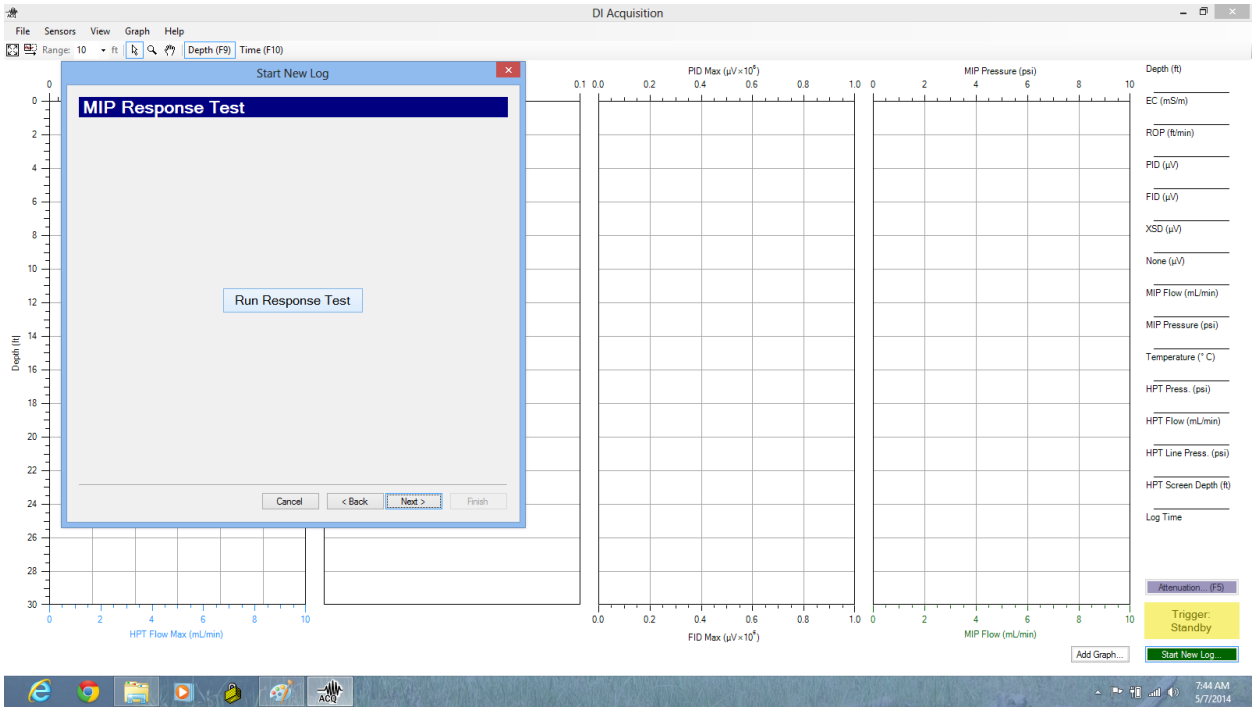

Figure 5.2: DI Acquisition Response Test Screen

1. Begin a new log in the DI-Acquisition software and proceed to the response test screen. The detector signals should be stable before proceeding with the test.
2. Measure out 500mL of tap or distilled water in a graduated beaker.
3. Using Table 5.3, determine the desired volume of stock standard to place into the 500ml measured volume of water to make up the working standard.
4. If the detector baselines have been monitored while the standard was being prepared select “Clear Response Test”.
5. When ready with the working standard prepare to run the response test by exposing the membrane to the working standard. Two acceptable methods are to pour the standard into a nominal 2-inch x 24-inch PVC pipe and insert the probe into the tube (Fig. 5.4) and the other method is to pour the working standard into a 40ml/vial and invert onto the membrane (Fig. 5.5).
6. Start the response test by clicking on the “Run Response Test” button (Fig. 5.2) and immediately expose the MIP membrane to the test solution (Figures 5.4 or 5.5).

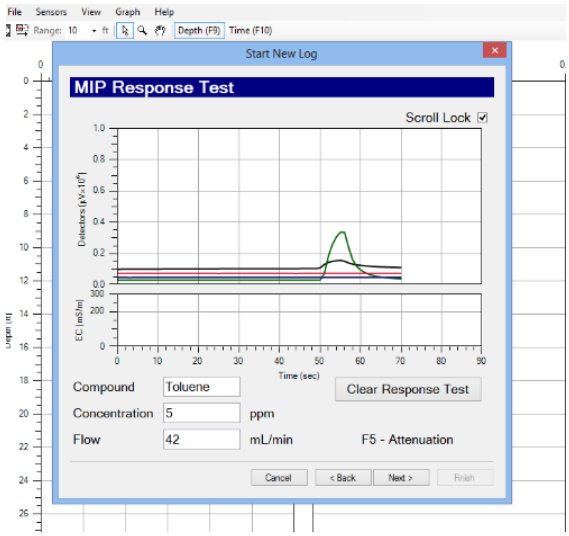

Figure 5.3: Running the Chemical Response Test

7. Leave the membrane exposed to the test solution for 45 seconds. This time is to be equal to the resonance time at each depth interval during probe advancement.
8. Starting the response test time file as the membrane is exposed to the test solution allows the trip time (Section 5.1.4) to be easily calculated by when response begins to climb which is approximately 50seconds in Fig. 5.3.
9. Fresh working standards need to be made for each test, they cannot be reused.
10. After the response has come through the detectors and adequate detector response is seen the operator may select “next” to move to the EC QA test.

Acceptable methods for performing the MIP Chemical Response Test

Figure 5.4 Probe immersed in steel or PVC pipe containing working standard

Figure 5.5: 40ml vial of working standard inverted onto membrane

5.1.4 Determination of Contaminant Trip Time:

Response testing also enables the operator to measure the chemical trip time which needs to be entered into the MIP software to accurately plot the contaminants depth position. The trip time is the time it takes for the contaminant to travel through the trunkline from the membrane to the detectors. The contaminant trip time is influenced primarily by trunkline length and carrier gas flow rates as well as the contaminant makeup specifically boiling point. The chemical response trip time can be determined from the results on the Pre-Log Response Test. Using Fig. 5.6 the Benzene trip time (TT) would be approximately 55 seconds. This response test would need to have been started right when the chemical used in the response test was exposed to the membrane. Additional typical response test graphs are located in Appendix I.

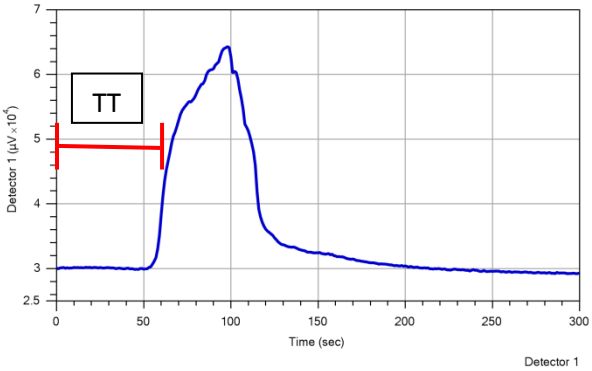

Figure 5.6: 5ppm Benzene on PID

5.1.5 Appropriate Chemical Response Test Concentrations and Response

The compound used in a chemical response test should be the site contaminant of concern or similar which will give you the most accurate response magnitude for that chemical as well as an accurate trip time. If the site objective is to delineate the extent of a dry cleaner plume then the operator should use PCE for the response tests at the lowest possible concentrations ~1ppm or less. If the site objective is to delineate the extent of the petroleum plume from a gas station then the operator should use one of the BTEX compounds or a gasoline mixture at or near the detection limit. If the site objective is to map out a plume source and high contaminant concentrations are expected then the response tests should be run at higher concentrations such as 10ppm-50ppm. This should reduce the possibility of trunkline/membrane carryover masking the chemical response tests.

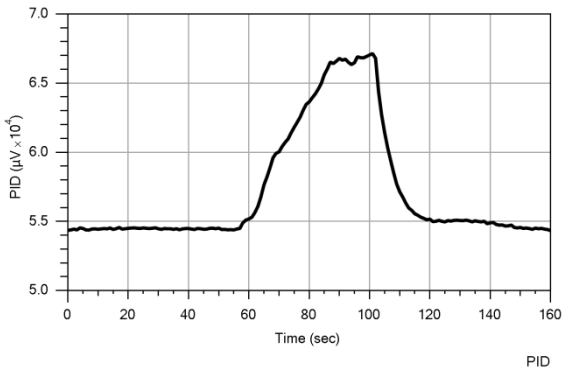

Figure 5.7: 2.5ppm Benzene on the PID

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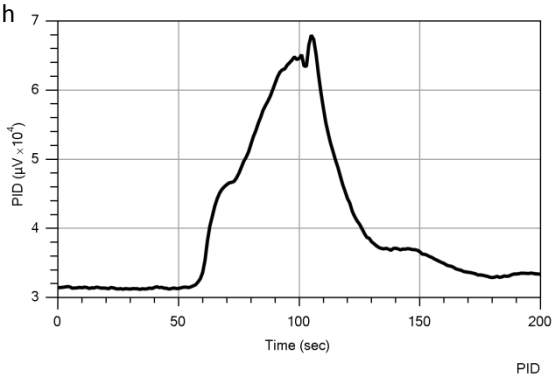


Figure 5.8: 5ppm TCE on the XSD

Figure 5.7 shows a benzene response over baseline on the PID of approximately 12,500μV on a 2.5ppm standard for a 5,000μV/1ppm. Figure 5.8 shows TCE responses over baseline on the XSD of 33,000μV on a 5ppm standard for approximately a 6,500μV/1ppm response.

5.1.6 Minimum Acceptable MIP Response Test Levels and Maintenance Tips

Geoprobe Systems specifies the following guidelines as minimum MIP response test values for performing MIP logging.

Detector systems can vary in the level of response for a given chemical concentration depending on detector age, model, and maintenance performed. However, it should be expected that the detector system would be able to provide at least a 5:1 signal to noise ratio (see Appendix I) for 1ppm of Benzene or TCE. Other compounds or concentration may be performed at the client requests however they may have different response magnitudes and signal to noise ratios at 1ppm. These specifications are required with operation of the PID and XSD (ECD or DELCD as well as alternative halogen detectors). The FID is a less sensitive detector typically used as a confirmation detector and one used for mapping natural gas components.

If the minimum response test levels are not achievable or throughout the day or project the detector sensitivity falls below these levels, the operator must stop and perform maintenance on the system to enhance the sensitivity of the detectors. Corrective actions could include:

- Changing MIP membrane (see section 9.0)
- Making a fresh chemical stock standard (see section 5.1.1). It does not take long for a volatile chemical standard to lose the original concentration.
- Decreasing trunkline carrier gas flow from 40ml/min to 30 or 20ml/min. This will lower the pressure in the trunkline and at the membrane which will increase system sensitivity. If this is corrective action is taken the operator must update the system trip time which has changed.
- Performing detector maintenance
    - Cleaning or replacing the PID bulb
    - Replacing the XSD probe assembly or reactor core
- Checking and adjusting detector gas flows - especially in the FID.
- Replacing the trunkline (an old trunkline can be a source of contaminant phase buildup. This will reduce detector sensitivity by causing contaminant dispersion in the trunkline which results in reduced response levels as well as delayed trip times).

It is wise for the MIP operator to monitor the detector response heights from the chemical response tests to evaluate membrane performance. With increased membrane footage, detector response will fall off indicating that it is time to change the membrane (see Appendix III). It may be possible to rejuvenate a MIP membrane by scrubbing with a wire brush.

5.2 EC Dipole Test

On the FI6000 and the DI-Acquisition software the EC dipole test screen (Fig. 5.10) will open up after the chemical response test is completed. When ready place the low (brass) side of the EC Dipole test jig (Fig. 5.9) between the EC dipole and body of the probe and start the low level test, hold for 5 sec until the system captures the data (Fig. 5.10). Repeat for the high (stainless steel) EC test. These tests should result in readings of 55mS/m and 290mS/m ± 10%.

Figure 5.9: EC Dipole Test Jig

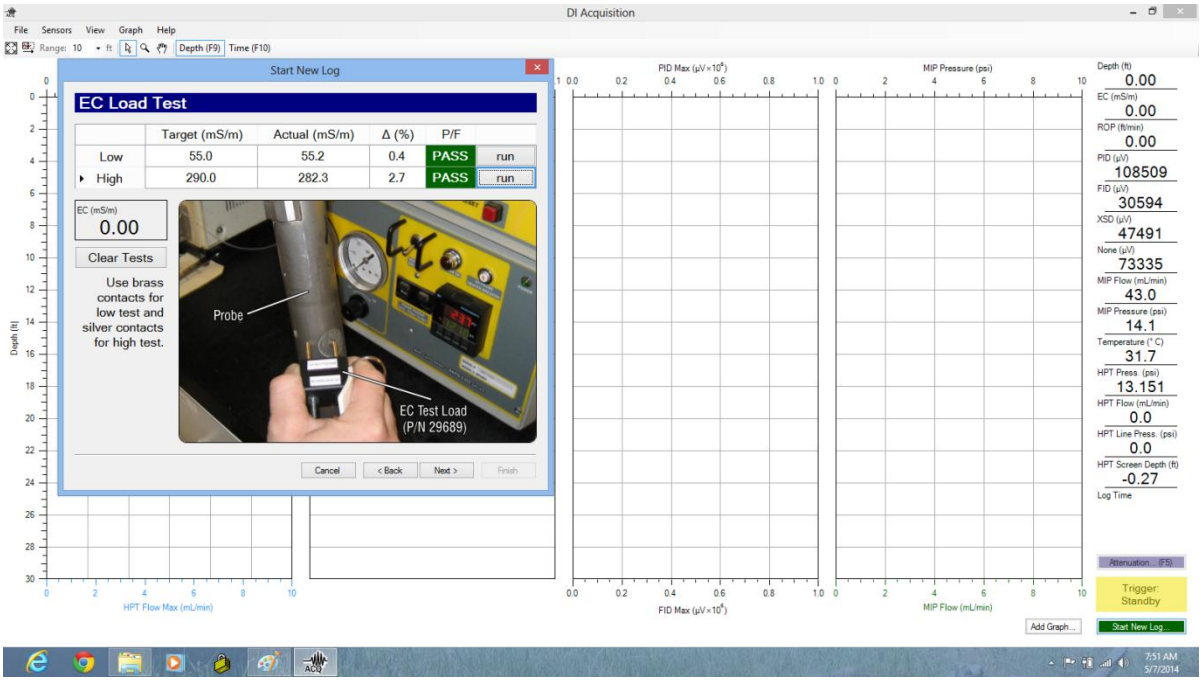


Figure 5.10: EC Dipole Test QA Screen

If the EC readings do not pass, the DI Acquisition (FI6000) software will prompt the user to proceed through a series of troubleshooting tests (Fig. 5.11). These tests will check the EC calibration (Fig. 5.12) to determine if the reason EC Test loads have failed was an issue internal to the FI6000 or if it is external in the trunkline-probe circuit. From here the operator should have an idea where to focus their attention to fix the problem.

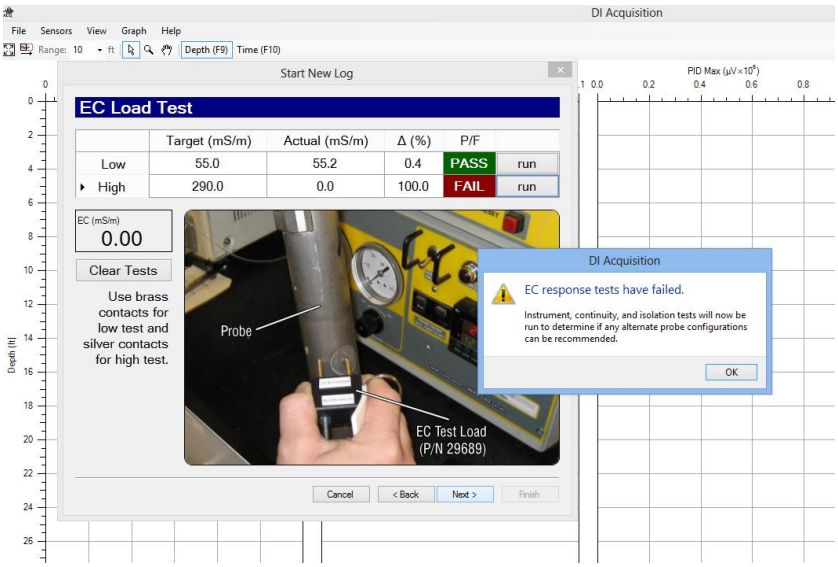


Figure 5.11: Failed EC Dipole Test Error Screen

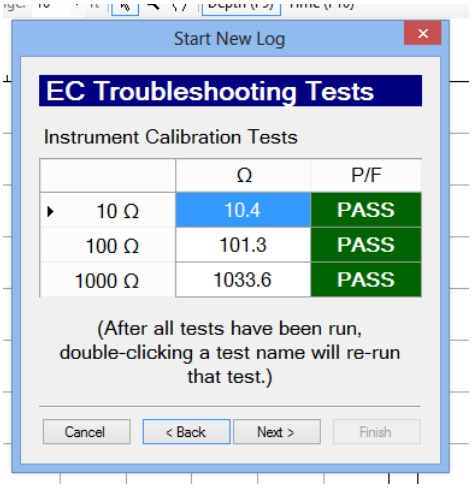


Figure 5.12: EC Calibration Check

5.3 HPT Reference Test – (MiHPT)

Reference testing is done to ensure that the HPT pressure sensor is in working order and to evaluate the condition of the HPT injection screen. The HPT reference test calculates atmospheric pressure which is required to obtain static water level readings and to determine the estimated K values for the log in our post log processing software the DI Viewer.

Reference Test Procedure

1. Connect a clean water source to the HPT controller and turn on the pump.
2. Allow water to flow through the system long enough so that no air remains in the trunkline or probe (air in the system can cause inaccurate flow and pressure measurements).
3. Insert the probe into the HPT reference tube and allow the water to flow out the valve adjusting the flow rate to between 200-300ml/min (Fig. 5.13). Ensure that the reference tube is close to vertical.
4. With a stable pressure reading and the water flowing out of the valve select “capture” - bottom with flow (Fig. 5.14)

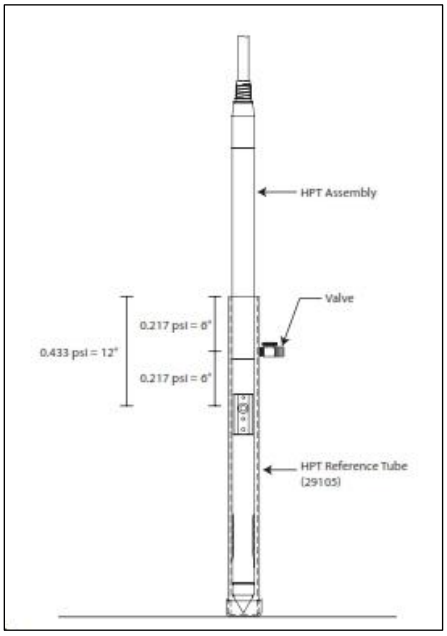


Figure 5.13: HPT Reference Test Setup

5. Close the valve and allow the water to overflow the top of the tube. When the pressure stabilizes select “capture” - top with flow.
6. Shut off the water flow. When the pressure stabilizes select “capture” - top flow = 0.
7. Open the valve and allow the water to drain out. When the pressure stabilizes select “capture” - bottom flow = 0.

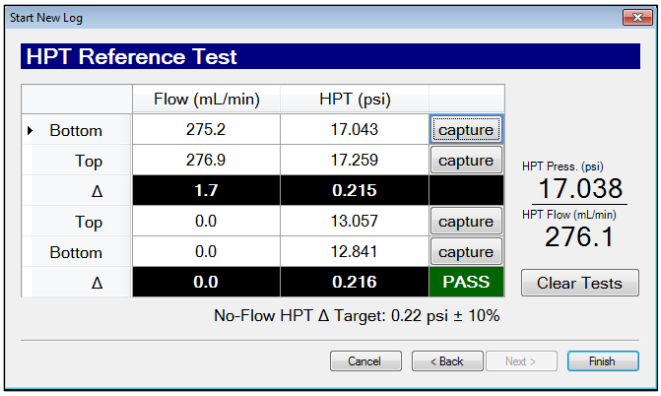


Figure 5.14: HPT Reference Test Screen

The HPT reference test reading flow = 0 is the true test of the condition of the pressure sensor and is the only sensor test to have a pass/fail reading on it. Ideally, the pressure difference between the top and bottom values will be 0.22 psi (1.52kPa). Typical pressure readings of the sensor will be in the 12PSI-15PSI (83kPa-104kPa) range.

6.0 Equipment Preparation for Site Work

The biggest issues to the performance of any specific MIP system is inadequate project preparation and system review, too heavy of a workload which reduces the ability to perform needed maintenance and inexperienced operators how do not fully understand the steps of troubleshooting.

When a MIP system is stored for a period of time between projects, operators must review the equipment and give it a full system checkup which includes checking detector gas flow rates, running response chemical response tests with known chemicals at concentrations at or near required site detection limits. This needs to be performed 1-2 weeks in advance of project work so there is time to obtain required supplies that might be needed for proper operation. A final checkout needs to be performed within 7 days of the project. If the MIP site contaminant of concern is an obscure chemical not normally tested for the operator should run some of that chemical for response tests to confirm it can be detected and to determine reasonable detection limits. The operator should be able to supply the consultant with pre-project performance data of all sensor information to be performed at the site which might include EC, MIP chemical response tests, and HPT reference test information.

If a MIP system is scheduled on a long job or has a number of jobs strung together it is in the best interest of the MIP service company to schedule a maintenance day at least every 3 weeks to allow the operator time to go through system and service the components that need attention. This will help to be able to keep to system performing well for the company and their clients. Pre project performance must still be able to be produced.

New operators will always be needed as the MIP community continues to grow, however it is imperative that operators who are running the MIP systems on their own have been properly trained by experts from their own company or at Geoprobe Systems® headquarters. An inadequately trained operator who faced difficulties onsite and does not understand the system and how to troubleshoot it will quickly bring frustration upon themselves, their company and clients. It is important that each operator is properly trained, is able to spend consistent time with the equipment and the software, and whenever possible operate of the equipment under the guidance of a mentor "MIP specialist."

7.0 MIP Field Operation

1. Power on the generator.
2. Open the gas cylinders that will be used for the MIP system (i.e. nitrogen, hydrogen, air, etc.).
3. Power on the GC and detectors and allow them to warm up (min. 20 minutes) to set temperature.
4. Power on the MIP controller, field instrument and laptop computer.
5. Check the trunkline supply and return flows of the system and MIP pressure. Compare these numbers to previous work.
6. Start the Acquisition software and start a new log.
7. Perform the chemical response test (Section 5.1.2) and record the height of the peak response and the trip time into a field notebook. Refer to Figure 5.4 and Appendix I and III.
8. Complete the EC dipole test (Section 5.3) and finish setting up the log.
9. Record the system parameters in a field notebook at this time (i.e. flow, pressure, trip time, detector baseline voltages).
10. Connect the stringpot cable to the stringpot and the stringpot wire to the weight located on the probe foot and pull keeper pin so the weight will drop to the ground.

NOTE: Do not allow the stringpot cable to snap back into the stringpot housing at a high rate of speed. This will ultimately damage the stringpot transducer.

11. Place the drive cushion onto the probing machine head.
12. Place a slotted drive cap to the MIP drive head.
13. Place the rod wiper on the ground and insert the point of the MIP probe into rod wiper opening.
14. Start the HPT water flow if running MiHPT.

    Note: It is important that there is always water flowing when the probe is moving to avoid soil particles from moving through and plugging up the screen.
15. Align the probe exactly straight and advance the probe to the starting depth: MIP membrane even with the ground surface.
16. Click the trigger button in the lower right hand corner of computer screen. (The Trigger label will flash and the background will change from yellow to green).
17. Standard advancement the probe is at a rate of 1ft/min meaning: advance 1 ft (30 cm) in 15 seconds and then hold at depth for 45 seconds, then advance to the next depth interval (1 foot) over 15 seconds and wait for 45 seconds. Do this until the predetermined log depth or until refusal is attained.

Advancement the MIP probe can be performed using a continuous push method with no stopping intervals which may be desirable in source level contamination. Data collected by this method will result in higher detection limits and is not directly comparable to data collected by the standard advancement method previously discussed.

NOTE: If the there is a loss in MIP pressure or temperature during the logging process, stop and evaluate the problem using the troubleshooting guide located in Appendix II.

NOTE: Refusal is attained when it takes longer than 1 minutes of continuous hammering to advance the probe one foot. This is the maximum time to reach one foot of probe travel.

18. Perform an HPT dissipation test (Section 7.1) in a zone of higher permeability indicated by lower HPT pressure if you are operating the MiHPT probe.
19. When the MIP log is complete, turn the trigger off and slowly return the stringpot cable into the stringpot housing.
20. Turn off the heater switch to the probe during tool string retraction so no as few contaminants as possible are diffused through the membrane and into the trunkline during retraction.
21. Raise the probe foot of the direct push machines foot assembly and place the rod wiper weldment under the foot assembly to keep it in place during rod retraction.
22. Pull the probe rod string using either the Geoprobe® rod grip pull system or a slotted pull cap.
23. When the MIP probe reaches the surface, clean the probe and membrane well with a detergent/water mix and rinse off well.
24. Now turn the probe heat back on to back off the membrane. Make sure the probe membrane and trunkline are clean of contaminants and the detector baselines are stable prior to running a post log response test. View the detector activity in the response test screen.
25. When the baselines are stable run a post log response test. These response test results should be written down in the field notes and compared to the initial test. This system check ensures the data for that log is valid.
26. When using the FI6000, the data will be saved into your designated folder on your laptop in a compact .zip file. Data from the MIP log can now be graphed and printed using the DI-Viewer software (Appendix IV).

7.1 Performing an HPT Dissipation Test

At least one dissipation test must be performed in order to calculate the static water level and estimated K readings from the HPT log. Dissipation tests need to be performed below the water table and are best in zones of high permeability where the injection pressure can dissipate off quickly once the flow is shut off. The following are the steps for running an HPT Dissipation test.

1. Stop in a zone of higher permeability which is indicated by lower HPT inject pressure.
2. Switch the DI Acquisition display view from the depth screen to the time screen by pressing the F10 key (F9 and F10 toggle between the depth and time screen of the acquisition software).

3. The screen will be grayed out which means that the data up to that point has not been saved. Select “Start Dissipation Test” which will turn the screen from gray to a white background indicating that you are now saving the time data.
   Now shut the pump switch off and when the line pressure reaches zero, turn the flow valve off.
4. The HPT Pressure will begin to drop (dissipate the hydrostatic increase) and allow it to stabilize so very little visible drop in pressure is seen. When the pressure has fully dissipated turn the flow valve and the pump switch back on. When the flow and pressure are reestablished select “End Dissipation test.”
5. Select F9 to return to the depth screen and advancing the tool into the ground.

Note: Performing a dissipation test in zones of higher permeability may only take 60 seconds or so but if the HPT pressure was higher to start with it may take a long time up to several hours to dissipate off to equilibrium. This is why targeting the most permeable zone to perform the dissipation tests is most desirable.

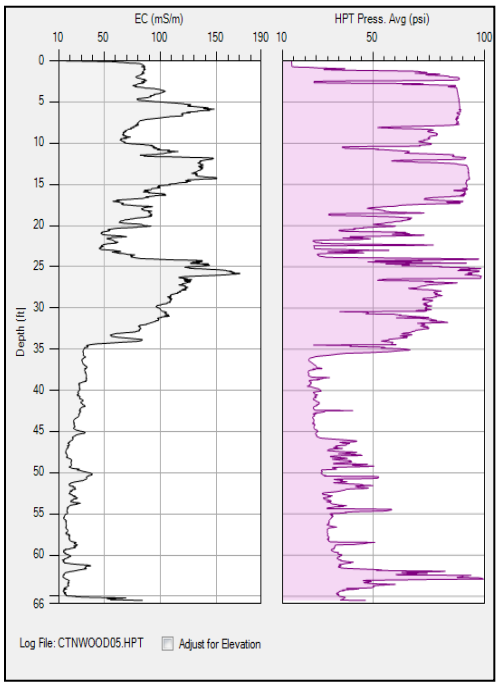


Figure 7.1: EC and HPT Pressure Graphs

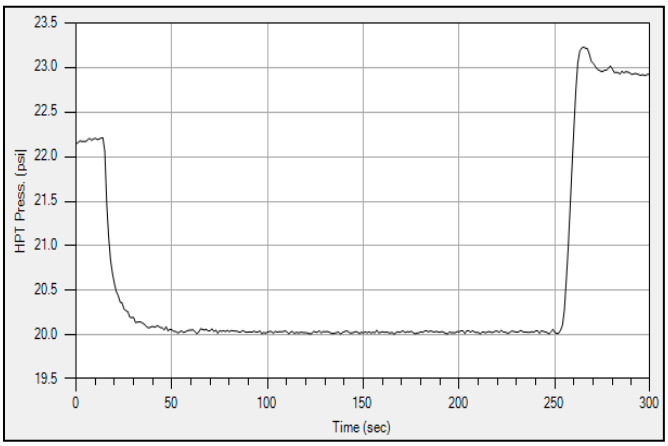


Figure 7.2: HPT Dissipation Test Screen.

The dissipation test shown in Figure 7.2 was performed in the lower pressure zones located at 39.5’ of the log shown in Figure 7.1. With HPT sands and gravels are indicated by lower injection pressure which is primarily seen below 35’ in the above log. The dissipation test in Figure 7.2 shows a higher pressure at the start of the test which falls off which is a result of shutting off the water flow. A good dissipation test will run for a period of time approximately 30-60seconds at a stabilized pressure and then turn the water flow back on during the saved log.

7.2 Detector Gain/Software Attenuation Changes

While mapping volatile contaminants with the MIP system operators commonly encounter highly contaminated/free product zones that can result in the detector signal climbing to the point of saturation or "flat lining." This occurs because the GC or detector system has a limited signal output range. What that range is varies depending upon the GC model or detector controller. Typical signal out limits for are 0-5VDC for SRI and Shimadzu GC models and 0-1VDC for HP/Agilent GCs and the OI XSD. The attenuation settings (software multipliers) for SRI and Shimadzu GCs and the XSD are based on a 10^x multiplication factor. The attenuation settings for detectors operated through an HP GC are based on a 2^x multiplication scale x = HP GC Range with the sum being the corresponding attenuation for the MIP software (Table 7.1).

As the probe is being advanced into higher concentration petroleum hydrocarbon soils the operator, if using an SRI GC, will want/need to adjust the GC gain on the PID and probably the FID from a gain setting of high to medium which takes those detector signals and divides them by a factor of 10 (Table 7.1). This reduction in the signal can be seen in the software both in the digital display as well as on the time graph. After the signal has been reduced the operator will need to select the attenuation tab/F5 in the DI Acquisition software and input a 10x multiplier in for the PID and the FID if both gain switches were changes to the medium setting.

If the operator chooses to go back to the highest sensitivity on those detectors after passing through the high contamination zone they need to first remove the multiplier in the software (F5) and then change the gain setting from medium to high on the GC – removing the signal divider. If either of these is performed in reverse fashion the log will see a very larger false positive peak because the signal is multiplied up without having a signal divider in place. The operator always wants to add the signal divider in first as they go into higher reading soils and remove it last as they come out of them.

Gain/Attenuation Settings on the GC detectors and the DI Acquisition software

HP GC* Range	DI Acq. Attenuation		SRI GC Gain	XSD Gain	DI Acq. Attenuation
0	1		High	High	1
1	2		Medium	Medium	10
2	4		Low	Low	100
3	8				

Table 7.1: GC gain/range settings and associated software multipliers.

*- The detectors on the HP GC can have attenuation settings up to a range of 7 on the GC corresponding to an acquisition software multiplication value of 128.

8.0 Replacing a Membrane on the MIP Probe

A probe membrane is considered in good working condition as long as two requirements are met:

1. Adequate signal response is achieved during the chemical response tests to see the required detection limits.
2. The difference between the supply and return flow has not increased by more than 3mL/min from the original settings. (A digital or bubble flow meter should be kept with the system at all times).

If either one of these requirements are not met, a new membrane must be installed as follows.

1. Turn the heater off and allow the block to cool to less than 50° C on the control panel readout.
2. Clean the entire heating block with water and a clean rag to remove any debris.
3. Dry the block completely before proceeding.
4. Remove the membrane using the membrane wrench (Fig. 8.1). Keep the wrench parallel to the probe while removing the membrane to ensure proper engagement with socket head cap screw.

NOTE: Do <u>not</u> leave the membrane cavity open for extended periods. Debris can become lodged in the gas openings in the plug.

5. Remove and discard the copper washer as shown in Figure 8.2. Each new membrane is accompanied by a new copper washer. **Do not reuse the copper washer**.
6. Clean the inside of the membrane socket with a q-tip and methanol removing dirt and debris that will be present.
7. Insert the new copper washer around the brass plug making sure that it sits flat on the surface of the block.
8. Install the new membrane by threading it into the socket. Thread the membrane into the socket by hand, do not use the membrane wrench until the membrane is nearly all the way threaded. Use the membrane wrench to tighten the membrane to a snug fit. Do not over-tighten.
9. Turn the carrier gas on and leave the heater off. Apply soapy water to the membrane and surrounding area to check for leaks. If bubbles form in the water around the edges of the membrane or in the wrench holes use the membrane wrench to further tighten the membrane.
10. Use a flow meter to check carrier flow. The difference between the supply flow from the MP6505 and the return flow from the trunkline should be less than 3ml/min. Record the values in a field notebook.

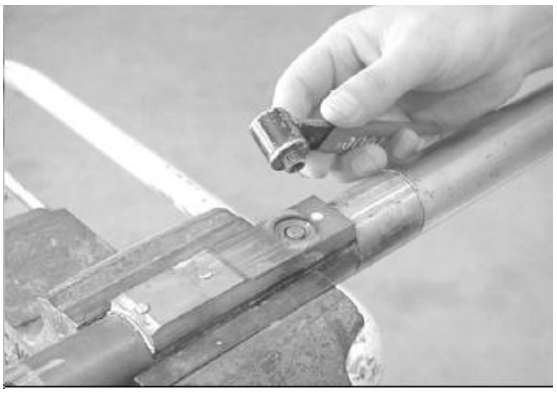
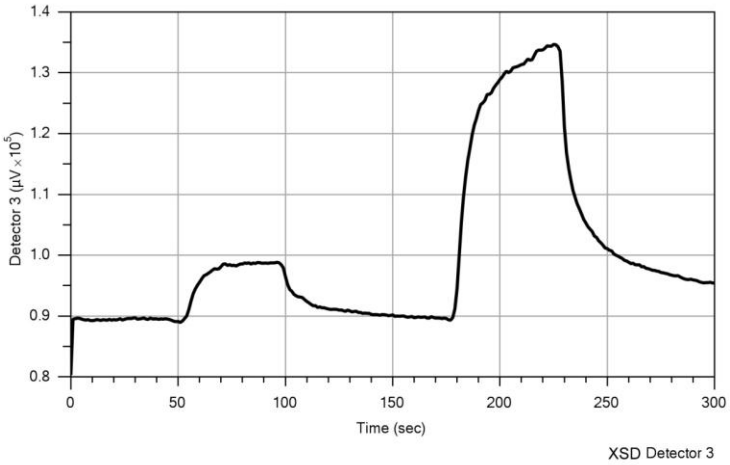


Figure 8.1: Unthread the membrane from the probe block.

Figure 8.2: Remove and discard the copper washer.

APPENDIX I

Typical Response Test Data

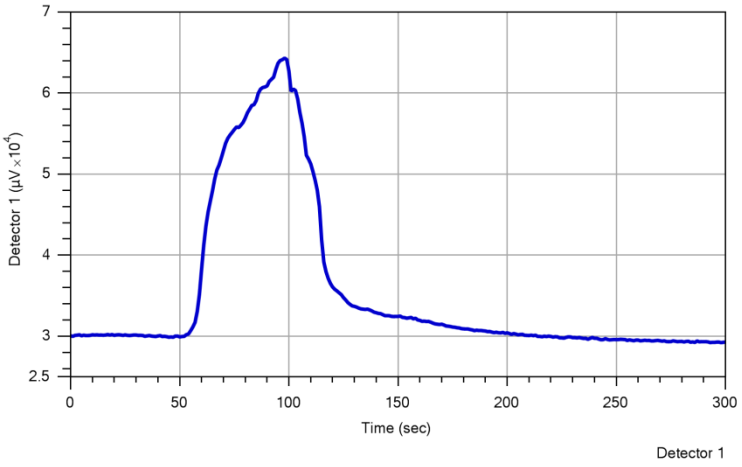


System Parameters:

MP6520 Probe with 121°C setpoint
150' PEEK Trunkline
40ml/min of Nitrogen Carrier Gas
XSD Temperature of 1,100°C

System Response:
1ppm – 9,000µV
5ppm- 45,000µV

Figure 1: Chemical Response Test: TCE 1 & 5ppm on XSD



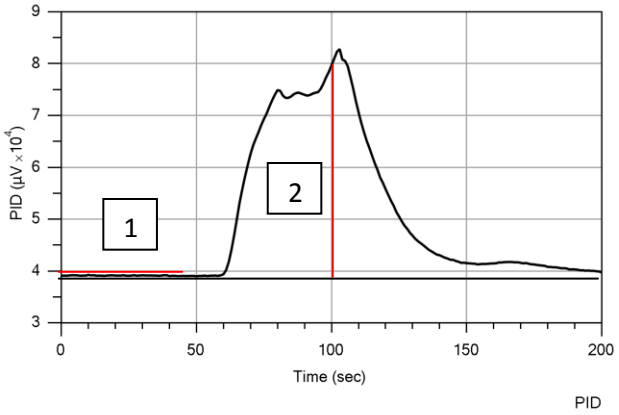
System Parameters:

MP6520 Probe with 121°C setpoint
150' PEEK Trunkline
40ml/min of Nitrogen Carrier Gas
PID Lamp intensity

System Response: 5ppm- 35,000µV

7,000µV/1ppm

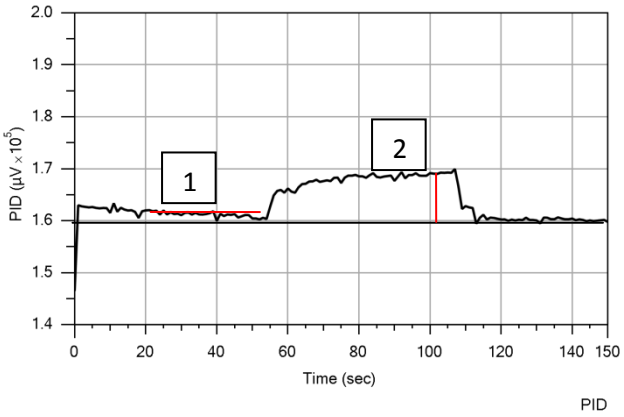
Figure 2: Chemical Response Test: Benzene 5ppm on PID



Response test - PID	5ppm Benzene
Response magnitude (2)	~40,000µV
Response/1ppm	~8,000µV
Baseline noise (1)	<500µV

Parameters: 150'TL/40ml/min flow/12PSI

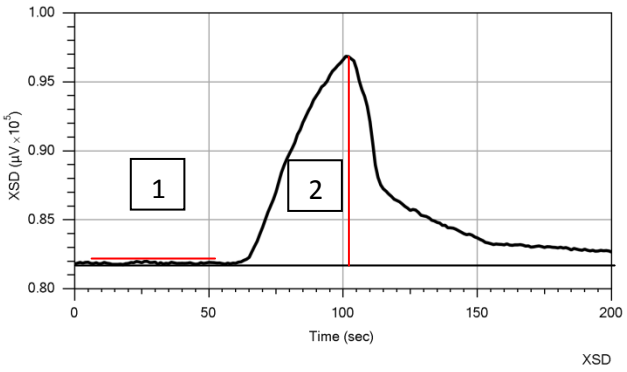
Acceptable response test. Response to baseline noise ratio is >5:1 at 1ppm



Response test - PID	1ppm Benzene
Response magnitude (2)	~8,000µV
Baseline noise (1)	~2,000µV

Parameters: 150'TL/39ml/min flow/12PSI

Not Acceptable response test
Response to baseline noise ratio is <5:1 for 1ppm Benzene
Quick Fix: Lowering carrier flow rate to 25-30ml/min will improve signal response 50% or more.



Response test - XSD	2.5ppm TCE
Response magnitude	15,000µV
Response/1ppm	6,000µV
Baseline noise	<300µV

Parameters: 150'TL/40ml/min flow/11.4PSI
Acceptable response test, Response to baseline noise ratio >5:1 for 1ppm TCE

1. Baseline noise is the amount of variation in baseline signal over a given time.
2. Signal response is the amount of rise in baseline over the stable baseline level.

APPENDIX II

Troubleshooting Guide

Loss of Pressure 1-2 PSI

- If the pressure loss has been gradual, and your MIP controller has a flow sensor check to see if the MIP supply flow has gradually dropped over the course of the log. This can happen due to the control box warming up and will be indicated by a gradual drop of both MIP pressure and flow. To resolve this increase the mass flow controller to bring the supply flow back to its original set point.
- Punctured membrane: Are there any obvious holes in the membrane with bubbles streaming out of them? Replace membrane.
- Membrane leaking out of the face – heavy frothing of bubbles on membrane face but no obvious punctures in membrane. **With the heat off**, place your thumb over the membrane**,** if the pressure goes back up to the gas pressure prior to the boring the pressure and flow loss is due to a leak in at the membrane face. Replace the membrane.
- Swagelok fitting connecting one of the trunkline gas lines to stainless steel gas line of the probe is loose. Check with soapy water, if bubbles build, fix by slowly tighten the gas line 1/16" nut to the probe.
- Examine for cuts, kinks & cracks in the length of the observable gas line. Expect to see bubbling when MEOH or soapy water is placed on it. Cut gas line prior to this and replace nut and ferrule and reconnect onto the probes steel gas line connection.
- Broken gas line somewhere else up the trunkline. Confirmed when trunkline connections are removed from the probe and close coupled. The carrier gas supply and return should be within 2ml/min, if it is >5ml/min first check with soapy water at the connecting nuts and exposed gas line then look for cuts in throughout the trunkline and see if they will show bubbles with soapy water placed on them. If this is seen you will likely need to change the trunkline.

Loss of Pressure >5 PSI

- Large puncture in membrane. Either visible puncture or observable streaming bubble when soapy water or methanol placed on membrane. Replace membrane.
- Loosen the 1/16" Swagelok nut on gas line. Check and carefully tighten.
- Broken gas line in the probe. Compare the supply versus return flow values (should $\leq$ 2/ml/min) of trunkline connected with the probe and with a close coupled trunkline. If close coupled supply/return flow is good but connected to the probe shows a big leak, there is a break is in the probe. This may be seen with soapy water placed on the edges of the heater block or on the top of the probe where the connections come out. If this produces bubbles it confirms a broken internal line or connection point. Replace the probe.

DI Acquisition - Flash Warnings:

The DI acquisition system, operated with the FI6000 field instrument, will flash a large warning screen – MIP pressure out of Range - to the operator if the probe pressure (PSI) changes over 1 PSI from the initial starting MIP pressure of the log. This alerts the operator that something in the system has changed and the operator can take the necessary precautions for a punctured membrane, broken gasline or a plug in the system.

Increase in Pressure (clearing a blockage)

- After setting the mass flow, an increase of more than 3 PSI over the original set pressure indicates a potential blockage, especially if you can verify that the pressure first dropped a 2-5 PSI prior to rising toward 20PSI.
  - Shut off the Nitrogen carrier gas flow ASAP. Do this by turning off the black regulator knob on the MIP controller or removing the carrier gas supply line from the breakout panel or the back of the MIP controller.
  - Remove the tools from the ground.
  - Look for a hole in the membrane and water or dirt got into the up-hole gas line just behind the membrane.
  - Remove connection tube and membrane.
  - Remove the trunkline gas lines from the top of the probe. Take note of which one had the gas flow coming out because this is the line that will be plugged.
  - Look for any obvious particles in either holes behind the membrane or in the gas line at the top of the probe. If any are evident attempt to remove them.
  - Take the return gas line at the surface and connect it to the supply gas connection on the breakout panel or on the back of the MIP controller.
  - Place the probe end of this line into a jar of methanol to see if the line is clear which is evident by streaming bubbles. If there are no bubbles, increase the flow to try to expel the blockage. If this does not work you may need to cut back the trunkline.
  - To clear out the probe take a 5 ml plastic syringe (or a 3 foot section of Teflon/PEEK gas line will work) filled with methanol and attempt to inject through the plugged gas line at the top of the probe. If it clears it will shoot the methanol in an arcing stream out one of the ports in the plug that sits behind the membrane.
  - The probe must be dried of the methanol which can be accelerated by heating the probe. Don't reconnect the trunkline to the detectors until you are sure the blockage is clear and the methanol is out of the system.
  - If the blockage cannot be cleared a new probe or trunkline will need to be connected.

Blinking Temperature Light

- If the temperature light on the MP6505 begins blinking in an unreadable number, it means that there is an open thermocouple in the system.
  - To complete the log in progress, replace the thermocouple for the trunkline with a thermocouple wire and twist-tie the wires together. This will fool the system to thinking there is continuity of the thermocouple wire and allow you to finish a log. The probe will continually heat set up this way and if left on when out of the ground it will overheat. When the log is complete remove the tricked thermocouple and remove tools from the ground.

- When you have the probe out of the ground, replace the thermocouple as follows.
  - Remove the connection tube from the probe.
  - Check the crimp connections of the thermocouple wires from the trunkline to the probe.
    - If one of the crimp connections has broken then strip back the wire on both sides of the thermocouple – probe and trunkline ends and reconnect in a new crimp connection and see if the probe temperature comes back.
    - If the thermocouple connection is good, the thermocouple wire in the probe has likely broken. Cut off the crimp connections of the thermocouple wires between the probe and the trunkline Check the resistance between the red and yellow thermocouple wires coming out of the probe. A resistance reading of approximately 40ohms indicates that the thermocouple is good reconnect. If they are open (O.L.) or mega ohms then the leads are broken on the thermocouple. Replace the thermocouple.
- To check the trunkline thermocouple wires, measure each wire from top to bottom. The resistances will be different between the two colored wires but should be somewhere approximately 50 ohms – 150ohms for the length of the trunkline. The resistances will also increase with an increase in trunkline length.
  - If they are open (no resistance) then there is a break in the trunkline. Replace the trunkline.

Blinking temperature readout or
Spiking in the Pressure and/or Temperature Data

- If spikes show up in the temperature or pressure data especially when related to hammer strikes it is likely an intermittent break in the thermocouple connection. Spiking of the temperature may reach single point readings of 250^{o}C in the data but may not be visible when watching the temperature display on the MIP controller.
  - When you check the resistance between the two thermocouple wires they may check out at approximately 40 ohms, however there likely is an intermittent break in the wire.
  - Replacing the thermocouple should eliminate the pressure and temperature data spikes.

Probe Not Reaching Temperature

- If the heater light is on but the temperature seems low (<100^{o}C with a set point of 120^{o}C) a heater may have broken in the probe.
  - Check the resistance of the heater wires.
    - If a heater is broken the resistance will be over 40 ohms. The probe needs to be replaced.
    - Two good heaters will read approximately 22 ohms on the MP6520, MP8520 and MK6530.
      - Check to see if the thermocouple has pulled of few inches out of the probe.
        - If the thermocouple duct has broken and pulled back away from the probe, the probe will need to be replaced and rebuilt.
        - A thermocouple can unscrew and vibrated loose out of the thermocouple duct connection if it is not secured with shrink tubing or electrical tape. Reseated back into the leur-lock connection and secure. When the thermocouple pulls away from the probe it measures the probe temperature in the wrong location.

Flash Warning:

The DI acquisition system, operated with the FI6000 field instrument, will flash a large warning screen – Temperature out of Range - to the operator if the temperature goes outside of a set range from the setpoint temperature of 121^{o}C. This alerts the operator that something in the system has failed and the operator can take the necessary precautions for a broken probe heater or thermocouple problem.

System explanations and warnings

MIP Flow

MIP flow is the carrier gas flow set by the MIP controller. This flow is supplying carrier gas to the trunkline and probe and is typically set to approximately 42ml/min. This parameter may be monitored by the DI-Acquisition system if the operator has the necessary components in their MIP Controller. The return flow, or Flow-R, is the flow coming back to the GC up the return gas line. Flow-S and Flow-R should be within 3-4ml/min and are usually much closer.

MIP Pressure

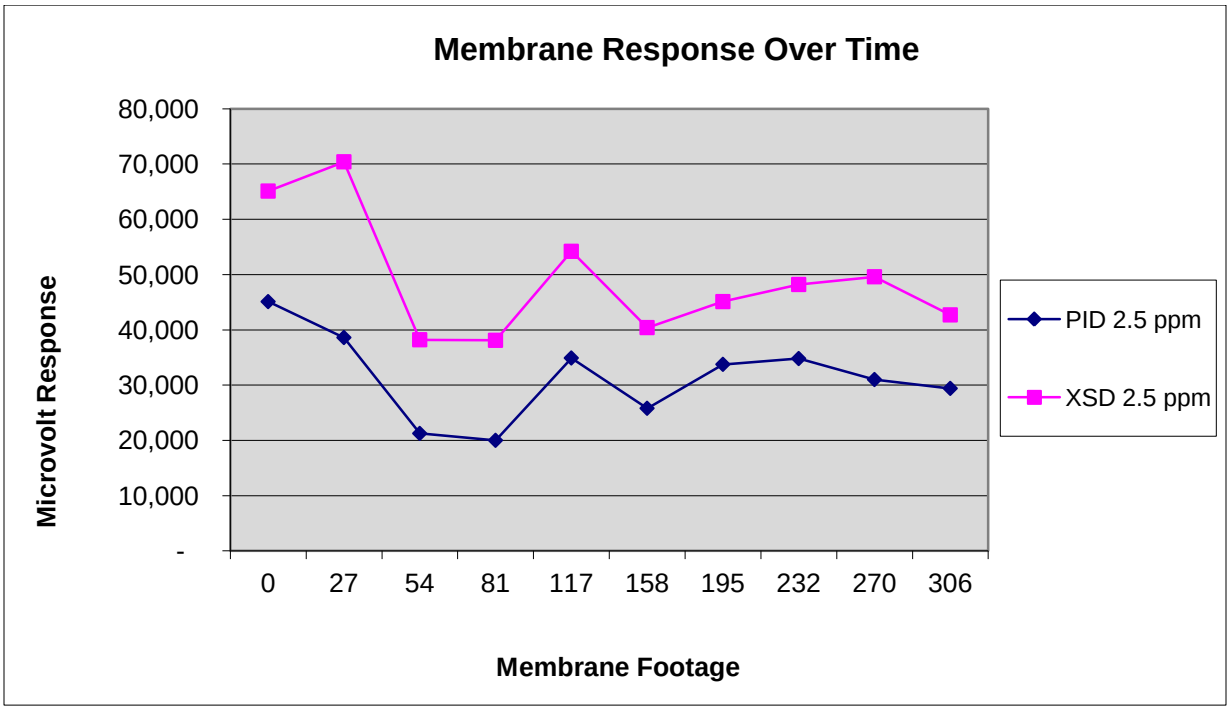
The MIP pressure is the back pressure of the carrier gas as it moves through the trunkline and probe. This is monitored digitally on the DI-Acquisition screen as well as by an analog pressure gauge on the front of the MIP controller. The MIP pressure is directly related to the MIP return flow (Flow-R) and the length of the trunkline. If the MIP pressure falls, the return flow has also dropped, if the MIP flow (Flow-S) has remained the same then there is likely a punctured membrane of problem with the gas lines.

APPENDIX III

Membrane Performance Control Charts

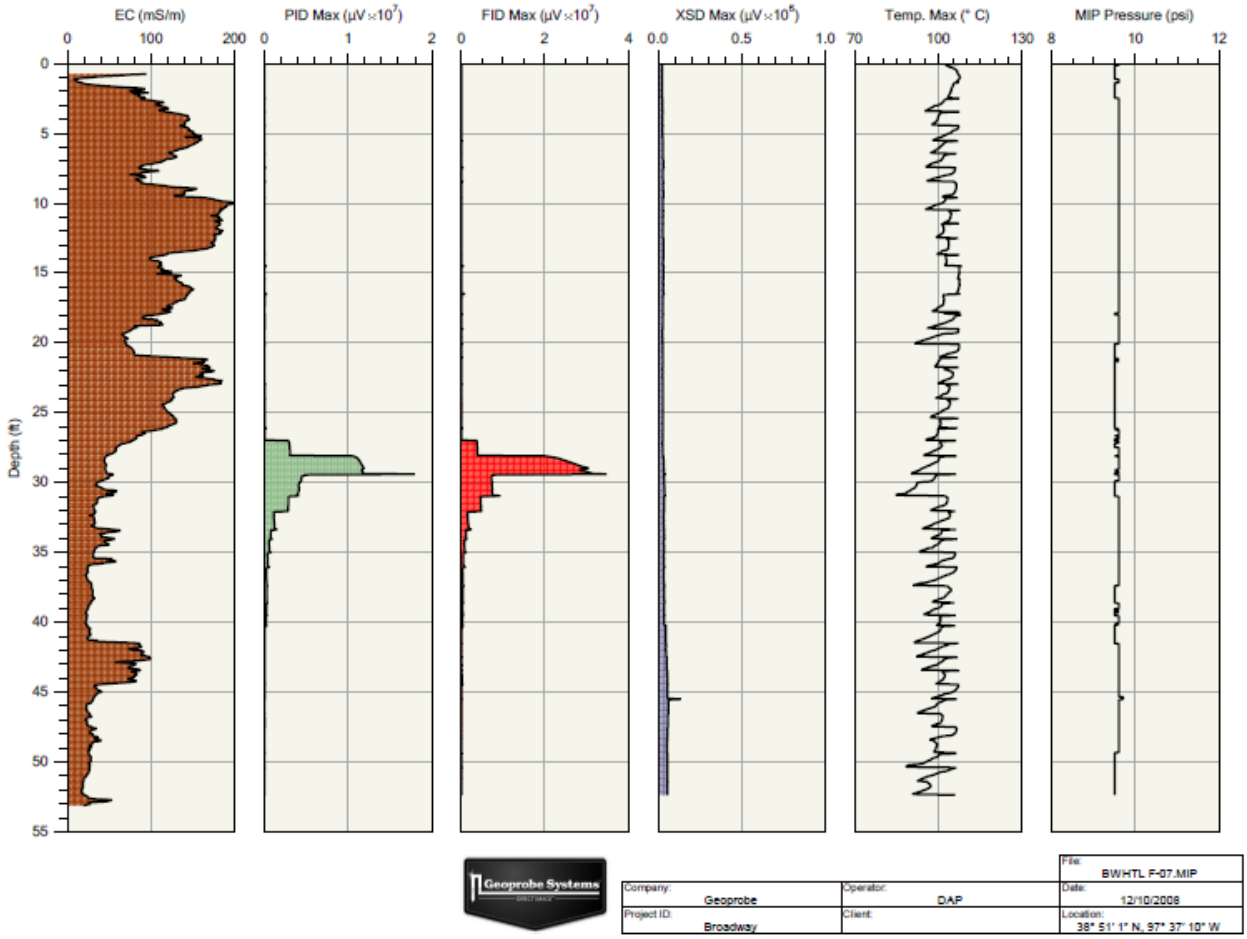
Response Tests using TCE

Pre/Post Log Response Test	Log ID:	PID Response 2.5ppm	XSD Response 2.5ppm	Log Footage	Membrane Footage
Pre-Log	MIP01	45,100	65,100	27	0
Pre-Log	MIP02	38,600	70,400	27	27
Pre-Log	MIP03	21,250	38,200	27	54
Pre-Log	MIP04	20,000	38,100	36	81
Pre-Log	MIP05	34,900	54,200	41	117
Pre-Log	MIP06	25,800	40,400	37	158
Pre-Log	MIP07	33.750	45,100	37	195
Pre-Log	MIP08	34,800	48,200	37	232
Pre-Log	MIP09	31,000	49,600	36	270
Post-Log	MIP09	29,400	42,700		306



APPENDIX IV

Sample Logs and Interpretation



Here is a MIP log with the graphs left to right: electrical conductivity, detectors (PID, FID and XSD), probe temperature and trunkline carrier gas pressure.

The above log shows contamination from 27ft to 33ft bgs. The main detector response is on the PID and FID with minimal response on the XSD (Halogen Specific Detector). This indicates that the main contaminant would not contain halogenated (Cl-, Br-, Fl-) atoms, but would likely be hydrocarbon based. The contaminants are present in the lower electrical conductivity formations which typically indicate courser grained formations of higher permeability. The temperature deflections of the MIP block heater are indicative of the probe heat cycling and the trunkline carrier gas maintains a constant stable pressure which indicates no leak or plug issues occurred with the gas line or membrane during the log.

Detector Interpretation

Standard MIP systems are able to identify compound families and determine general compound classes. The identification of individual compounds is not possible. Standard MIP systems have a continuous carrier gas flow that is brought to the detectors from the down-hole probe. To be able to effectively speciate (determine specific contaminant chemicals) the operator would need a highly modified system in place. The carrier gas stream would need to be run through a mass spectrometer or trapped and run a secondary GC onsite.

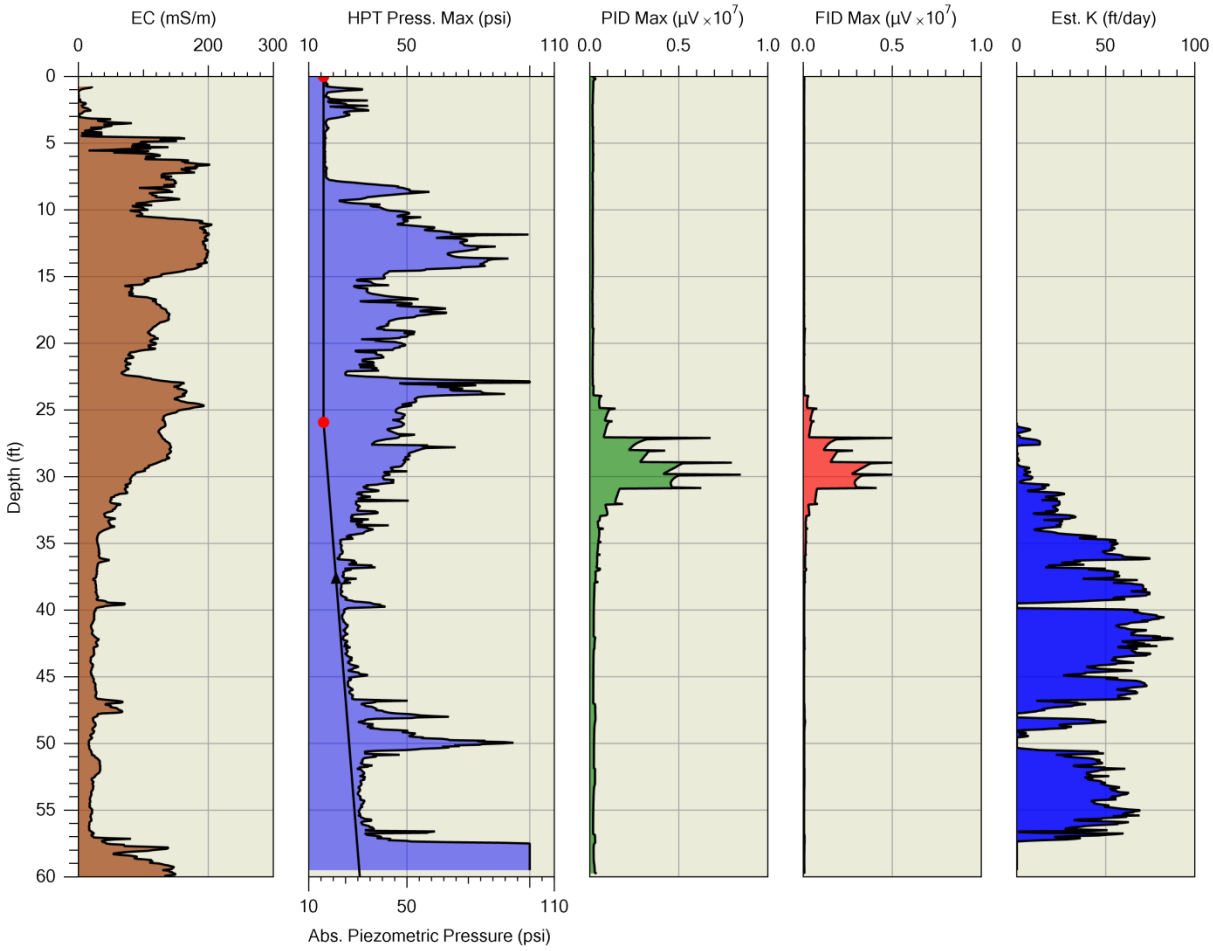
Typical standard MIP configurations use 3 gas phase detectors: a photo-ionization detector (PID), flame-ionization (FID) and a halogen specific detector (XSD). The PID responds to compounds which have an ionization potential $\leq$ electron voltage of the PID bulb. These compounds include both chlorinated and non-chlorinated hydrocarbons. A typical PID bulb has a 10.6eV lamp. The FID will respond when organic compounds (anything containing carbon) are present in the carrier gas stream in high enough concentration burn up in the flame which increases the flames ionization voltage. The XSD responds only to halogenated compounds which are made up of chlorinated (most typical halogen environmental contaminant), brominated and fluorinated compounds. Based upon which detector or detector series a contaminant responds on, we can determine if the contaminants are halogenated or petroleum based.

Petroleum hydrocarbons will respond on the PID and FID but not on the XSD. Fresh gasoline primarily contains aromatic hydrocarbons such as benzene, toluene, ethyl benzene and xylenes, which respond strongly on a photo-ionization detector (PID) and not so well on the FID. As gasoline breaks down or weathers the molecular structure changes from primarily aromatic to mainly straight chain hydrocarbons (single bonded hydrocarbons). Straight chain hydrocarbons typically do not show up on the PID do having a higher ionization potential but will respond on a flame ionization detector (FID). Weathered petroleum will still have a decent signal on the PID but may show a stronger FID signal.

Chlorinated compounds such as trichloroethylene and perchloroethylene are detected by the XSD and PID and respond in a similar profile. This is typical of the common double bonded chlorinated compounds seen in the subsurface which have an ionization potential that the PID can see. Chlorinated compounds without multiple bonds such as chloroform, methylene chloride and 1,1,1,-trichloroethane have an ionization potential higher than the PID electron voltage which results in a solid response on the XSD but will not show up on the PID.

The only sure way of determining contaminant concentration from MIP responses is to take confirmation soil and/or groundwater samples for laboratory analysis. After obtaining the results the actual concentrations can be compared to the MIP detector responses and concentrations may be estimated across the site.

MiHPT Log Example– Combined MIP & HPT



The addition of the HPT sensor to the MIP detectors and EC has provided valuable information to the subsurface lithogy encountered by the MIP operator. The above log shows graphs left to right: electrical conductivity, HPT injection pressure with the absolute piezometric pressure profile on the secondary axis, detectors (PID and FID) and estimated hydraulic conductivity (K).

The above log shows contamination from 24ft to 31ft bgs both on the PID & FID at similar magnitudes which is likely from petroleum hydrocarbons but without showing the XSD we cannot tell for sure that there are no halogenated (Cl-, Br-, Fl-) compounds present. The contaminants are present in the higher electrical conductivity and HPT pressure formations which indicate finer grained formations of lower permeability. The second graph with the Absolute Peizometric profile graph has a triangle on the increasing line at approximately 37 feet which indicates that an HPT dissipation test was performed at that depth. By taking the hydrostatic pressure at that interval and subtracting off the weight of water (0.445psi/ft) until the atmospheric pressure (calculated in the pre log HPT reference test) we can see the static water table is approximately 26 feet indicated by the red dot. Estimated hydraulic conductivity (K) is shown as the final graph which is a relationship between HPT injection pressure and HPT flow.

APPENDIX V

GC1000 Configuration and Operating Parameters

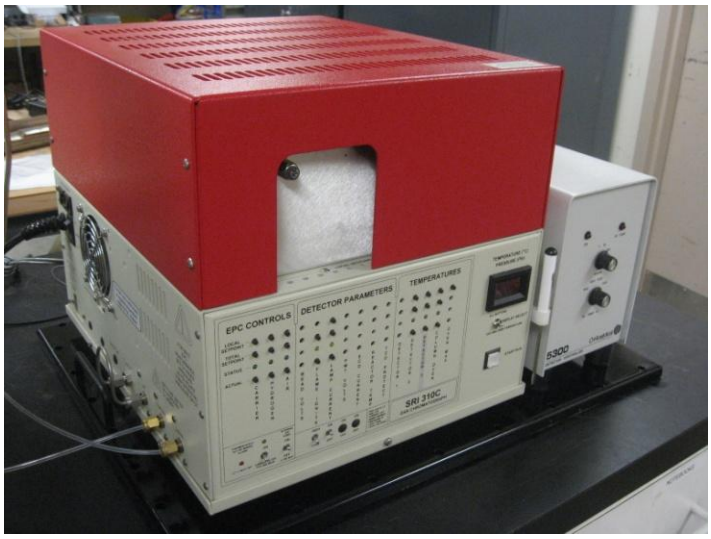


Figure 1: GC1000: SRI 310GC with XSD Controller

GC1000 Configuration

SRI310 GC with PID, FID & OI Analytical XSD
(all standalone detectors)

Flows:

TL Carrier (N_2): 40ml/min
Detector split 60:40 – 24ml/min-XSD
16ml/min-FID

Nafion Dryer (installed in GC Oven)
80ml/min (2x carrier flow rate)

A built in air compressor is split underneath the GC between the XSD & FID. The XSD & FID air supply is controlled through the GC air pressure screw control on front of GC and with different air line sizes and lengths to provide 250ml/min to the FID and 30 ml/min to the XSD.

Detectors front of GC to back: XSD, FID & PID

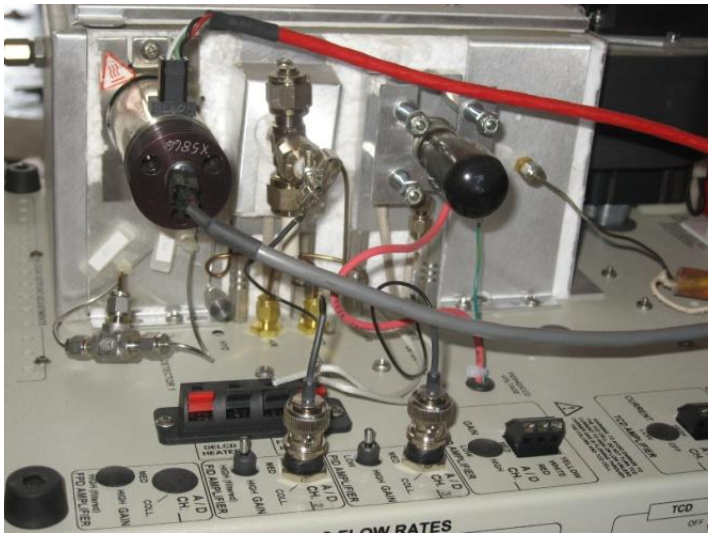


Figure 2: GC Detectors – left to right - XSD, FID, PID

SRI 310 GC Detector 1 position – XSD
(not controlled by GC)

SRI 310 GC Detector 2 position – FID

SRI 310 GC Detector 3 position – PID

Nafion dryer installed inside GC oven

GC Oven set to 85°C – 130°C max temp.

Flow comes into the GC oven via a 1/16" bulkhead fitting located in the 4th detector position furthest back (upper right inside oven) behind the PID detector. The trunkline will connect to this bulkhead and a 1/16" stainless steel line transports flow into the Nafion dryer. Silco steel takes this to the PID lamp which is inserted up to the lamp and backed off a 1/16" and tightened. A 1/16" stainless steel line brings it back into the GC oven where it is split between the FID and XSD and sent to them via a silco-steel line to the XSD and a stainless steel line to the FID.

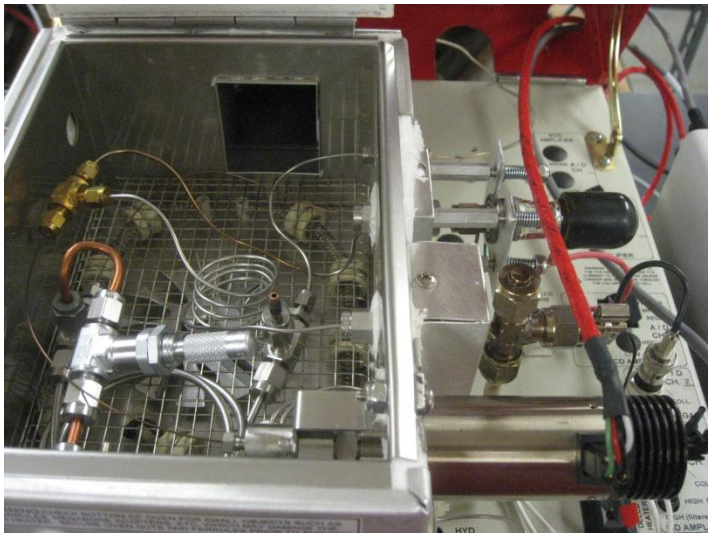


Figure 3: GC Oven Configuration

Detector Operating Parameters:

PID:

- MIP Carrier Flow (N_2) – 100% - 40ml/min
- Carrier return back into oven split between XSD & FID
- Detector Temperature setting – 150°C
- PID current 70 (0.70ma)

FID:

- Carrier N_2 MIP effluent – 40% - 16ml/min
- Hydrogen – 25ml/min
- AIR – 250ml/min
- Detector Temperature setting – 250°C
- FID igniter set at -600 (6.0V)

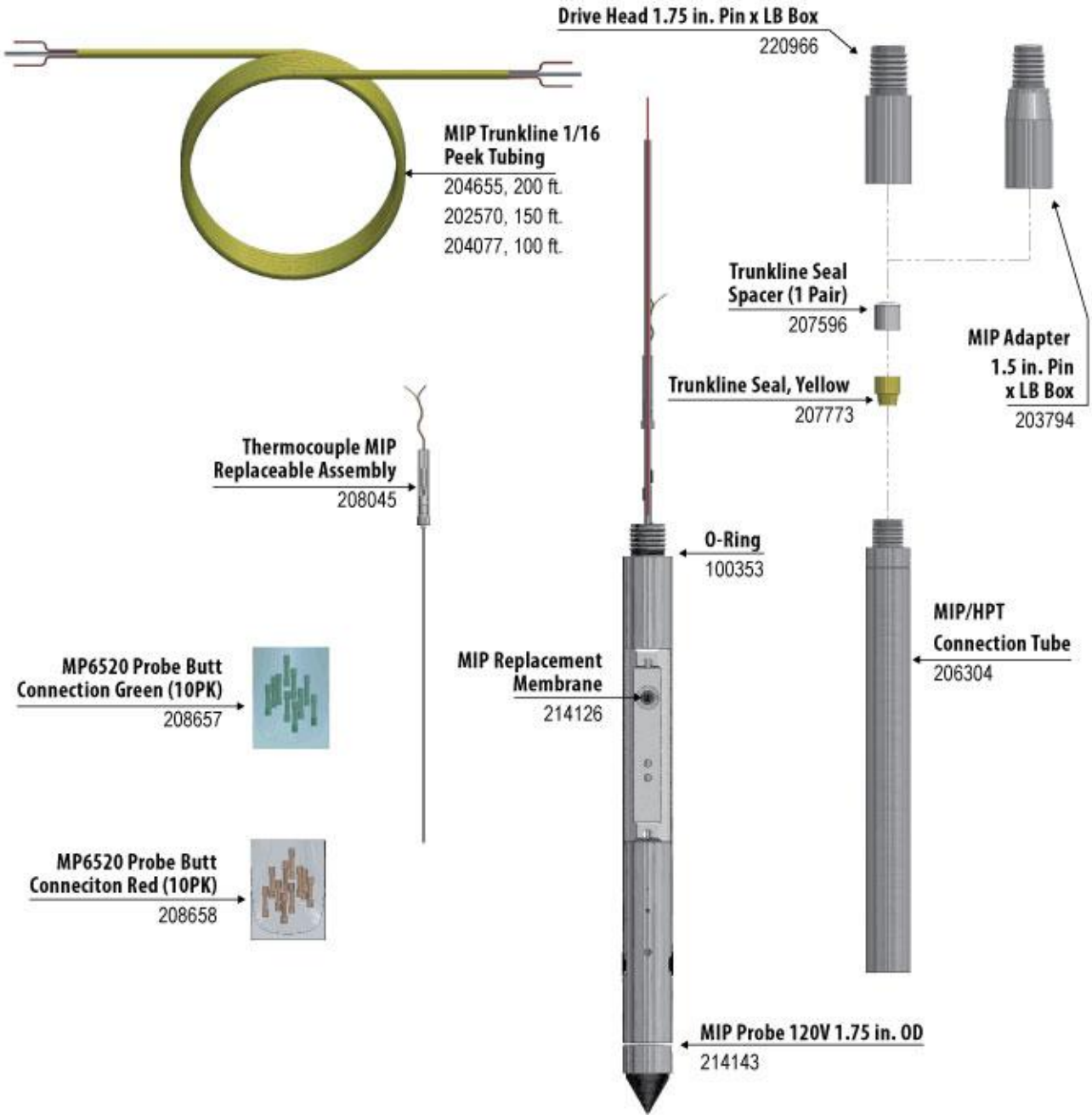
XSD:

- Carrier N_2 MIP effluent – 60% - 24ml/min
- Air – 30ml/min (split 50:50 wall & jet input of XSD)
- Detector Temperature setting – 1,100°C

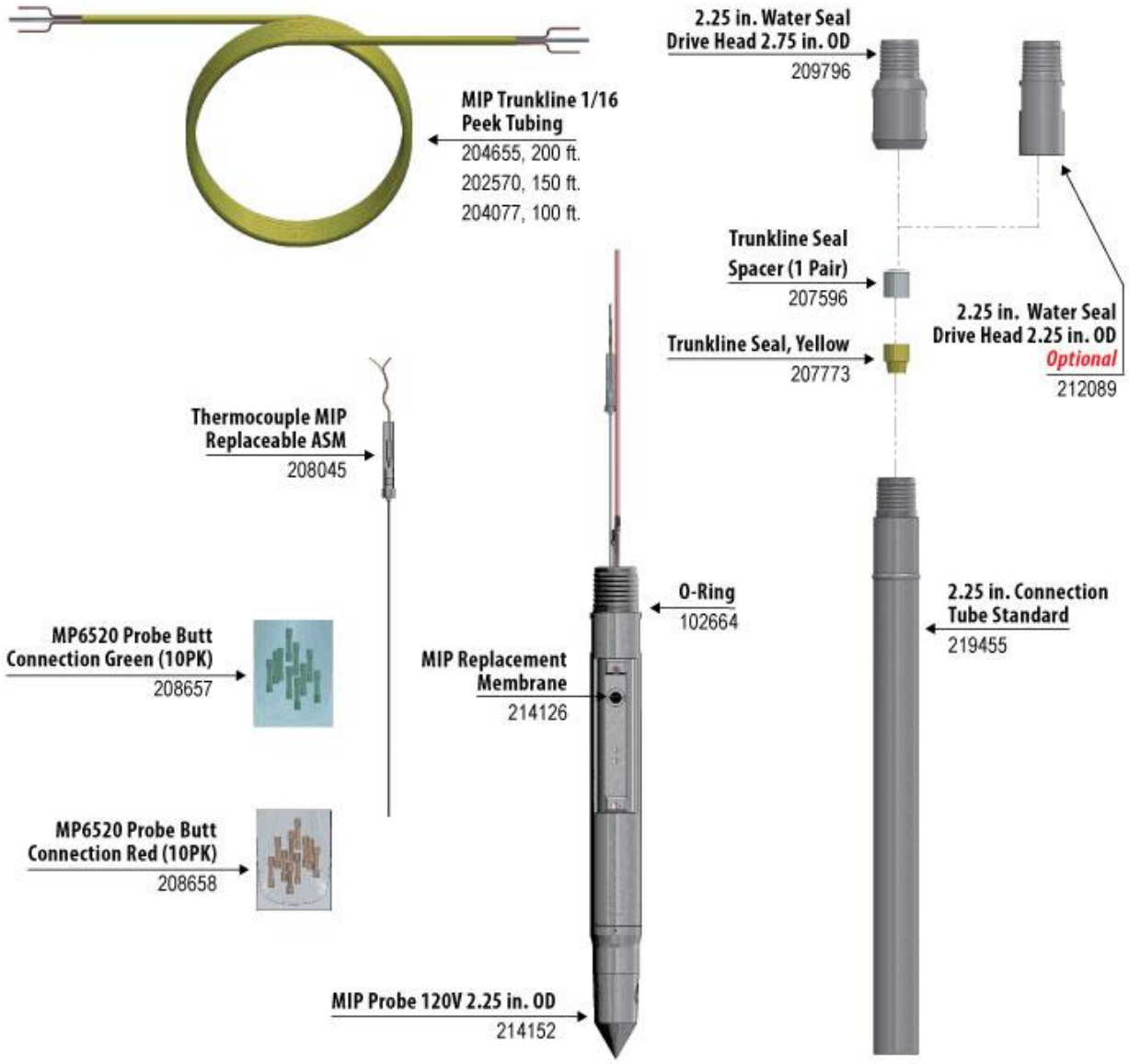
APPENDIX VI

MIP Tool Configurations

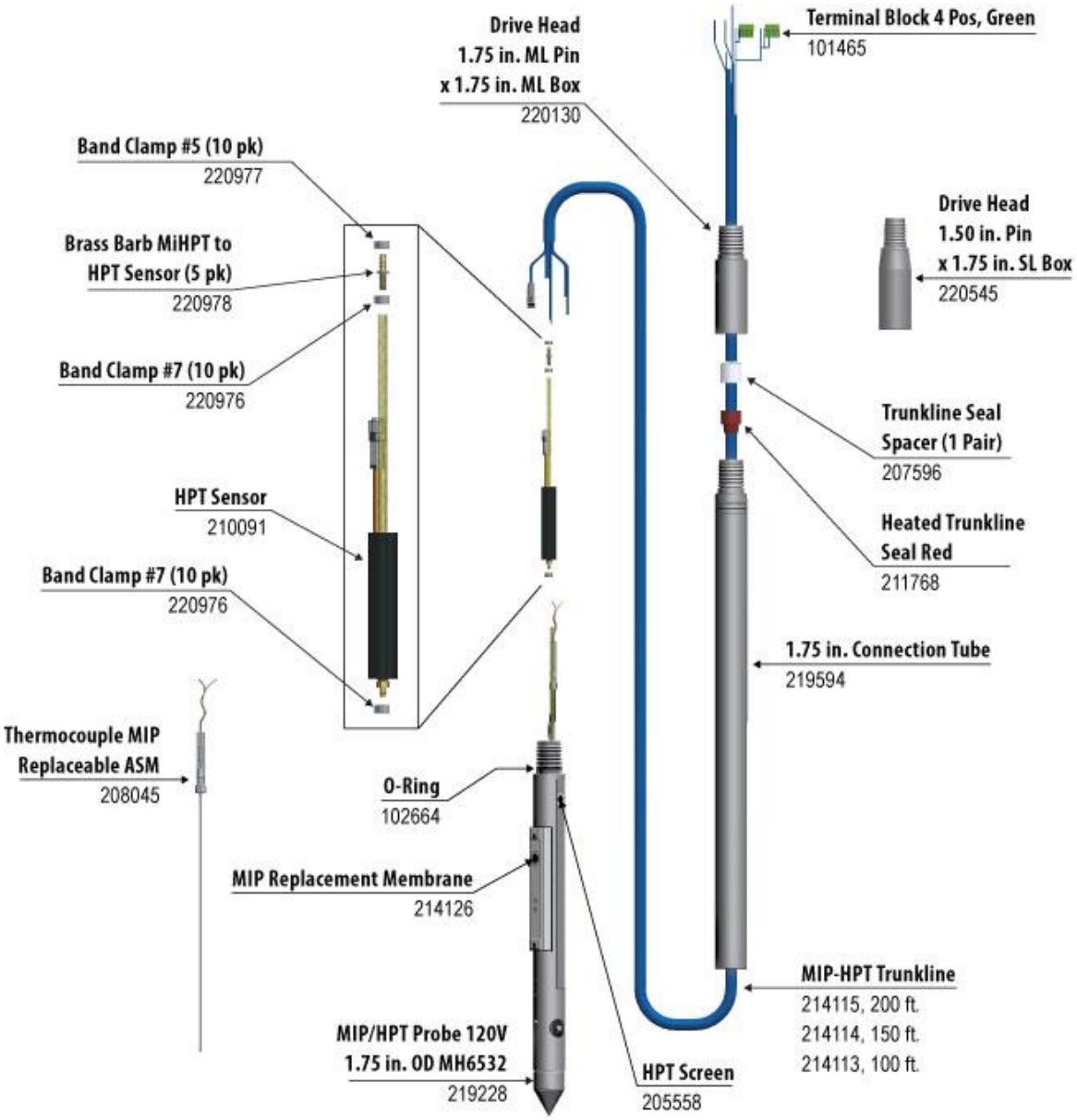
MIP - MP6520 (1.5 in. / 1.75 in. system)



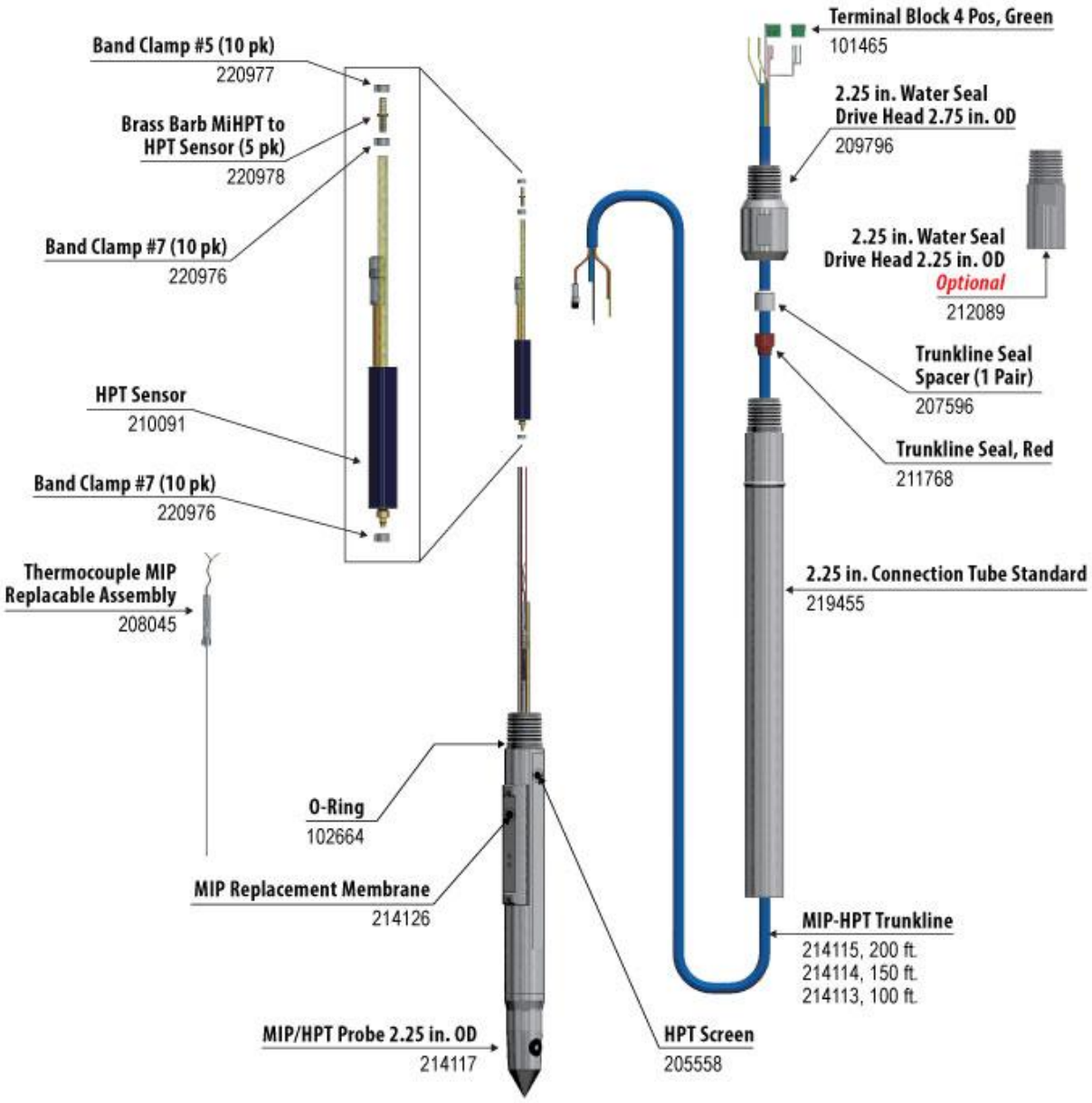
MIP – MP8520 (2.25 in. System)



MiHPT – MH6532 (1.5 in. / 1.75 in. system)



MiHPT – MH8530 (2.25 in. System)



A DIVISION OF KEJR, INC.
-Corporate Offices-
1835 Wall Street • Salina, KS 67401
1-800-436-7762 • Fax 785-825-2097
www.geoprobe-DI.com