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Curtiss-Wright Flow Control Corporation, Target Rock Division

Remedial Investigation/Feasibility Study Work Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site Number 1-52-119

February 12, 2009

ARCADIS

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Appendices

1. Introduction

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan has been prepared by ARCADIS on behalf of Curtiss-Wright Flow Control Corporation, Target Rock Division (Target Rock), and is being submitted pursuant to Section II of the Order On Consent (Order) Index # W1-1031-04-10 that was executed by the New York State Department of Environmental Conservation (NYSDEC) and Target Rock, effective August 10, 2008. The Order requires that an RI/FS be conducted for the Target Rock Site (referred to in this RI/FS Work Plan as the Site). The Site is currently listed in the Registry of Inactive Hazardous Waste Disposal Sites in New York State as Site Number 1-52-119 with a Classification 2.

The general objectives of the RI/FS process are as follows:

- Determine the nature and extent of the constituents of potential concern (COPCs) on-site, and if warranted based on the on-site perimeter/property boundary sampling data, off-site, and assess potential impacts to the public health, welfare, and the environment caused by the release or potential release of COPCs at the Site.

- Develop and evaluate alternatives for remedial action, if needed, to prevent, mitigate, or otherwise respond to or remedy a release or potential release of COPCs at or from the Site by conducting an FS.

- Compile all related (i.e., current and previous) data collected from the Site into one, comprehensive RI Report.

- Incorporate all elements of an RI/FS, as set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, the National Contingency Plan (NCP), the United States Environmental Protection Agency (USEPA) Guidance Document entitled Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, dated October 1988, and any subsequent revisions thereto, in effect at the time this RI/FS Work Plan is submitted, and appropriate USEPA and NYSDEC technical and administrative guidance documents (including the following: NYSDEC 1990; NYSDEC 1998; NYSDEC 2002).

- Conduct the RI in a dynamic manner to allow flexibility in the technical approach via phasing of field efforts (if warranted), thereby maximizing effectiveness of data collection efforts and quality/usability of data.

This RI/FS Work Plan provides the framework for the activities to be conducted as part of the RI/FS for the Site, as required by the Order, and includes the following elements:

- A summary of the previous investigations and remedial actions that have been completed prior to the preparation of this RI/FS Work Plan is presented in Section 2.0, which includes the Site description and history, the environmental setting, and previous investigations and remedial actions;
- The Conceptual Site Model (CSM) is presented in Section 3.0;
- Preliminary Applicable or Relevant and Appropriate Requirements (ARARs)/New York State Standards, Criteria, and Guidance (SCGs) are discussed in Section 4.0;
- The approach and goals for the RI and the FS are discussed in Section 5.0;
- The proposed Scope of Work for the RI/FS Work Plan is presented in Section 6.0;
- The Project Management Plan and anticipated schedule are presented in Section 7.0;
- References cited in this RI/FS Work Plan are listed in Section 8.0;
- The following Appendices:
    - Appendix A – Field Sampling Plan
    - Appendix B – Quality Assurance Project Plan
    - Appendix C – Health and Safety Plan
    - Appendix D – Citizen Participation Plan

2. Site Description and Background

This section of the RI/FS Work Plan provides the Site description and background.

2.1 Site Description

The Site is located at 1966E Broadhollow Road, East Farmingdale, Town of Babylon, Suffolk County, New York and is identified by Tax Map Number: District 0100, Section 031, Block 1, Lots 2.2 through 2.4. The Site location is shown on Figure 1. The approximately 11-acre Site contains two manufacturing buildings (east building and west building), each situated on 5-acre lots, and a 1-acre right-of-way. The west building is used for manufacturing and contains office space; the east building is used for shipping and receiving, valve testing, and contains additional manufacturing and office space. The areas of the Site not occupied by buildings are largely paved and used for parking. The Site is secured by a perimeter fence and automatic gate. The Site is situated on relatively flat topography on the western edge of an industrial area. Residential areas are located to the west and south of the Site. A commercial building is located to the north of the Site. Current Site features and structures are shown on Figure 2.

Target Rock manufactures valves used primarily for nuclear power applications. Manufacturing processes include machining and testing of valves. One of the elements of the manufacturing process is the non-destructive testing of the valves for minor cracks. Target Rock began manufacturing operations at the Site in 1982 and operations have been ongoing to the present.

2.2 Site History

The Site was originally used as a sand and gravel pit. In 1972 the east building was constructed and was used as a warehouse by J.C. Penney until Target Rock occupied the building in 1981. The exact date of construction of the west building is unknown. The west building was leased as office space by Target Rock until it was purchased by Target Rock and expanded by 40,000 square feet in 1975. Target Rock began manufacturing and testing valves at the Site in early 1982 after the east building was purchased by Curtiss-Wright Corporation in mid-1981.

2.3 Environmental Setting

This section of the RI/FS Work Plan provides a brief, physical description of the Site, the local geology, and the area hydrogeology.

2.3.1 Site Topography

The Site is approximately 75 feet above mean sea level (msl) and, topographically, is relatively flat, sloping downward to the east and southeast. The Site area was once used as a gravel pit; the land surface rises sharply upward along the southern and western property boundaries and then levels off into a residential area. The closest natural surface water body is Massapequa Creek, which is located approximately 2.5 miles to the southwest of the Site.

2.3.2 Local Geology

The unconsolidated geologic deposits underlying Suffolk County consist of clay, silt, sand, and gravel that overlie southward-dipping consolidated bedrock. The crystalline bedrock consists mainly of Precambrian age granite, gneiss, and schist. The overlying unconsolidated sediments were deposited during the Cretaceous age and form, in ascending order, the Raritan and Magothy Formations. During the Pleistocene period, glacial meltwater deposited outwash material forming what is presently known as the Upper Glacial aquifer.

The Raritan Formation consists of the Lloyd Sand and the Raritan Clay. The Lloyd aquifer (the hydrogeologic equivalent of the Lloyd Sand) consists of fine to coarse sand, gravel, commonly with a clayey matrix, and lenses and layers of silty and solid clay. The Raritan confining unit (the hydrogeologic equivalent of the Raritan Clay) is regionally continuous and consists of silty and solid clay, and lenses and layers of sand. Because of its low permeability, the Raritan Clay serves as a confining unit for the underlying Lloyd Sand.

The Magothy Formation is a deltaic deposit consisting of fine to medium sand, clayey in part, interbedded with lenses and layers of coarse sand, silt, and sandy and solid clay. Gravel is common in the basal zone of the Magothy Formation.

The Upper Glacial aquifer consists primarily of till and glacial outwash deposits. The till, composed of clay, sand, gravel, and boulders, forms the Harbor Hill and Ronkonkoma terminal moraines. These terminal moraines represent the farthest

advance of late-Pleistocene glaciation on Long Island. South of the morainal deposits is a glacial outwash plain, which extends from the Harbor Hill and Ronkonkoma moraines to the Great South Bay, and consists of fine to very coarse sand and pebble to boulder sized gravel.

Bedrock beneath the Site is found at an approximate elevation of 1,200 feet below msl. The Lloyd aquifer, which overlies bedrock, has a surface elevation of approximately 850 feet below msl. The Raritan Clay has a surface elevation of approximately 650 feet below msl. The Magothy aquifer is present from an approximate elevation of mean sea level (i.e., 0 feet msl) to 650 feet below msl. The Upper Glacial aquifer corresponds to the saturated upper part of the highly permeable Pleistocene deposits of sand and gravel.

Soil borings (described in Section 2.4 of this RI/FS Work Plan) drilled at the Site indicate that tan sand and gravel deposits (Upper Glacial aquifer) are underlain by laminated sands and silts, with the upper surface of the laminated sands and silts encountered from approximately 30 to 35 feet below land surface (ft bls). Minor amounts of fill are also present at the Site (LMS, 1993). Approximately 5 to 10 feet of fill were encountered in the area near the former dry well (monitoring well TRMW-4 boring) and in the vicinity of monitoring well TRMW-2.

2.3.3 Area Hydrogeology

The principal aquifers underlying the project area are the Upper Glacial aquifer and Magothy aquifer; these hydrogeologic units are in direct hydraulic connection with each other. Groundwater in the Upper Glacial aquifer and Magothy aquifer occurs under unconfined conditions at and near the Site (although the Magothy aquifer in other areas of Long Island can exhibit semi-confined conditions; the degree of confinement increases with depth due to stratification of the numerous silt and clay lenses). Within the project area, the average horizontal hydraulic conductivity of the Upper Glacial aquifer is approximately 270 feet per day (ft/d), with an anisotropy ratio of approximately 10:1 (horizontal to vertical, respectively) (McClymonds and Franke, 1972). The average horizontal hydraulic conductivity of the Magothy aquifer in the project area is approximately 50 ft/d, with an anisotropy ratio of approximately 100:1 (horizontal to vertical, respectively) (McClymonds and Franke, 1972).

The depth to groundwater at the Site is approximately 15 ft bls. Water-level elevation data collected at the Site indicate a resultant direction of shallow groundwater flow that is horizontally south-southeasterly. This is consistent with the south-southeasterly

horizontal regional direction of groundwater flow. It is important to note that the water-level elevation data was obtained from monitoring wells that are screened approximately 10 to 25 feet beneath the water table.

Slug testing conducted in the monitoring wells at the Site by LMS during the Phase II Investigation in 1992 indicated an average horizontal hydraulic conductivity (K) of 53 ft/d. The horizontal hydraulic gradient in the shallow groundwater system was approximately 0.001 ft/ft. Based on the hydraulic conductivity and hydraulic gradient data, the average horizontal groundwater velocity was approximately 0.23 ft/d (LMS, 1993).

Public water supply wells located within a half-mile radius of the Site are shown on Figure 1. A well search was conducted by ERM during a 1996-1997 hydrogeologic investigation at the Site. The well search results are documented in ERM's May 1997 Hydrogeologic Investigation report (ERM, 1997). The following public water supply wells were identified during the well search:

- Well S-39709 is located hydraulically upgradient/sidegradient of the Site and is owned by the East Farmingdale Water District. Well S-39709 is screened in the Magothy aquifer with a total depth of 712 ft bls. According to the East Farmingdale Water District, this well is currently active.

- Wells S-20041 and S-20042 are located hydraulically sidegradient of the Site and are owned by the East Farmingdale Water District. Well S-20041 is screened in the Upper Glacial aquifer with a total depth of 268 ft bls; Well S-20042 is screened in the Magothy aquifer with a total depth of 585 ft bls. According to the East Farmingdale Water District, well S-20041 is currently inactive and well S-20042 is currently active.

- Wells N-7852 and N-11004 are located hydraulically downgradient/sidegradient of the Site and are owned by the Village of Farmingdale. Wells N-7852 and N-11004 are screened in the Magothy aquifer with total depths of 457 ft bls and 347 ft bls, respectively. According to the Village of Farmingdale Water District, these wells are currently active.

Wells S-37503 and S-37504D were located at the Site. Well S-37503 was a plant process cooling water well with a total depth of 23 ft bls. Well S-37504D was a diffusion well with a total depth of 22 ft bls. These wells are not operational.

2.4 Previous Investigations and Remedial Activities

This section of the RI/FS Work Plan summarizes the previously completed investigations and remedial activities at the Site. Such previously-collected data have been considered during the preparation of this RI/FS Work Plan and will be documented in the final RI Report (see Section 6.2.7). The results of the investigations and remedial activities performed by other parties are summarized below and incorporated herein by reference. These investigations and remedial activities are also summarized in the Records Search Report for the Site that was prepared by ARCADIS (ARCADIS, 2008).

From mid-1982 to September 1983 wastewater from valve testing operations was discharged to a dry well located toward the rear of the east manufacturing building (i.e., south side of the building). Wastewater from these operations contained less than 5 percent 1,1,1-trichloroethane (1,1,1-TCA), classifying it as an industrial waste discharge rather than a hazardous waste discharge. The Suffolk County Department of Health Services (SCDHS) collected several samples from the dry well in 1982 and 1983. The analytical results indicated that 1,1,1-TCA, tetrachloroethene (PCE), and other volatile organic compounds (VOCs) were detected. In addition, during an April 1982 inspection by the SCDHS, a number of stored drums were present at the Site. The drums contained various compounds, including oils, Freon, acetone, kerosene, 1,1,1-TCA, PCE, and unknowns. The drum storage area was located on the east side of the east building.

In late 1983, at the direction of the SCDHS, Target Rock conducted the following actions: (1) discontinued wastewater discharge to the dry well located toward the rear of the east manufacturing building (i.e., south side of the building); (2) pumped and cleaned out the dry well prior to removal; (3) removed the dry well and surrounding impacted soils; and, (4) installed two (2) 2,000-gallon stainless steel storage tanks to contain the wastewater. The storage tanks were installed in the vicinity of the former dry well that was removed. In addition, a secure drum storage area was constructed on the east side of the east building, which involved the construction of a roof and a berm. The secure drum storage area was inspected and approved by the SCDHS.

A Phase I Investigation was conducted at the Site by Roux Associates, Inc. (Roux) in 1988 and a Phase II Investigation was conducted at the Site by Lawler, Matusky and Skelly Engineers (LMS) in 1992. These investigations were conducted under contract to the NYSDEC.

A hydrogeologic investigation was conducted at the Site by ERM-Northeast (ERM) in 1996 and 1997 related to the wastewater discharge to the former dry well located toward the rear of the east manufacturing building (i.e., south side of the building).

An environmental compliance assessment was conducted at the Site by P.W. Grosser Consulting, Inc. (PWGC) in 2002 to identify and evaluate the presence of recognized environmental conditions and to determine Target Rock's level of compliance with applicable environmental regulations.

A 550-gallon underground storage tank (UST) was removed on the western side of the west building and VOC-impacted soils were excavated from the Site by AARCO Environmental Services Corp. (AARCO) in May 2003 under the oversight of the SCDHS. An investigation of the former UST area was conducted at the Site by AARCO in October 2003.

Soil remediation and groundwater testing were conducted at the Site by CA RICH Consultants, Inc. (CA RICH) in 2004 to further investigate and remediate previously identified on-site soil impacts associated with the former UST area and test the shallow groundwater quality in the vicinity of the west building at the Site.

2.4.1 Investigations

This section summarizes the following completed investigations that were performed at the Site: (1) Phase I Investigation conducted by Roux in 1988 under contract to the NYSDEC, (2) Phase II Investigation conducted by LMS in 1992 under contract to the NYSDEC, (3) Hydrogeologic Investigation conducted by ERM in 1996 and 1997, (4) Environmental Compliance Assessment conducted by PWGC in 2002, (5) Former UST Area Investigation and Remediation conducted by AARCO in October 2003, and, (6) Groundwater Testing and Remediation conducted by CA RICH in 2004.

2.4.1.1. Phase I Investigation

A Phase I Investigation was conducted at the Site by Roux in 1988. The Phase I Report was prepared in May 1988 for the NYSDEC and included a preliminary Hazard Ranking Score (HRS), an assessment of the available information, and recommendations for Phase II studies (Roux, 1988).

The Phase I Investigation indicated that, based on the discharge of wastewater containing solvents, and the apparent direct pathway to the water table, there was a

possibility for groundwater contamination at the Site. The Phase I Report recommended that a Phase II Investigation be conducted at the Site to determine if there was groundwater contamination and if present, its extent.

2.4.1.2. Phase II Investigation

Based on the findings of the Phase I Investigation Report, a Phase II Investigation was conducted at the Site by LMS in 1992. The Phase II Investigation Report was prepared in May 1993 (LMS, 1993).

The Phase II Investigation scope of work included a literature review, a Site reconnaissance, a groundwater investigation, soil sampling, groundwater sampling, and catch basin sampling.

The groundwater investigation involved the installation of four (4) permanent monitoring wells (TRMW-1 through TRMW-4) in July 1992 and slug testing to determine the average horizontal hydraulic conductivity of the aquifer within each monitoring well's screened interval. The monitoring wells were screened at or near the bottom of the Upper Glacial aquifer as the intent of the Phase II Investigation was to evaluate constituents with densities greater than water (e.g., 1,1,1-TCA) that were discharged to the dry well located on the south side of the east building. The water table was encountered at approximately 10 ft bls.

One (1) soil sample was collected from the TRMW-4 boring at the water table (12-14 ft bls) and submitted to a laboratory for the analysis of target compound list (TCL) VOCs, TCL semi-volatile organic compounds (SVOCs), TCL pesticides, TCL polychlorinated biphenyls (PCBs), target analyte list (TAL) metals, and extraction procedure (EP) toxicity metals. TRMW-4 is located in the vicinity of the former dry well. The purpose of this soil sample was to determine whether any residual soil impacts existed in the vicinity of the former dry well. The analytical results for the soil sample that was collected from the TRMW-4 boring (12-14 ft bls) indicated that organic constituents (i.e., VOCs, SVOCs, pesticides, PCBs) were not detected above the laboratory quantitation limits. The EP toxicity analysis indicated that leachable metals were not detected above the laboratory quantitation limits.

Groundwater samples were collected from monitoring wells TRMW-1 through TRMW-4 and submitted to a laboratory for the analysis of TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals and filtered metals (if necessary), cyanide, chemical oxygen demand (COD), and total dissolved solids/total suspended solids

(TDS/TSS). The analytical results for the groundwater samples that were collected from monitoring wells TRMW-1 through TRMW-4 indicated that 1,1,1-TCA was detected at concentrations of 43 micrograms per liter (ug/L) in TRMW-2 and 66 ug/L in TRMW-4, which was above the NYSDEC Class GA groundwater standard for 1,1,1-TCA (5 ug/L). 1,1,1-TCA was detected at an estimated concentration of 4 ug/L in monitoring well TRMW-3 and was not detected above the laboratory quantitation limit in monitoring well TRMW-1. Other VOCs were detected at low-level concentrations generally below the laboratory quantitation limits.

One (1) water sample and one (1) soil sample were collected from a catch basin located adjacent to the former drum storage area and submitted to a laboratory for the analysis of TCL VOCs, TCL SVOCs, TCL pesticides, and TCL PCBs. The analytical results for the water sample that was collected from a catch basin located adjacent to the former drum storage area indicated that 1,1,1-TCA was detected at a concentration of 20 ug/L and 1,1-dichloroethene (1,1-DCE) was detected at a concentration of 7 ug/L. The analytical results for the soil sample that was collected from the catch basin indicated that a number of tentatively identified compounds (TICs) were detected; compounds primarily associated with petroleum products. The soil sample appeared to be slightly stained with oil and exhibited a petroleum hydrocarbon odor.

The Phase II Investigation Report recommended the following:

- Periodic sampling of the monitoring wells to evaluate groundwater concentrations over time and additional investigation if the constituent concentrations remained stable or increased.

- Conduct an inventory of wells in the area to determine whether any public or residential wells are located downgradient of the Site and sampling of downgradient wells to ensure that the Site is not impacting the groundwater quality.

- Installation of several additional wells downgradient of the Site.

- Conduct a file review to ensure that USTs that were removed were not leaking and that the USTs currently on-site were in compliance with environmental regulations. Documentation reviewed by LMS during the literature review indicated that six USTs were present at the Site in 1984.

2.4.1.3. Hydrogeologic Investigation

A hydrogeologic investigation was conducted at the Site by ERM in 1996 and 1997 (ERM, 1997). The hydrogeologic investigation was conducted in accordance with a NYSDEC-approved Work Plan that was submitted in November 1995. The Work Plan was related to the wastewater discharge to the former dry well located on the south side of the east building.

The hydrogeologic investigation scope of work included the installation of a new upgradient monitoring well (TRMW-5), groundwater sampling, a well search, and groundwater modeling.

The new upgradient monitoring well (TRMW-5) was installed in April 1996. The monitoring well was installed at the northern property boundary, north of the west building. Monitoring well TRMW-5 was screened from 20 to 40 ft bls so that the screen interval would be consistent with the screen interval of the other upgradient monitoring well (TRMW-1) at the Site.

Groundwater samples were collected from monitoring wells TRMW-1 through TRMW-5 and submitted to a laboratory for the analysis of TCL VOCs by NYSDEC Analytical Services Protocol (ASP) Method 91.1. The analytical results for the groundwater samples that were collected from monitoring wells TRMW-1 through TRMW-5 between April 1996 and March 1997 indicated that VOCs were not detected above the laboratory quantitation limit in upgradient monitoring wells TRMW-1 and TRMW-5 (with the exception of chloroform at a concentration of 1 ug/L in November 1996), and downgradient monitoring wells TRMW-3 (with the exception of acetone at a concentration of 3 ug/L in March 1997) and TRMW-4 (with the exception of 1,1,1-TCA at a concentration of 9 ug/L in March 1997). 1,1,1-TCA, 1,2-dichloroethene (1,2-DCE), and 1,1-dichloroethane (1,1-DCA) were detected at concentrations of 7 ug/L, 28 ug/L, and 1 ug/L, respectively, in downgradient monitoring well TRMW-2 in April 1996. The concentrations of the constituents detected in TRMW-2 consistently decreased during the four quarters of groundwater monitoring that were conducted between April 1996 and March 1997.

A well search was conducted to identify all potential downgradient receptors. Public water supply wells were identified and listed in the Hydrogeologic Investigation report (ERM, 1997). Five (5) public water supply wells were identified during the comprehensive well search. Three of the wells are located either upgradient or sidegradient and two of the wells are located downgradient/sidegradient.

A two-dimensional solute transport modeling study was conducted to evaluate potential downgradient impacts from the wastewater discharge to the former dry well in 1982-1983. The objective of this effort was to simulate the off-site migration of constituents contained in the wastewater and to determine whether any downgradient receptors were impacted in the past or would be impacted in the future. The solute transport model simulated the generation of a slug-like plume of 1,1,1-TCA and its downgradient migration following the disposal of process wastewater in the on-site dry well in 1982-1983. 1,1,1-TCA plume concentrations were predicted to decline through natural attenuation with time and distance from the Site. The solute transport modeling indicated that no receptors have been or will be impacted by the simulated 1,1,1-TCA release.

Based on the consistency of the groundwater monitoring data and the concentrations of constituents that were detected during the 1996-1997 groundwater monitoring program, the Hydrogeologic Investigation report (ERM, 1997) indicated that there is no continuing source of VOC impacts, and recommended that the groundwater monitoring program be discontinued and that no additional remediation was required at the Site.

2.4.1.4. Environmental Compliance Assessment

An environmental compliance assessment was conducted at the Site by PWGC in 2002 to identify and evaluate the presence of recognized environmental conditions and to determine Target Rock's level of compliance with applicable environmental regulations (PWGC, 2002).

The environmental compliance assessment scope of work included a visual inspection of the Site and surrounding areas, interviews, a review of historical information and aerial photographs, and a review of pertinent local, state, federal, and facility records.

Findings of the environmental compliance assessment related to Site environmental conditions are as follows:

- According to a regulatory agency database search, the Site was listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database as a NFRAP (no further remedial action is planned) site and on the Hazardous Substance Waste Disposal Site Inventory (HSWDS) database as a delisted site.

- Groundwater beneath the Site is approximately 25 feet below grade and flows to the south. One groundwater monitoring well was observed at the Site at the time of the Site inspection and a second well was noted on the survey map that was provided to PWGC by Target Rock.

- Sanitary wastewater is discharged to the municipal sewer system, which is part of the Southwest Sewer District that is operated by the Suffolk County Department of Public Works (SCDPW). The buildings were connected to the municipal sewer in approximately late 1982. Storm drains are located throughout the parking areas.

- PWGC's Site inspection identified the presence of eight aboveground storage tanks (ASTs) and two drum storage areas at the Site. Secondary containment is provided for all of the ASTs and the drum storage areas and no evidence of spills and/or staining around any of the ASTs was observed during the Site inspection.

- PWGC's Site inspection identified the presence of one fuel oil UST and four propane USTs at the Site. In addition to the five active USTs, six former USTs were reportedly removed from the Site. The one fuel oil UST is properly permitted with the SCDHS.

2.4.1.5. Former UST Area Investigation

A former UST area investigation was conducted at the Site by AARCO in 2003 (AARCO, 2004). The investigation of the former UST area was conducted in October 2003 subsequent to the discovery and removal of one (1) 550-gallon UST and the excavation of VOC-impacted soils in May 2003. Endpoint soil samples collected from the former UST excavation area indicated that VOC-impacted soils were still present following excavation activities.

2.4.1.5.1. Former UST Area Background

An out-of-service 550-gallon UST of former unknown use was identified by Target Rock personnel on the western side of the west building. The SCDHS and other appropriate parties were notified that the UST was to be removed; the UST was removed by AARCO under the oversight of the SCDHS in May 2003. The top of the UST was located just below land surface and the bottom of the UST was located approximately 4 ft bls. Following removal, the UST was inspected and no pitting or

holes were observed; the UST was then transported off-site for disposal/salvage at an appropriate facility.

2.4.1.5.2. Former UST Area Investigative Activities

The former UST area investigation involved the advancement of soil borings and the collection of soil samples to determine the approximate lateral and vertical extent of any remaining soil impacts following the removal of impacted soils in May 2003 (see Section 2.4.2.2 for a description of soil remediation activities), the advancement of one (1) temporary groundwater monitoring well and the collection of one (1) groundwater sample, and the inspection and sampling of two (2) adjoining leaching structures to determine the prior uses of the structures and determine if the structures were related to the former UST.

Eight (8) soil borings (SB-1 through SB-8) were advanced using direct push drilling techniques (i.e., Geoprobe®) to facilitate the collection of soil samples. The soil borings were advanced around the former UST area to depths ranging from 12 to 16 ft bls. The water table was encountered at approximately 14 ft bls during soil boring advancement. The soil samples were field screened using a photoionization detector (PID) and visual and olfactory observations were noted. PID readings ranged from non-detect to 250 parts per million (ppm). Soil samples from SB-1 (16-17 ft bls), SB-5 (10-12 ft bls), SB-6 (8-9 ft bls), and SB-8 (9-10 ft bls) were submitted to a laboratory for the analysis of Suffolk County List VOCs by EPA Method 8260, NYSDEC STARS List SVOCs by EPA Method 8270, and Suffolk County List metals. The analytical results for the soil samples that were collected from soil borings SB-1, SB-5, SB-6, and SB-8 indicated that VOCs were not detected above regulatory action levels, with the exception of SB-5 (10-12 ft bls), where PCE was detected at a concentration of 9,700 micrograms per kilogram (ug/kg), trichloroethene (TCE) was detected at a concentration of 780 ug/kg, and 1,1,1-TCA was detected at a concentration of 500 ug/kg. Soil boring location SB-5 was located approximately 10 feet south of the former UST excavation area. VOCs were not detected above the laboratory method detection limit in the soil samples collected from SB-6 and SB-8. SVOCs and metals were not detected above regulatory action levels.

One (1) temporary monitoring well (GW-1) was advanced using direct push drilling techniques (i.e., Geoprobe®) to facilitate the collection of a groundwater sample. GW-1 was advanced at the SB-1 soil boring location. The groundwater sample was collected using a 2-foot stainless steel screen that was set at 14 to 16 ft bls. A sheen was observed on the sample tubing and a slight odor was noted. The groundwater

sample was submitted to a laboratory for the analysis of Suffolk County List VOCs by EPA Method 8260, NYSDEC STARS List SVOCs by EPA Method 8270, and Suffolk County List metals. The analytical results for the groundwater sample that was collected from GW-1 indicated that VOCs were detected above regulatory action levels. PCE was detected at a concentration of 280 ug/L, TCE was detected at a concentration of 200 ug/L, 1,1,1-TCA was detected at a concentration of 95 ug/L, 1,1-DCA was detected at a concentration of 17 ug/L, and cis-1,2-DCE was detected at a concentration of 48 ug/L. SVOCs were not detected above the laboratory method detection limit; metals were not detected above regulatory action levels.

The two (2) adjoining leaching structures were inspected and soil samples were collected from approximately 8 ft bls from within each structure. The soil sample collected from the "distribution box" structure (i.e., structure closest to the building) exhibited a PID reading of 150 to 250 ppm and appeared to be impacted based on visual and odor observations. The soil sample collected from the overflow structure (OF-1) did not exhibit any PID responses nor evidence of impacts based on visual and odor observations. The soil samples were submitted to a laboratory for the analysis of Suffolk County List VOCs by EPA Method 8260, NYSDEC STARS List SVOCs by EPA Method 8270, Suffolk County List metals, and total petroleum hydrocarbons (TPH) by EPA Method 8015. The analytical results for the soil sample that was collected from the "distribution box" structure indicated that VOCs were detected at concentrations above regulatory action levels. PCE was detected at a concentration of 17,000 ug/kg, 1,1,1-TCA was detected at a concentration of 37,000 ug/kg, 1,1-DCA was detected at a concentration of 7,500 ug/kg, and 1,2,4,5-tetramethylbenzene was detected at a concentration of 2,200 ug/kg. SVOCs were either not detected above the laboratory method detection limit or detected below regulatory action levels. Metals (chromium, copper, and nickel) were detected above regulatory action levels. TPH was not detected above the laboratory method detection limit. The analytical results for the soil sample that was collected from the overflow structure indicated that VOCs were not detected above regulatory action levels. SVOCs were not detected above the laboratory method detection limit. Metals and TPH were not detected above regulatory action levels.

The Evaluation of Former UST Area & Remedial Work Plan Report (AARCO, 2004) recommended the following:

- Excavation of additional soil beyond the initial former UST area excavation.
- Additional shallow groundwater sampling.

- Remediation of the "distribution box" structure.

2.4.1.6. Groundwater Testing

Groundwater testing was conducted at the Site by CA RICH in 2004 (CA RICH, 2004). These activities were performed in accordance with a SCDHS-approved Work Plan dated March 5, 2004. The purpose of the work was to test the shallow groundwater quality in the vicinity of the west building at the Site.

The groundwater testing involved the advancement of temporary monitoring wells and the collection of groundwater samples. Four (4) temporary monitoring wells (GW-1 through GW-4) were advanced using direct push drilling techniques (i.e., Geoprobe®) to facilitate the collection of groundwater samples. GW-1 was advanced at the B-3 soil boring location, which was situated within the "distribution box" structure. GW-2 and GW-3 were advanced at the B-8 and B-9 soil boring locations, respectively, which were situated upgradient of the former UST excavation area. GW-4 was advanced at the B-10 soil boring location, which was situated southwest of the former UST excavation area. The groundwater samples were collected from 16 to 18 ft bls. The groundwater samples were submitted to a laboratory for the analysis of VOCs by EPA Method 8260. The analytical results for the groundwater samples that were collected from GW-1 through GW-4 indicated that VOC concentrations were below NYSDEC Class GA groundwater standards.

The Soil Remediation & Groundwater Testing Report (CA RICH, 2004) recommended that one (1) permanent monitoring well be installed in the southern portion of the former UST excavation area to evaluate VOC concentrations over time in the shallow groundwater in this area of the Site.

2.4.2 Remedial Activities

2.4.2.1. Former Dry Well Remedial Activities

As discussed previously, at the direction of the SCDHS, Target Rock conducted the following actions in late 1983: (1) discontinued wastewater discharge to the dry well located toward the rear of the east manufacturing building (i.e., south side of the building), (2) pumped and cleaned out the dry well prior to removal, (3) removed the dry well and surrounding impacted soils, and, (4) installed two (2) 2,000-gallon stainless steel storage tanks to contain the wastewater. The storage tanks were installed in the vicinity of the former dry well that was removed. In addition, a secure drum storage area was constructed at the Site, which involved the construction of a

roof and a berm. The secure drum storage area was inspected and approved by the SCDHS.

2.4.2.2. Former UST Area Remedial Activities

Subsequent to the removal of the former UST that was located on the western side of the west building, the surrounding soils were observed to be impacted (i.e., solvent-type odors and visual evidence of impacts were noted). Impacted soils were excavated by AARCO in May 2003 (AARCO, 2004) to the extent practicable using a backhoe; approximately 21 tons of soil were excavated and transported off-site for disposal as F002 Hazardous Waste Solids at CWM Chemical Services, LLC in Model City, New York.

The soil excavation activities were limited by the building foundation on the east side of the excavation (i.e., western wall of west building). One (1) endpoint soil sample was collected from each of the four sidewalls of the excavation and two (2) endpoint soil samples were collected from the bottom of the excavation (approximately 8 ft bls). The majority of the endpoint soil samples appeared to be impacted based on odor and visual observations.

The endpoint soil samples were submitted to a laboratory for the analysis of Suffolk County List VOCs by EPA Method 8260, NYSDEC STARS List SVOCs by EPA Method 8270, and Suffolk County List metals. The analytical results of the endpoint soil samples indicated that elevated concentrations of VOCs were detected; specifically PCE and other solvent-type VOCs. The highest concentrations of total VOCs (332 milligrams per kilogram [mg/kg]) were detected in the southern sidewall soil sample; elevated concentrations were also detected in the eastern (234 mg/kg) and northern (197 mg/kg) sidewall soil samples, and the southern bottom soil sample (175 mg/kg). SVOCs and metals impacts were not evident based on the soil sample analytical data.

The SCDHS also noted the presence of two manhole covers adjacent to the former UST area and requested that these structures be sampled to ascertain if they were related to the former UST.

Additional soil remediation activities associated with the former UST area were conducted at the Site by CA RICH in 2004 (CA RICH, 2004). These activities were performed in accordance with a SCDHS-approved Work Plan dated March 5, 2004. The purpose of the work was to further investigate and remediate previously identified

on-site soil impacts associated with the former UST area, including the "distribution box" and overflow structures, at the Site.

The soil remediation involved the advancement of soil borings and the collection of soil samples to further delineate the lateral extent of any remaining soil impacts, the dye testing of potential discharge points to determine whether any liquids discharged into selected interior drainage structures are conveyed directly to the existing municipal sewer system or to the on-site sanitary system situated behind the western building, and the excavation and off-site disposal of impacted soil.

Ten (10) soil borings (B-1 through B-10) were advanced using direct push drilling techniques (i.e., Geoprobe®) to facilitate the collection of soil samples. The soil borings were advanced in the vicinity of the former UST excavation area and in the "distribution box" and overflow structures. The water table was encountered at approximately 15 ft bls during soil boring advancement. The soil samples were field screened using a PID. Select soil samples were submitted to a laboratory for the analysis of VOCs by EPA Method 8260. The soil sample collected from the "distribution box" structure was also analyzed for Suffolk County List metals. The analytical results for the soil samples that were collected from select soil borings and field screening were used to determine the extent of the additional soil excavation and to pre-characterize the soil for off-site disposal.

Two indoor floor drains and three slop sinks were physically evaluated via dye testing. Dyed water was introduced into the structures in an effort to visually trace the fluid flow until a municipal sewer connection was reached. Dye testing observations revealed that an out-of-service open plumbing fitting situated behind a slop sink discharged directly into the "distribution box" structure. These interior remnants of the piping were removed by Target Rock at the request of the SCDHS. All other structures that were dye tested were observed to be plumbed directly to the municipal sewer.

Impacted soils were excavated from an area approximately 38 feet by 14 feet. The soil excavation area extended approximately 5 feet north, 5 feet west, and 20 feet south of the initial former UST excavation area (i.e., soil remediation work conducted by AARCO in May 2003). Approximately 255 tons of soil were excavated and transported off-site for disposal as 'hazardous waste' at the Stablex Facility in Canada. The soil was pre-treated and stabilized at the Stablex Facility to produce a non-hazardous concrete-like material that was placed in a storage cell and permanently landfilled. In addition, excavated soil that was excavated from the bottom of the excavation and

containerized in five (5) 55-gallon drums was transported off-site for disposal as 'hazardous waste' at CWM Chemical Services, LLC in Model City, New York.

Twelve (12) endpoint soil samples were collected from the sidewalls and bottom of the excavation following the completion of the excavation activities. The endpoint soil samples were submitted to a laboratory for the analysis of VOCs by EPA Method 8260B. The analytical results of the endpoint soil samples indicated that PCE was detected above SCDHS cleanup criteria (1,400 ug/kg) in one soil sample (South Bottom), at a concentration of 8,200 ug/kg. However, VOCs were not detected in a soil sample (South Bottom 2) collected only 4 feet to the south of the sample "South Bottom". This bottom endpoint soil sample was collected at a depth of approximately 12 ft bls (approximately 3 ft above the water table). The subsurface soil was remediated to the extent physically feasible (undermining the adjacent building footing was the concern). Based on the endpoint soil sample data, the impacted soil that was left in place is assumed to be a minimal volume.

A vacuum truck was used to remove soil from the bottom (8 ft bls) of the "distribution box" structure to a depth of approximately 13.5 ft bls, at which depth the concrete rings were undermined and the structure collapsed. The concrete rings and additional soil were then removed using a track-hoe. An endpoint sample could not be collected prior to the collapse of the concrete rings; however, pre-excavation soil sample analytical results indicated that the VOCs and metals concentrations at 14 ft bls were below SCDHS soil cleanup levels. The soil removed from the "distribution box" structure was also transported off-site for disposal at the Stablex Facility in Canada. The former "distribution box" structure influent pipe was plugged with concrete at the building line. The steel covers and concrete collars were removed from both the "distribution box" and overflow structures; the former structures were then backfilled.

3. Conceptual Site Model

Based upon the analytical results of previous investigations, the current CSM has been developed and is provided below. A review of existing reports, available data, historical information, and on-site impacts to soil and groundwater has been completed as part of the development of the CSM.

Based on the above, the following CSM was developed:

- **On-Site Soils:**
  - VOCs: Various VOCs (primarily 1,1,1-TCA; PCE; TCE; 1,1-DCA) were detected in soil samples collected from the former UST area and former "distribution box" structure area. The soil in the former "distribution box" structure area was remediated to less than the SCDHS cleanup levels and therefore does not represent a potential continuing source of VOC impacts to groundwater. The soil between approximately 12 ft bls and the water table (i.e., soil that could not be excavated) in the former UST area may be a potential concern. As discussed previously, it is assumed that there may be a minimal volume of impacted soil still present in the former UST area.
  - SVOCs: SVOCs were not detected above regulatory action levels in soil samples collected from the former UST area and former "distribution box" structure area. The concentrations of SVOCs in soil prior to remediation (i.e., excavation of soil driven by VOC impacts) did not represent a source of potential impacts to groundwater.
  - Metals: Metals were not detected above regulatory action levels in the former UST area and the concentrations of metals in soil prior to remediation (i.e., excavation of soil driven by VOC impacts) did not represent a source of potential impacts to groundwater quality. The soil in the former "distribution box" structure area, where metals were detected above regulatory action levels, was remediated to less than the SCDHS cleanup levels and therefore does not represent a potential continuing source of metals impacts to groundwater.
- **On-Site Groundwater:**
  - VOCs: The detections of various VOCs above SCGs (primarily 1,1,1-TCA; PCE; TCE; 1,2-DCE; 1,1-DCA) in groundwater samples indicate potential impacts from the former UST area and former dry well area. Groundwater sample analytical results from temporary monitoring well GW-1 indicate that individual VOCs were detected in on-site groundwater in the former UST area at concentrations up to 280 ug/L (PCE). This groundwater sample was collected in the vicinity of the former UST area (i.e., downgradient [southeast] edge of the former UST excavation area) by

AARCO in October 2003 subsequent to the initial former UST excavation activities, but prior to the additional soil remediation activities that were conducted by CA RICH in 2004. The analytical results for the groundwater samples collected from temporary monitoring wells GW-1 through GW-4 (CA RICH, 2004) in the vicinity of the former UST area indicated that VOC concentrations were below NYSDEC Class GA groundwater standards.

- SVOCs: SVOCs were generally not detected above the laboratory quantitation limit in groundwater samples collected from the Site.

- Metals: Metals were detected at low-level concentrations below SCGs in a groundwater sample collected from the former UST area.

This CSM will be re-evaluated and revised (as needed) as additional data are collected for the Site.

4. Preliminary ARARs/SCGs

The selection of ARARs/SCGs for the Site will be consistent with the requirements of the NCP (USEPA, 1990) and USEPA Guidance (USEPA, 1988). In addition, New York State regulatory guidance, such as the Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002), Technical and Operational Guidance Series (TOGs) Memoranda, and Technical and Administrative Guidance Memoranda (TAGM), and related guidance documents will be considered in the evaluation/selection process.

Because of the iterative nature of the RI/FS process, the identification of ARARs/SCGs and remedial technologies will continue throughout the RI/FS as the understanding of the Site conditions and potential remedial technologies evolves.

5. RI/FS Work Plan Approach and Goals

This section of the RI/FS Work Plan describes the approach, rationale, and goals for the RI/FS.

5.1 Remedial Investigation Approach

To successfully meet the RI objectives in an effective manner, additional on-site data will be collected during the RI. The general hydrogeologic framework on-site was defined during the Phase II Investigation (LMS, 1993) and the 1996-1997 Hydrogeologic Investigation (ERM, 1997). The data collected during the investigations performed by others between 1992 and 2004 further characterized the existing on-site conditions.

The existing on-site data was used to develop the RI scope of work proposed in this RI/FS Work Plan. This approach guarantees that the most complete and recent data set is embedded within the decision-making process so that a complete and focused RI is performed. This approach does not slow or limit the RI process, but rather provides a sound technical basis for the field efforts based on the best available data.

In particular, this RI/FS Work Plan provides a detailed scope of work for investigating soil, groundwater, soil vapor, and sub-slab soil vapor on-site to meet the stated goals of the RI (see below). The RI data will be evaluated after it has been received, reviewed, and validated. However, prior to the data validation process, unvalidated data will be provided to the NYSDEC to allow for a timely review and determination as to whether additional investigative activities are required. Should the RI data indicate further investigative activities (e.g. on-site indoor air quality, off-site groundwater, off-site soil vapor) are necessary to meet the RI goals, a supplemental RI Work Plan, in the form of a focused letter detailing proposed additional investigative activities and rationale, will be submitted to the NYSDEC. Additional work, if necessary, will be implemented in a timely manner, with NYSDEC approval.

The decision-making process for the RI activities is as follows:

- If warranted, based on the on-site groundwater quality data collected from the temporary monitoring wells (i.e., vertical profile borings [VPBs]) located along the southern and western perimeters/property boundaries and existing permanent monitoring wells, additional investigative activities will be identified and performed upon receiving NYSDEC approval, as described above.

- If warranted, based on the temporary monitoring wells (VPBs) groundwater quality data, additional permanent on-site monitoring wells will be installed to monitor groundwater quality over time.

- Soil vapor sampling and sub-slab soil vapor sampling will be conducted on-site in accordance with NYSDEC DER-13/Strategy for Evaluating Soil Vapor Intrusion at Remedial Sites in New York (NYSDEC, 2006) and NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2006).

- If warranted, based on the on-site sub-slab soil vapor sample quality data (i.e., concentration levels), on-site indoor air quality sampling will be conducted.

- If warranted, based on the soil vapor and groundwater quality data collected from the temporary monitoring wells (i.e., VPBs) and soil vapor points located along the southern and western perimeters/property boundaries, off-site soil vapor sampling will be identified and performed upon receiving NYSDEC approval, as described above.

- If warranted, based on the soil quality data from soil borings AGW-8 through AGW-10 (see Section 6.2.1.1), additional soil borings will be identified and drilled to delineate the soil impacts in the vicinity of these soil borings, upon receiving NYSDEC approval, as described above.

5.2 RI Goals

The following are the specific goals of the RI and FS:

- Characterize the shallow groundwater quality on-site.

- Characterize the shallow (i.e., approximately 8 ft bls) soil vapor quality on-site.

- Characterize the sub-slab soil vapor quality on-site (i.e., beneath the west building and the southwest and southeast portions of the east building).

- Fully develop the list of COPCs for the Site.

- Determine if on-site remediated areas (i.e., former UST area) are a potential continuing source(s) of impacts to groundwater.

- Characterize the nature and extent of risks posed by potentially affected on-site media.

- Determine potential receptors and exposure pathways associated with potential exposure to soil, groundwater, and soil vapor.

- Determine if additional data collection efforts are warranted to meet RI goals based on the data collected on-site. If it is determined that additional data collection efforts are warranted beyond that described in Section 6.2.1, then additional investigation activities that may be needed to meet RI goals will be identified, as described in Section 5.1.

5.3 Feasibility Study Approach

Based on the knowledge of existing information pertaining to the Site physical setting and COPC type and distribution from previous investigations (Section 2), it is anticipated that a Focused Feasibility Study (FFS) will be developed. It is expected that the FFS will result in a streamlined decision-making process related to the selection of the preferred final remedy (if additional remedial actions are warranted). The FFS will include evaluation of a short-list of applicable remedial technologies (if warranted) that have been demonstrated to be effective in meeting the FS criteria.

6. RI/FS Tasks

This section describes the proposed RI/FS efforts.

6.1 Scoping the RI/FS

The scoping process, for the purpose of identifying and defining the RI/FS tasks described below, included the following:

- Visits to the Site.

- Evaluation of the Order requirements and relevant State and Federal guidance documents.

- Evaluation of existing reports and data for the Site and surrounding area.

6.2 Remedial Investigation

This section of the RI/FS Work Plan describes the proposed work scope for the RI. The proposed RI work scope includes on-site investigation, and, if warranted based on

the on-site investigation data, off-site investigation (see Section 5.1). Table 1 and Figure 2 of this RI/FS Work Plan provide additional information and justification for the scope of work presented in this section.

Field sampling, laboratory analysis, and field work for the RI will be conducted in accordance with the protocols described in the Sampling and Analysis Plan (SAP), as described below and documented, in detail, in Appendix A (Field Sampling Plan [FSP]); Appendix B (Quality Assurance Project Plan [QAPP]); Appendix C (Health and Safety Plan [HASP]), and Appendix D (Citizen Participation Plan [CPP]).

The specific activities of the proposed RI are summarized, as follows:

- Drill on-site soil borings to collect soil samples, drill on-site temporary monitoring wells (VPBs) to collect groundwater samples from the shallow groundwater system, and drill on-site temporary points to collect soil vapor samples from the shallow vadose zone.

- Collect on-site sub-slab soil vapor samples from beneath the west building and southwest and southeast portions of the east building by advancing temporary points.

- Collect groundwater samples from existing monitoring wells (TRMW-1 through TRMW-5) on-site.

- Based on an evaluation of data collected above, assess the need for additional investigation efforts and, if necessary, identify additional investigation activities that may be needed to meet RI goals, as described in Section 5.1.

6.2.1 Proposed Remedial Investigation

The following subsections of this RI/FS Work Plan describe, in detail, the rationale for the proposed RI scope of work. The scope of work is presented in detail in Table 1 and on Figure 2. Detailed field methodology is provided in Appendix A (FSP). Quality Assurance/Quality Control (QA/QC) procedures and protocols, analyte lists, analytical methods, and sample handling procedures are provided in Appendix B (QAPP). Health and safety procedures are provided in Appendix C (HASP). Community outreach and participation activities are provided in Appendix D (CPP).

6.2.1.1. Proposed Soil Investigation

Based on the results of the soil sampling programs undertaken by others (Section 2.4.1), the RI has been developed to meet the previously-stated RI objectives. The proposed RI field investigation to be undertaken at the Site includes subsurface soil sampling.

The proposed soil boring locations (AGW-8 through AGW-10) are presented on Figure 2. A description of each boring to be advanced during this program, as well as the corresponding soil samples and constituents of analysis, are provided in Table1. The detailed rationale for the RI soil borings is described below.

The soil borings will be advanced utilizing the direct push drilling methodology (Geoprobe® or equivalent equipment). The soil borings will be advanced to the water table. The total depths of the proposed soil borings are anticipated to be approximately 15 to 18 ft bls. The final total depths of the soil borings will be determined by the on-site field geologist based on the depth that the water table is encountered in the field. Continuous soil core sampling will be performed and soil core samples will be lithologically logged in each proposed soil boring.

The number of soil samples collected for laboratory analysis in each proposed soil boring has been estimated for the purposes of this RI/FS Work Plan but will be determined in the field based on visual observations and field screening (i.e., PID measurements). In addition to the analyses specified in Table1, soil core samples will be screened in the field with a PID. If field PID readings above background concentrations are detected in any boring, then the soil sample exhibiting the highest field PID reading, as well as the soil sample collected from that boring that is already planned for analysis (i.e., water table interface), will be submitted to the laboratory for the analysis of VOCs. In addition, soil samples exhibiting field PID readings of 50 ppm or greater above background concentrations will also be submitted to the laboratory for the analysis of VOCs.

The following text describes the rationale and objectives for investigating on-site areas:

Former UST Area

Proposed Soil Borings AGW-9 and AGW-10 will be advanced in the former UST area (i.e., just west of northwestern corner of west building) to characterize soil quality just above the water table (i.e., capillary fringe zone). The soil quality data will be used to

evaluate if there is a continuing source of VOC impacts to groundwater. The soil samples collected from Soil Borings AGW-9 and AGW-10 will be submitted to the laboratory for the analysis of VOCs.

Drum Storage Area

Proposed Soil Boring AGW-8 will be advanced in the vicinity of the drum storage area (i.e., just east of southeastern corner of east building) to characterize soil quality just above the water table (i.e., capillary fringe zone). The soil sample(s) collected from Soil Boring AGW-8 will be submitted to the laboratory for the analysis of VOCs.

6.2.1.2. Proposed Groundwater Investigation

The proposed groundwater RI consists of the advancement of eleven (11) temporary monitoring wells (nine [9] VPBs and two [2] water table points) on-site and the sampling of five (5) existing on-site monitoring wells. Temporary monitoring wells AGW-6 and AGW-10 will be advanced to the water table for the collection of groundwater samples. A VPB will be advanced at the AGW-9 location to characterize groundwater quality beneath the potential source area. The existing data collected and interpretations made to this point were used to determine the best locations for the temporary monitoring wells proposed herein. The locations of the proposed temporary monitoring wells and existing monitoring wells are shown on Figure 2. Table 1 provides the complete description/rationale for the proposed scope of work.

Existing Monitoring Wells TRMW-2 and TRMW-4 are located hydraulically downgradient of the former UST area based on the understanding of the current, shallow horizontal groundwater flow direction. TRMW-4 is also located in the vicinity of the former dry well area. As discussed previously, the monitoring wells are screened below the water table, with TRMW-2 screened approximately 10 feet below the water table (screened from 20 to 30 ft bls) and TRMW-4 screened approximately 25 feet below the water table (screened from 35 to 45 ft bls). The last time that groundwater samples were collected from the monitoring well network was in March 1997, which was prior to the remedial activities that were implemented at the former UST area in 2003 and 2004. The highest and most recent total VOC (TVOC) concentration detected in each of the monitoring wells is summarized in the table below.

Monitoring Well ID	Highest TVOC Concentration (ug/L)	March 1997 TVOC Concentration (ug/L)
TRMW-1	ND	ND
TRMW-2	45	9
TRMW-3	4	3
TRMW-4	100	9
TRMW-5	1	ND

ND – VOCs not detected above laboratory detection limit

Groundwater samples collected from temporary monitoring wells in 2003 and 2004 in the vicinity of the former UST area indicated that the highest TVOC concentration detected was 640 ug/L at the GW-1 location (AARCO, 2004). The GW-1 temporary monitoring well was advanced in the southeastern corner of the former UST excavation area. The analytical results for the groundwater samples collected from temporary monitoring wells GW-1 through GW-4 (CA RICH, 2004) in the vicinity of the former UST area indicated that VOC concentrations were below NYSDEC Class GA groundwater standards.

To augment the existing permanent monitoring well network that is screened below the water table and to assess groundwater quality, additional on-site shallow temporary monitoring wells are proposed. The proposed on-site groundwater portion of the RI will consist of the drilling and sampling of eleven (11) temporary monitoring wells (AGW-1 through AGW-11) and the sampling of five (5) on-site existing permanent monitoring wells (TRMW-1 through TRMW-5). Proposed temporary monitoring well locations AGW-1 through AGW-11, with the exception of AGW-6 and AGW-10, will be drilled to approximately 55 ft bls. Groundwater samples will be collected from AGW-1 through AGW-5, AGW-7 through AGW-9, and AGW-11 from the following approximate depths: 1) 1-2 ft below the water table (estimated to be approximately 15 ft bls), 2) 35 ft bls

(approximately 20 ft below the water table and beneath the bottom of the screen interval of monitoring well TRMW-2), and, 3) 55 ft bls (approximately 40 ft below the water table and beneath the bottom of the screen intervals of monitoring wells TRMW-2 and TRMW-4). Proposed temporary monitoring well locations AGW-6 and AGW-10 will be drilled to approximately 1-2 ft below the water table and groundwater samples will be collected.

6.2.1.3. Proposed Soil Vapor Investigation

The proposed soil vapor portion of the RI consists of the advancement of nine (9) temporary points on-site and eight (8) temporary sub-slab points. The temporary exterior soil vapor points will be co-located with temporary monitoring wells AGW-1 through AGW-8 and AGW-11. The locations of the proposed temporary soil vapor points and sub-slab points are shown on Figure 2. Table 1 provides the complete description/rationale for the proposed scope of work.

The temporary exterior soil vapor points will be advanced to a depth of approximately 8 ft bls utilizing the direct push drilling methodology (Geoprobe® or equivalent equipment) and soil vapor samples will be collected using the Geoprobe® Post Run Tubing (PRT) System. The PRT System allows for the collection of soil vapor samples at the desired sampling depth while significantly reducing the chances of rod leakage and ambient air contamination. O-ring connections enable the PRT System to deliver a vacuum-tight seal that prevents sample contamination from ambient air and assures that the sample is taken from the desired depth at the bottom of the boring.

The temporary sub-slab points will be advanced utilizing a manual slide hammer (Geoprobe® or equivalent equipment) to a depth of approximately 2 inches below the bottom of the floor slab and soil vapor samples will be collected using the Geoprobe® PRT System.

6.2.2 Data Analysis and Management

Samples will be analyzed in accordance with the analytical methods listed in the QAPP (Appendix B). The chemistry data will be transferred from the laboratory and maintained in a database format. The laboratory will provide Electronic Data Deliverables (EDDs), which will be uploaded directly into the database.

For soil and groundwater analytical samples associated with the RI, the laboratory will produce NYSDEC ASP Category B deliverable packages and will produce Contract

Laboratory Program (CLP)-type data packages that will contain all information needed for formal validation of the data. For soil vapor analytical samples associated with the RI, the laboratory will produce Level IV electronic Comprehensive Validation Packages (eCVPs) that will contain all information needed for formal validation of the data. Data validation will be performed on the data in accordance with USEPA Region 2 Standard Operating Procedures (SOPs) (USEPA, 2001; USEPA, 2003). These procedures are specific with regard to evaluation of holding time, surrogate and spike recoveries, precision of duplicate measurements, instrument performance, blank contamination, compound identification, and compound quantification. Data will be qualified as necessary in accordance with the SOPs. Additional information is provided in the QAPP (Appendix B). Following completion of the above validation, data usability summary reports (DUSRs) will be prepared in accordance with DER-10 and appended to the RI Report.

6.2.3 Site Characterization Deliverables

Following full evaluation and analysis of the field and analytical data, a determination will be made as to the validity of the CSM. If it is determined that additional on-site or off-site characterization is necessary, those investigative activities will be detailed in a letter submitted to the NYSDEC, as described in Section 5.1. The comprehensive RI Report will be submitted following completion of the RI and full evaluation of data collected; this submittal and subsequent approval by the NYSDEC will conclude the RI process.

6.2.4 Sampling and Analysis Plan

The SAP is the umbrella document that consists of Appendices A through D. The SAP includes the following required elements:

- The FSP (Appendix A) defines sampling and data gathering methods consistent with NYSDEC Draft DER-10 (NYSDEC, 2002) and the "Field Methods Compendium," OER 9285.2-11 (draft July 1993).
- The QAPP (Appendix B) describes the QA/QC protocols necessary to achieve the initial data quality objectives.
- The HASP (Appendix C) protects persons at and near the Site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The CPP (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC, 1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002).

6.2.5 Evaluation of Data Gaps and Refining RI/FS Objectives

During the course of the data collection and evaluation tasks described in previous sections, remaining or new data gaps may be identified. If clear and pertinent data gaps are identified, they will be addressed with the NYSDEC with the goal of limiting the interruption in the field work.

6.2.6 Human Health Exposure Assessment

Upon completion of data collection and analysis, in accordance with DER-10, a qualitative exposure assessment will be performed and an exposure assessment report will be prepared to be included with the RI Report. The assessment will focus on identifying COPCs, evaluating actual or potential exposure pathways, characterizing the potentially exposed receptors, and identifying how any unacceptable exposure pathways might be eliminated/mitigated.

6.2.7 Remedial Investigation Report

Once sufficient information is collected to complete the RI and address the RI objectives, as described in Section 1.0 herein, then the RI Report will be prepared and submitted to the NYSDEC for review. The RI Report will incorporate relevant data generated on behalf of Target Rock prior to this RI, as discussed above, and will be written following applicable USEPA and NYSDEC guidance, and will be consistent with the requirements of the Order for the Site.

6.3 Feasibility Study

Once the RI has been approved by the NYSDEC, the need for performing an FS will be evaluated. If deemed appropriate, an FS will be performed in accordance with USEPA and NYSDEC guidelines and the Order. The FS process will include a

preliminary screening of alternatives, followed by an FFS that includes the evaluation of remedial alternatives for the Site that are appropriate under CERCLA, NYSDEC TAGMs, TOGs, and the NCP. At a minimum, alternatives will be evaluated for their ability to eliminate or mitigate significant threats to public health and the environment at the Site through the proper application of scientific and engineering principles.

6.3.1 Preliminary Screening of Alternatives

The "Preliminary Screening of Alternatives Letter Report" will be prepared as a deliverable after finalizing the RI Report and will be submitted to the NYSDEC for the purpose of obtaining NYSDEC agreement on a short-list of potential remedial alternatives prior to conducting the full analyses.

6.3.2 Focused Feasibility Study

It is anticipated that preparation of an FFS will streamline efforts and NYSDEC decisions related to a preferred remedy (if additional remedial actions are warranted).

6.3.2.1. Detailed Analysis of Alternatives

A detailed analysis of alternatives described in the FFS will be performed. The analysis of each remedial alternative will be based on an evaluation of the nine criteria established in the NCP and NYSDEC TAGM #4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990).

The FFS will be submitted to the NYSDEC following approval of the RI report.

7. Project Management Plan

For project responsibilities and communication see the organization chart in the QAPP (Appendix B). At the appropriate time, an ARCADIS New York licensed professional engineer will serve as FS Task Manager.

Subcontractors used for specialty services, such as drilling, laboratory analysis, surveying, etc. will be subcontractors that ARCADIS has relied on for similar tasks performed previously. Any subcontractor utilized will meet the requirements of the NYSDEC.

7.1 Project Schedule

This section presents a conceptual target duration schedule for implementing the RI activities presented in this RI/FS Work Plan. Once written approval is received from the NYSDEC to implement the RI field activities, a revised schedule with target dates will be submitted to the NYSDEC. The project duration will depend on whether additional investigation efforts are required, as described in Section 5.1. Once the RI is complete the schedule will be updated to include the RI Report and the FS, if required.

Work Activity	*Duration*
RI/FS Work Plan Approval	--
Mobilization (including scheduling of drilling subcontractor and utility clearance)	2 weeks
Implement On-Site RI Field Activities	3 weeks
Laboratory Analysis of Samples	2 weeks

The NYSDEC will be provided with five (5) days advance notice of the commencement of field work. In general, the sequence of field activities and related rationale for the RI are as follows:

1. Conduct pre-field planning including field verification of sampling locations and utility mark-outs.

2. Perform on-site RI soil boring, temporary monitoring well advancement, temporary soil vapor point advancement, and temporary sub-slab soil vapor point advancement, and collect soil, groundwater, soil vapor, and sub-slab soil vapor samples. These data will provide information on whether further characterization of VOCs is needed.

3. If necessary based on the data collected in item 2, prepare a letter detailing additional activities that may be required, as described in Section 5.1.

4. Prepare and issue RI Report.

8. References

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Table 1. Summary of Proposed Remedial Investigation and Rationale, Target Rock Site, East Farmingdale, New York.

Sample Location	Proposed Sample ID	Proposed Total Depth (ft bls)	Proposed Groundwater Sampling Intervals (ft bls)	Proposed Groundwater Laboratory Analysis	Proposed Soil Vapor Sampling Interval (ft bls)	Proposed Soil Vapor Laboratory Analysis	Proposed Soil Core Collection Interval [1] (ft bls)	Proposed Soil Laboratory Analysis	General Rationale
Former Dry Well Area and Downgradient of Former UST Area	AGW-1	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To augment existing permanent monitoring well TRMW-4 that is screened approximately 25 feet below the water table and to assess groundwater quality.
	SV-1	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the southern perimeter/property boundary.
Downgradient of Former UST Area	AGW-2	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To augment existing permanent monitoring well TRMW-2 that is screened approximately 10 feet below the water table and to assess groundwater quality.
	SV-2	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the southern perimeter/property boundary.
Downgradient of Former UST Area	AGW-3	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To assess groundwater quality along the eastern side of the west building and downgradient of the former UST area.
	SV-3	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the eastern side of the west building.
Southwestern Property Boundary	AGW-4	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To assess groundwater quality along the southwestern property boundary.
	SV-4	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the southwestern property boundary.
Western Property Boundary	AGW-5	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To assess groundwater quality along the western perimeter/property boundary.
	SV-5	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the western perimeter/property boundary.
Western Property Boundary	AGW-6	17	16 - 17	TCL VOC	--	--	--	--	To assess shallow (i.e., water table) groundwater quality along the western perimeter/property boundary.
	SV-6	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the western perimeter/property boundary.
Southern Property Boundary	AGW-7	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To assess groundwater quality along the southern perimeter/property boundary.
	SV-7	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the southern perimeter/property boundary.

See footnotes on last page.

Table 1. Summary of Proposed Remedial Investigation and Rationale, Target Rock Site, East Farmingdale, New York.

Sample Location	Proposed Sample ID	Proposed Total Depth (ft bls)	Proposed Groundwater Sampling Intervals (ft bls)	Proposed Groundwater Laboratory Analysis	Proposed Soil Vapor Sampling Interval (ft bls)	Proposed Soil Vapor Laboratory Analysis	Proposed Soil Core Collection Interval [1] (ft bls)	Proposed Soil Laboratory Analysis	General Rationale
Drum Storage Area	AGW-8	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	0 - 16	TCL VOC	Proposed Soil Boring AGW-8 will be advanced in the vicinity of the drum storage area to assess soil quality just above the water table (i.e., capillary fringe zone) and to assess groundwater quality.
	SV-8	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality in the vicinity of the drum storage area.
Former UST Area	AGW-9	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	8 - 16	TCL VOC	Proposed Soil Boring AGW-9 will be advanced in the former UST area to characterize soil quality just above the water table (i.e., capillary fringe zone) and to assess groundwater quality. The soil quality data will be used to evaluate if there is a continuing source of VOC impacts to groundwater.
Former UST Area	AGW-10	17	16 - 17	TCL VOC	--	--	8 - 16	TCL VOC	Proposed Soil Boring AGW-10 will be advanced in the former UST area to characterize soil quality just above the water table (i.e., capillary fringe zone) and to assess the shallow (i.e., water table) groundwater quality. The soil quality data will be used to evaluate if there is a continuing source of VOC impacts to groundwater.
Southern Property Boundary	AGW-11	55	16 - 17 34 - 35 54 - 55	TCL VOC	--	--	--	--	To assess groundwater quality along the southern perimeter/property boundary.
	SV-9	8	--	--	7.5 - 8	TO-15 VOC List [2]	--	--	To assess soil vapor quality along the southern perimeter/property boundary.
Sub-Slab Soil Vapor	SS-1 through SS-6	-- [3]	--	--	-- [3]	TO-15 VOC List [2]	--	--	To assess sub-slab soil vapor quality beneath the west building.
	SS-7 and SS-8	-- [3]	--	--	-- [3]	TO-15 VOC List [2]	--	--	To assess sub-slab soil vapor quality beneath the southwest portion of the east building.
Existing On-Site Monitoring Wells	TRMW-1	--	--	TCL VOC	--	--	--	--	Sampling of the monitoring wells will determine the current VOC concentrations at depths approximately 10 to 30 feet below the water table. These data will be used in conjunction with the VPB data to assess groundwater quality on-site.
	TRMW-2	--	--	TCL VOC	--	--	--	--	
	TRMW-3	--	--	TCL VOC	--	--	--	--	
	TRMW-4	--	--	TCL VOC	--	--	--	--	
	TRMW-5	--	--	TCL VOC	--	--	--	--	

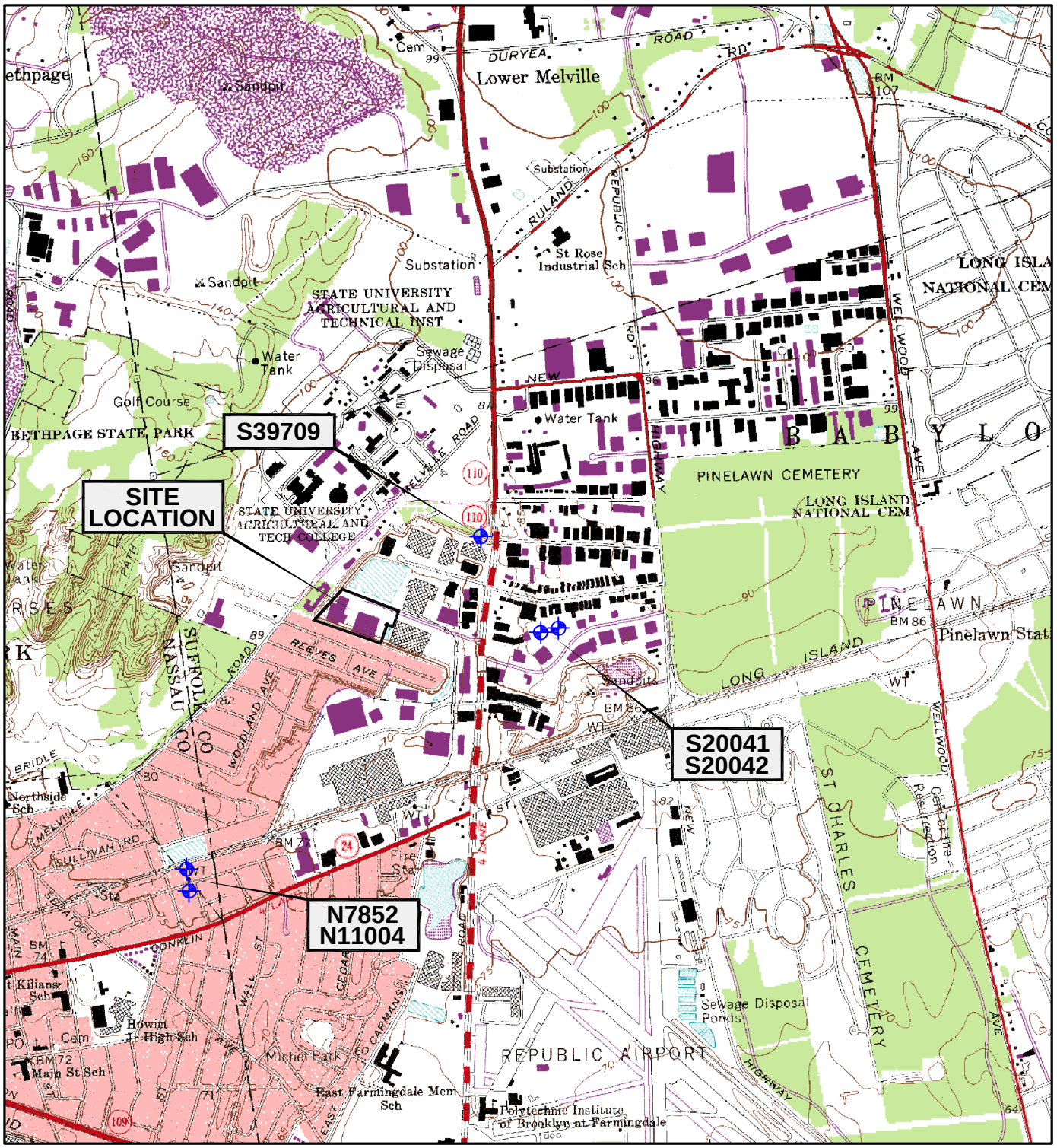
1 This is the interval that soil cores will be collected from for lithologic description and field screening purposes. A soil sample will be collected from the capillary fringe zone and submitted to the laboratory for analysis. Additional samples will be collected if PID readings above background concentrations are detected. In addition, any soil sample exhibiting a PID reading of 50 ppm or greater above background concentrations will be submitted to the laboratory for analysis.

2 EPA Method TO-15 Volatile Organic Compound List (Modified Air Toxics Ltd. TO-15 Low-Level Compound List). This list is consistent with the aqueous and soil VOC list.

3 Sub-slab soil vapor samples will be collected at an approximate depth of 2 inches below the bottom of the floor slab.

ft bls Feet below land surface.

TCL VOC Target Compound List Volatile Organic Compounds.



MAP SOURCE: USGS 7.5 MINUTE QUADRANGLES, HUNTINGTON, NY, 1979 AND AMITYVILLE, NY, 1979.

LEGEND:

PUBLIC WATER SUPPLY WELL

TARGET ROCK SITE
EAST FARMINGDALE, NEW YORK

PUBLIC WATER SUPPLY WELL LOCATIONS

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FIGURE 1

CITY:MELVILLE DIV/GROUP:ENV DB:ALS LD: PIC: PM:MW TM:CK LYR:ON=*;OFF=*REF* G:\APROJECT\Curtiss-Wright\Target Rock\CAD\Final RI FS WP Figures\Figure 1.dwg LAYOUT: 1SAVED: 6/30/2008 11:29 AM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---PLOTSTYLETABLE: ARCADIS_MELVILLE.CTB PLOTTED: 10/2/2008 4:47 PM BY: SANCHEZ, ADRIAN

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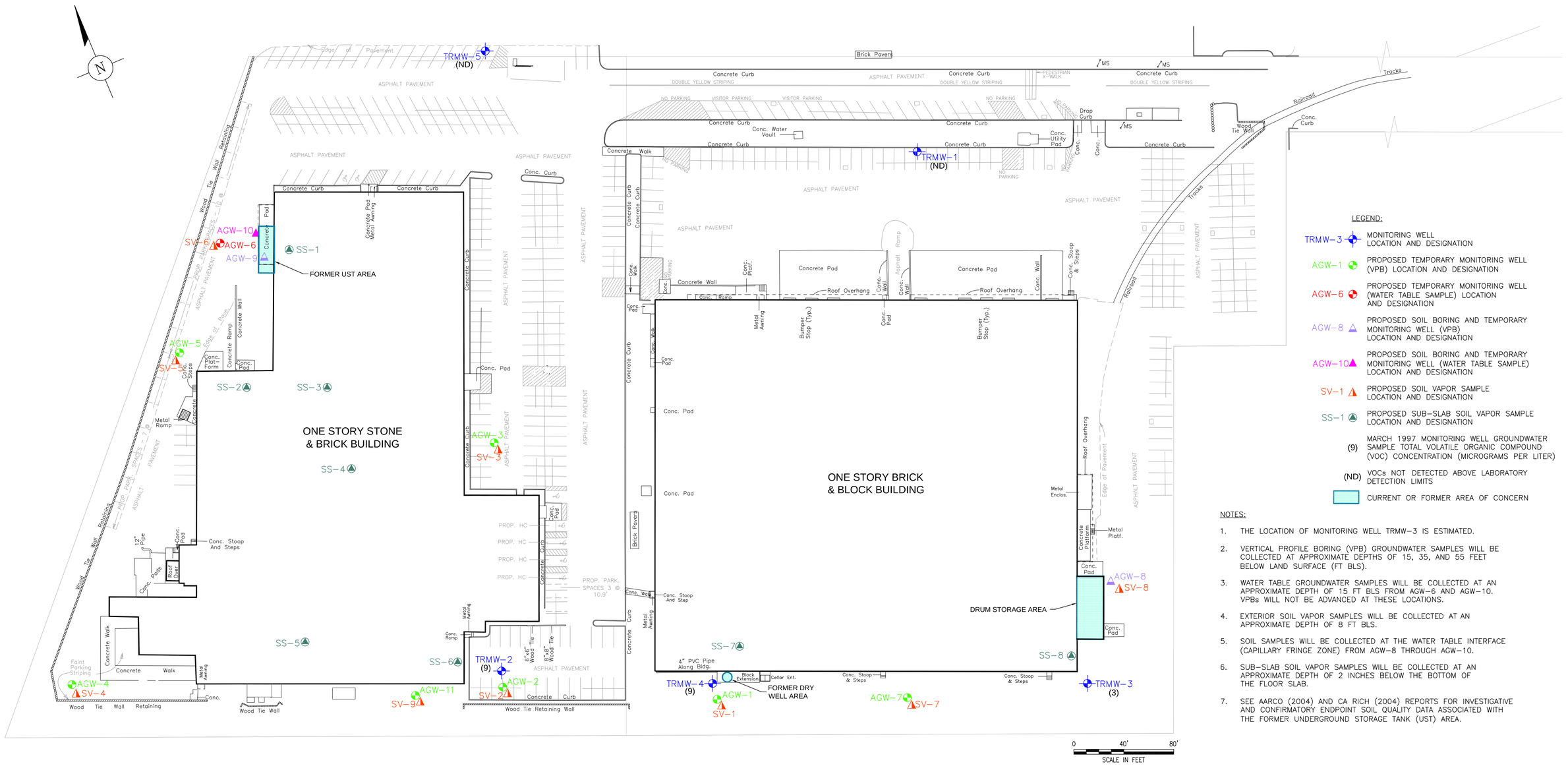

LEGEND:

- TRMW-3 — MONITORING WELL LOCATION AND DESIGNATION
- AGW-1 — PROPOSED TEMPORARY MONITORING WELL (VPB) LOCATION AND DESIGNATION
- AGW-6 — PROPOSED TEMPORARY MONITORING WELL (WATER TABLE SAMPLE) LOCATION AND DESIGNATION
- AGW-8 — PROPOSED SOIL BORING AND TEMPORARY MONITORING WELL (VPB) LOCATION AND DESIGNATION
- AGW-10 — PROPOSED SOIL BORING AND TEMPORARY MONITORING WELL (WATER TABLE SAMPLE) LOCATION AND DESIGNATION
- SV-1 — PROPOSED SOIL VAPOR SAMPLE LOCATION AND DESIGNATION
- SS-1 — PROPOSED SUB-SLAB SOIL VAPOR SAMPLE LOCATION AND DESIGNATION
- (9) — MARCH 1997 MONITORING WELL GROUNDWATER SAMPLE TOTAL VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION (MICROGRAMS PER LITER)
- (ND) — VOCs NOT DETECTED ABOVE LABORATORY DETECTION LIMITS
- CURRENT OR FORMER AREA OF CONCERN

NOTES:

1. THE LOCATION OF MONITORING WELL TRMW-3 IS ESTIMATED.
2. VERTICAL PROFILE BORING (VPB) GROUNDWATER SAMPLES WILL BE COLLECTED AT APPROXIMATE DEPTHS OF 15, 35, AND 55 FEET BELOW LAND SURFACE (FT BLS).
3. WATER TABLE GROUNDWATER SAMPLES WILL BE COLLECTED AT AN APPROXIMATE DEPTH OF 15 FT BLS FROM AGW-6 AND AGW-10. VPBs WILL NOT BE ADVANCED AT THESE LOCATIONS.
4. EXTERIOR SOIL VAPOR SAMPLES WILL BE COLLECTED AT AN APPROXIMATE DEPTH OF 8 FT BLS.
5. SOIL SAMPLES WILL BE COLLECTED AT THE WATER TABLE INTERFACE (CAPILLARY FRINGE ZONE) FROM AGW-8 THROUGH AGW-10.
6. SUB-SLAB SOIL VAPOR SAMPLES WILL BE COLLECTED AT AN APPROXIMATE DEPTH OF 2 INCHES BELOW THE BOTTOM OF THE FLOOR SLAB.
7. SEE AARCO (2004) AND CA RICH (2004) REPORTS FOR INVESTIGATIVE AND CONFIRMATORY ENDPOINT SOIL QUALITY DATA ASSOCIATED WITH THE FORMER UNDERGROUND STORAGE TANK (UST) AREA.

TARGET ROCK SITE
EAST FARMINGDALE, NEW YORK

REMEDIAL INVESTIGATION PROGRAM PROPOSED SOIL BORING, TEMPORARY MONITORING WELL, AND SOIL VAPOR SAMPLE LOCATIONS

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FIGURE 2

CITY:MELVILLE DIV/GROUP:ENV DB:ALS LD: PIC: PM:MW TM:CK LYR:ON=*;OFF=*REF*
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Basemap

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Appendix A

Field Sampling Plan

ARCADIS
Infrastructure, environment, facilities

Imagine the result

Curtiss-Wright Flow Control Corporation, Target Rock Division

Appendix A

Field Sampling Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site Number 1-52-119

December 30, 2008

ARCADIS

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Senior Scientist

Douglas A. Smolensky
Senior Project Advisor/Hydrogeologist

Michael W. Wolfert
Project Manager/Hydrogeologist

Appendix A
Field Sampling Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site # 1-52-119

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Our Ref.:
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Date:
December 30, 2008

1. Introduction

This Field Sampling Plan (FSP) has been prepared by ARCADIS on behalf of Curtiss-Wright Flow Control Corporation, Target Rock Division (Target Rock) as a component of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Target Rock Site (Site) in East Farmingdale, New York (NYSDEC Site Number 1-52-119). The FSP serves as the primary reference that describes the methods and procedures for environmental sample collection activities conducted under direction of the New York State Department of Environmental Conservation (NYSDEC) for the NYS Superfund Program for the Site.

This FSP has been prepared as a component of the Sampling and Analysis Plan (SAP), which is the umbrella document that consists of Appendices A through D of the RI/FS Work Plan. The SAP includes the following required elements:

- This FSP (Appendix A) defines sampling and data gathering methods consistent with NYSDEC Draft DER-10 (NYSDEC, 2002) and the "Field Methods Compendium," OER 9285.2-11 (draft July 1993).

- The Quality Assurance Project Plan (QAPP) (Appendix B) describes the quality assurance/quality control (QA/QC) protocols necessary to achieve the project data quality objectives.

- The Health and Safety Plan (HASP) (Appendix C) details procedures for protecting persons at and near the Site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The Citizen Participation Plan (CPP) (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC, 1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002). Various cross-references to other portions of the SAP are included, as appropriate, in the following sections.

The Community Air Monitoring Plan (CAMP) is included as Attachment A-1 to this FSP.

1.1 Plan Organization

This FSP contains the following sections:

- Section 2: "Site Description and Background" provides the Site description.
- Section 3: "Remedial Investigation Activities" summarizes the type of sampling to be performed in accordance with the FSP.
- Section 4: "Pre-Field Preparation and Equipment" describes preparation and equipment needed prior to mobilization to the field.
- Section 5: "Sampling Associated with Remedial Investigation Activities" describes the sampling associated with the following RI activities:
    - Drilling of soil borings and collection of soil samples.
    - Drilling of temporary monitoring wells and collection of groundwater samples.
    - Drilling of temporary soil vapor points and collection of soil vapor samples.
    - Drilling of temporary sub-slab soil vapor points and collection of sub-slab soil vapor samples.
    - Collection of groundwater samples from permanent monitoring wells.
    - Collection of hydraulic (water-level) measurements from permanent monitoring wells.
- Section 6: Investigation-Derived Waste (IDW) Sampling.
- Section 7: Sample Collection, Labeling, Handling, and Analysis.
- Section 8: Field Decontamination Procedures.

- Section 9: Waste Management and Disposal.

2. Site Description and Background

The Site is located at 1966E Broadhollow Road, East Farmingdale, Town of Babylon, Suffolk County, New York and is identified by Tax Map Number: District 0100, Section 031, Block 1, Lots 2.2 through 2.4. The approximately 11-acre Site contains two manufacturing buildings (east building and west building), each situated on 5-acre lots, and a 1-acre right-of-way. The west building is used for manufacturing and contains office space; the east building is used for shipping and receiving, valve testing, and contains additional manufacturing and office space. The areas of the Site not occupied by buildings are largely paved and used for parking. The Site is secured by a perimeter fence and automatic gate. The Site is situated on relatively flat topography on the western edge of an industrial area. Residential areas are located to the west and south of the Site. A commercial building is located to the north of the Site.

Target Rock manufactures valves used primarily for nuclear power applications. Manufacturing processes include machining and testing of valves. One of the elements of the manufacturing process is the non-destructive testing of the valves for minor cracks. Target Rock began manufacturing operations at the Site in 1982 and operations have been ongoing to the present.

3. Remedial Investigation Activities

The primary goals of the proposed RI activities are listed in Section 5.2 (RI Goals) of the RI/FS Work Plan. Sample collection efforts include obtaining discrete soil samples from soil borings, groundwater samples from temporary and permanent monitoring wells, soil vapor and sub-slab soil vapor from temporary points, and IDW liquid media samples for waste characterization purposes.

4. Pre-Field Preparation and Equipment

The following sections describe the preparation that will be performed and equipment that is needed prior to mobilization to the field to conduct the activities specified in this FSP. The field project team (technicians, scientists, and engineers) will be responsible for obtaining, operating, and maintaining the required equipment, collecting the samples as specified herein, and for procuring and maintaining sample containers or canisters pertinent to the collection of environmental samples. The following text describes these procedures in detail.

In general, the pre-cleaned environmental sample containers (bottles) or canisters (SUMMA® canisters) will be provided by the analytical laboratory in accordance with procedures and requirements set forth in the QAPP (Appendix B). The sample containers or canisters will be inventoried and inspected prior to sampling to verify that the required containers or canisters are present and in good condition. Specific sample container and canister inspection procedures are as follows:

- Water and soil sample bottles will be inventoried and inspected to ensure that the required bottles are present, visually clean, unbroken, and have been properly preserved (see QAPP) by the laboratory.

- SUMMA® canisters (for soil vapor sample collection) will be inventoried and inspected to ensure that the required canisters and flow controllers are present, the canisters have the proper initial vacuum (see QAPP), and the gauges are working properly.

Field equipment will be inventoried and inspected by the field team members performing the work. The equipment and forms listed below will be available and used during the course of the field activities:

- Personal Protective Equipment (PPE) and air monitoring equipment, as defined in the HASP and CAMP.

- Health and safety forms as specified in the HASP.

- Field daily logs or bound logbook, as specified in the QAPP.

- Weighted tape measure, accurate to one-hundredth of one foot.

- Micro-90® low-phosphate detergent (or equivalent) and new scrub brushes.

- Sufficient quantities of distilled/deionized water.

- 4-millimeter thick plastic sheeting.

- Digital Camera.

The following additional equipment/forms shall be used during collection of soil samples for lithologic characterization and/or laboratory analysis:

- Sample/Core Logs, calibration logs, and chain-of-custody forms (as specified in the QAPP).
- Portable table for logging soil samples.
- Two, plastic 5-gallon buckets for soil core sampler (i.e., Geoprobe® Macro-Core® Soil Sampler) decontamination (decontamination procedures are provided in Section 8 of this FSP).
- Stainless steel spoon or trowel for soil sample collection.
- Plastic coolers for sample preservation, storage, and shipment.
- Soil sample containers (dependent on analysis performed; refer to the QAPP – Appendix B).

The following additional equipment/forms shall be used during collection of groundwater samples from temporary and permanent monitoring wells:

- Water Sampling Logs, calibration logs, and chain-of-custody forms (as specified in the QAPP).
- Variable speed, 2-inch diameter submersible pump, motor lead, support cable, submersible pump control box, and portable 110-volt or 230-volt generator.
- New polyethylene tubing.
- Electronic water-level indicator, accurate to one-hundredth of one foot.
- Portable field parameter meters including pH, conductivity, temperature, and the associated calibration standards.
- Purge water containers (New York State Department of Transportation-compliant 55-gallon capacity "bung-top" drums).
- Plastic coolers for sample preservation, storage, and shipment.
- Water sample containers (dependent on analysis performed; refer to the QAPP – Appendix B).

- Other required equipment not specified herein will be provided by the drilling subcontractor.

The following additional equipment/forms shall be used during collection of soil vapor and sub-slab soil vapor samples from temporary soil vapor and sub-slab soil vapor points:

- Soil Vapor and Sub-Slab Soil Vapor Sampling Logs, calibration logs, and chain-of-custody forms (as specified in the QAPP).
- New ¼-inch inside diameter (I.D.) Teflon®-lined tubing.
- New ¼-inch outside diameter (O.D.) Teflon® tubing.
- Fittings and wrenches.
- A portable vacuum pump capable of producing very low flow rates (i.e., 100 to 200 milliliters per minute [mL/min]).
- Rotameter or an electric flow sensor.
- Tracer gas source (i.e., helium).
- Helium detector.
- Stainless steel SUMMA® canisters.
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes) or flow rate (e.g., 200 mL/min).
- Stainless steel "T" fitting (for collecting duplicate samples).
- Other required equipment not specified herein will be provided by the drilling subcontractor.

5. Sampling Associated with Remedial Investigation Activities

The following sections describe the sampling methods associated with the RI activities. The QAPP provides additional details regarding Field Records and QA/QC samples

frequency and protocols (Section 4.1 – Field QA/QC), sample labeling (Section 4.2 – Preparation and Preservation of Sample Containers), and sample custody (Section 4.4 – Sample Custody).

5.1 Sample Locations

The locations of the proposed soil borings, proposed temporary monitoring wells, proposed temporary soil vapor and sub-slab soil vapor points, and the locations of existing monitoring wells proposed for sampling as part of the RI are shown on Figure 2 of the RI/FS Work Plan.

5.2 Soil Borings

This section describes the methods to collect soil samples from soil borings. The soil borings will be drilled using direct push drilling methodology. Soil cores will be collected from the soil borings using a Geoprobe® Macro-Core® Soil Sampler.

Soil sample collection rationale for the RI is described in Section 6.2.1 of the RI/FS Work Plan. Soil samples will be analyzed for the analytes specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan. Additional details on soil sample collection are described below.

The drilling and sampling of soil borings will include the following activities:

1. Determine location of the soil boring and avoid overhead/underground utilities, per the HASP.

2. The approximate location will be measured and shown on a location sketch.

3. The direct push drill rig will be mobilized to the proposed location.

4. If asphalt or concrete pavement is present, the driller will drill or core through the pavement, exposing the underlying surface soil.

5. Drilling will commence and soil cores will be collected as specified in the RI/FS Work Plan.

6. The field geologist (in coordination with Driller) will monitor the formation drilled through evaluation of collected soil cores.

7. Soil samples will be collected for the specified analyses (see RI/FS Work Plan and QAPP for details).

8. Boreholes will be abandoned as described below.

Discrete soil cores will be collected using a Geoprobe® Macro-Core® Soil Sampler. The Geoprobe® Macro-Core® Soil Sampler will be equipped with a stop-pin and piston (Closed-Piston Soil Sampling). The general sequence of soil core collection (by Driller), lithologic logging (by field Geologist), soil sample collection (by field Geologist), and record keeping is as follows:

- Fit the sampler with a disposable soil sampler liner.
- Lower the sampler to the desired sampling depth.
- Remove stop-pin and piston rod to release point assembly.
- Drive sampler to collect representative soil core.
- Withdraw the sampler from the borehole, remove soil sampler liner from sampler, and cut soil sampler liner to expose undisturbed soil core.
- Record the amount of recovery and soil type on the Sample/Core Log. Specific information recorded will include:
    - The structure of the soils sampled, including layering/stratification features, and the dominant soil types.
    - The color of soils.
    - The moisture content of soils.
    - Soil grain features, including grain sizes, degree of sorting, angularity, and mineralogy.
    - Identification of any rock fragments, organic material, or other components.

- Following collection, the soil core sample will be screened for volatile organic compounds (VOCs) using a photoionization detector (PID). The HASP provides health and safety action levels.

- Soil samples will be collected for the appropriate laboratory analysis (see QAPP and Table 1 of the RI/FS Work Plan).

- Sample collection, labeling, and handling procedures are described in Section 7 of this FSP.

- Soil not submitted for laboratory analysis will be placed back into the borehole and clean sand will be used to backfill the balance of the borehole to land surface.

- The sampler will be decontaminated in accordance with Section 8 of this FSP.

5.3 Temporary Monitoring Wells

This section describes the methods to collect groundwater samples from temporary monitoring wells. The temporary monitoring well boreholes will be drilled using direct push drilling methodology. Groundwater samples will be collected from the temporary monitoring wells using a Geoprobe® Screen Point Groundwater Sampler (water table samples) or a Geoprobe® Groundwater Profiler (vertical profile borings [VPBs]).

The temporary monitoring well groundwater samples are intended to serve as screening-level samples that will be collected from a temporary well; therefore, temporal repeat sampling of temporary monitoring well sample intervals will not be performed.

Groundwater sample collection rationale for the groundwater portion of the RI is described in Section 6.2.1 of the RI/FS Work Plan. Groundwater samples will be analyzed for the analytes specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan. Additional details on temporary monitoring well groundwater sample collection are described below.

5.3.1 Temporary Monitoring Well Drilling and Groundwater Sampling

Groundwater samples will be collected from temporary monitoring wells using a Geoprobe® Screen Point Groundwater Sampler or a Geoprobe® Groundwater Profiler.

The general sequence of temporary monitoring well advancement (by Driller), groundwater sample collection (by field Geologist), and record keeping is as follows:

- The assembled Geoprobe® Screen Point Groundwater Sampler will be driven to the desired sampling depth.
- Extension rods will be used to hold the temporary screen in position while the probe rods and sampler sheath are retracted to expose the screen. The sampler sheath will form a mechanical annular seal above the screen interval.
- Polyethylene tubing will be fitted with a check valve assembly (check valve and check ball) and lowered into the screen interval.
- The tubing and check valve assembly will be oscillated up and down to pump groundwater to the surface.
- Once groundwater has been pumped to the surface, the tubing and check valve assembly will be withdrawn from the screen interval and probe rods, and groundwater will be decanted from the tubing to allow for the collection of the groundwater sample for the appropriate laboratory analysis (see QAPP and Table 1 of the RI/FS Work Plan).
- If a VPB will be advanced at a location, a Geoprobe® Groundwater Profiler will be used as follows:
    - Dual tube probe rods and a solid drive point will be driven to the desired sampling depth.
    - The inner 1-inch diameter probe rods and solid drive point will be removed so that a Schedule 40 polyvinyl chloride (PVC) screen can be installed.
    - Extension rods equipped with an insert tool will be used to lower and hold the screen assembly in position at the base of the cutting shoe.
    - A rod grip handle will then be used to retract the outer 2.25-inch diameter probe rods as the screen is held in position with the extension rods.

- As the probe rods are retracted, the 0.75-inch diameter, 12-inch long, 10-slot screen is exposed to the formation. The screen head seats against the reduced ID of the cutting shoe and O-rings provide a seal.
- Polyethylene tubing will be fitted with a check valve assembly (check valve and check ball) and lowered into the screen interval.
- The tubing and check valve assembly will be oscillated up and down to pump groundwater to the surface.
- Groundwater will be purged from each sampling interval prior to sample collection.
- Once groundwater purging has been completed, the tubing and check valve assembly will be withdrawn from the screen interval and probe rods, and groundwater will be decanted from the tubing to allow for the collection of the groundwater sample for the appropriate laboratory analysis (see QAPP and Table 1 of the RI/FS Work Plan).
- The screen will be retrieved using a retrieval tool.
- The 1-inch diameter probe rods and solid drive point will be reinserted into the drill string to advance to the next sampling interval.

- Sample collection, labeling, and handling procedures are described in Section 7 of this FSP.
- The borehole will be backfilled with clean sand if only a water table groundwater sample will be collected.
- The borehole will be abandoned with a 95% cement/5% bentonite grout mixture from the bottom up if a VPB is advanced.
- The sampling equipment will be decontaminated in accordance with Section 8 of this FSP.

5.4 Temporary Soil Vapor Points

This section describes the methods to collect soil vapor samples from temporary soil vapor points. The temporary soil vapor point boreholes will be drilled using direct push drilling methodology. Soil vapor samples will be collected from the temporary soil vapor points using the Geoprobe® Post Run Tubing (PRT) System. The PRT System allows for the collection of soil vapor samples at the desired sampling depth while significantly reducing the chances of rod leakage and ambient air contamination. O-ring connections enable the PRT System to deliver a vacuum-tight seal that prevents sample contamination from ambient air and assures that the sample is taken from the desired depth at the bottom of the boring. A tracer gas (i.e., helium) test will be conducted at all of the temporary soil vapor point locations to check the seal established around the sampling point.

The temporary soil vapor point samples are intended to serve as screening-level samples that will be collected from a temporary point; therefore, temporal repeat sampling of temporary soil vapor point sample intervals will not be performed.

Soil vapor sample collection rationale for the soil vapor portion of the RI is described in Section 6.2.1 of the RI/FS Work Plan. Soil vapor samples will be analyzed for the analytes specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan. Additional details on temporary soil vapor point sample collection are described below.

5.4.1 Temporary Soil Vapor Point Drilling and Soil Vapor Sampling

Soil vapor samples will be collected from temporary soil vapor points using the Geoprobe® PRT System. The general sequence of temporary soil vapor point advancement (by Driller), soil vapor sample collection (by field Geologist), and record keeping is as follows:

- A temporary soil vapor sampling point consisting of 1.25-inch diameter steel drive rods will be advanced to a depth of approximately 8 feet below land surface (ft bls).

- An expendable PRT System point holder and expendable PRT System point will be affixed at the downhole end of the rods. Once the desired sample depth is reached, the sampling assembly will be retracted approximately 6 inches, allowing the expendable point to disengage from the rods, and creating a void in the subsurface for soil vapor sample collection.

- A bentonite seal will be placed around the outside of the rods at the ground surface.

- Teflon®-lined tubing (¼-inch I.D.) and a PRT adapter will then be inserted down the center of the rods. A bentonite seal will be placed around the outside of the tubing and the inside of the rods. The system is airtight and the potential for rod leakage is significantly reduced using O-ring connections and the bentonite seals. New Teflon®-lined tubing will be used at each sample location.

- A portable vacuum pump and rotameter will be used to purge at least 1.5 volumes of air from the temporary soil vapor point and tubing at a rate of approximately 100 to 200 mL/min. Tracer gas (i.e., helium) testing will be conducted during purging to check the seal established around the temporary soil vapor point. Organic vapors levels will be measured with a PID and the purged air will be monitored for the presence of helium using the helium detector.

- A laboratory pre-calibrated 0.5-hour flow controller (i.e., calibrated to collect the soil vapor sample at a rate of less than 200 mL/min) with an in-line particulate filter and vacuum gauge will be attached to the SUMMA® canister.

- Following purging and tracer gas testing, the ¼-inch I.D. Teflon®-lined tubing will be connected to the ¼-inch O.D. Teflon® tubing using a reducing coupling and the ¼-inch O.D. Teflon® tubing will be connected to the flow controller and the SUMMA® canister.

- A duplicate soil vapor sample will be collected at one of the locations using a stainless steel "T" fitting and a second SUMMA® canister.

- The SUMMA® canister valve will be opened, the sample start time and initial vacuum will be recorded, and the soil vapor sample will be collected.

- The SUMMA® canister vacuum and sample time duration will be monitored during sampling and the SUMMA® canister valve will be closed when the vacuum is between 5 and 10 inches of mercury (Hg).

- The sample end time and final vacuum will be recorded. Weather-related data such as barometric pressure and wind speed will also be recorded.

- Soil vapor samples will be collected for the appropriate laboratory analysis (see QAPP and Table 1 of the RI/FS Work Plan).
- Sample collection, labeling, and handling procedures are described in Section 7 of this FSP.
- The borehole will be backfilled with clean sand.
- The rods will be decontaminated in accordance with Section 8 of this FSP.

5.5 Temporary Sub-Slab Soil Vapor Points

This section describes the methods to collect sub-slab soil vapor samples from temporary sub-slab soil vapor points. The temporary sub-slab soil vapor point boreholes will be drilled using a core drill or rotary hammer drill and a manual slide hammer. Sub-slab soil vapor samples will be collected from the temporary sub-slab soil vapor points using the Geoprobe® PRT System.

The temporary sub-slab soil vapor point samples are intended to serve as screening-level samples that will be collected from a temporary point; therefore, temporal repeat sampling of temporary sub-slab soil vapor point sample intervals will not be performed.

Sub-slab soil vapor sample collection rationale for the soil vapor portion of the RI is described in Section 6.2.1 of the RI/FS Work Plan. Sub-slab soil vapor samples will be analyzed for the analytes specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan. Additional details on temporary sub-slab soil vapor point sample collection are described below.

5.5.1 Temporary Sub-Slab Soil Vapor Point Drilling and Soil Vapor Sampling

Sub-slab soil vapor samples will be collected from temporary sub-slab soil vapor points using the Geoprobe® PRT System. The general sequence of temporary sub-slab soil vapor point advancement (by Driller), sub-slab soil vapor sample collection (by field Geologist), and record keeping is as follows:

- A 1.5-inch diameter borehole will be advanced through the concrete floor slab using a core drill or rotary hammer drill.

- A temporary sub-slab soil vapor sampling point consisting of 1.25-inch diameter steel drive rods will be advanced using a manual slide hammer to a depth of approximately 3 inches below the bottom of the floor slab.

- An expendable PRT System point holder and expendable PRT System point will be affixed at the downhole end of the rods. Once a depth of 3 inches below the bottom of the floor slab is reached, the sampling assembly will be retracted approximately 3 inches, allowing the expendable point to disengage from the rods, and creating a void in the subsurface for sub-slab soil vapor sample collection.

- A bentonite seal will be placed around the outside of the rods at the floor slab surface.

- Teflon®-lined tubing (¼-inch I.D.) and a PRT adapter will then be inserted down the center of the rods. A bentonite seal will be placed around the outside of the tubing and the inside of the rods. The system is airtight and the potential for rod leakage is significantly reduced using O-ring connections and the bentonite seals. New Teflon®-lined tubing will be used at each sample location.

- A portable vacuum pump and rotameter will be used to purge at least 1.5 volumes of air from the temporary sub-slab soil vapor point and tubing at a rate of approximately 100 to 200 mL/min.

- A laboratory pre-calibrated 0.5-hour flow controller (i.e., calibrated to collect the soil vapor sample at a rate of less than 200 mL/min) with an in-line particulate filter will be attached to the SUMMA® canister.

- Following purging, the ¼-inch I.D. Teflon®-lined tubing will be connected to the ¼-inch O.D. Teflon® tubing using a reducing coupling and the ¼-inch O.D. Teflon® tubing will be connected to the flow controller and the SUMMA® canister.

- The SUMMA® canister valve will be opened, the sample start time and initial vacuum will be recorded, and the sub-slab soil vapor sample will be collected.

- The SUMMA® canister vacuum and sample time duration will be monitored during sampling and the SUMMA® canister valve will be closed when the vacuum is between 5 and 10 inches of Hg.

- The sample end time and final vacuum will be recorded. Weather-related data such as barometric pressure and wind speed will also be recorded.

- Sub-slab soil vapor samples will be collected for the appropriate laboratory analysis (see QAPP and Table 1 of the RI/FS Work Plan).

- Sample collection, labeling, and handling procedures are described in Section 7 of this FSP.

- The borehole will be backfilled with clean sand to the bottom of the floor slab and the concrete floor slab will be restored with hydraulic cement.

- The rods will be decontaminated in accordance with Section 8 of this FSP.

5.6 Groundwater Sample Collection and Hydraulic Measurements in Monitoring Wells

As described in the RI/FS Work Plan (and summarized in Table 1 of the RI/FS Work Plan), existing monitoring wells will be sampled as part of the groundwater RI.

5.6.1 Hydraulic Measurements

Hydraulic (i.e., water-level) measurements will be collected using the following procedures:

1. For each monitoring well location, water-level measurements will be collected by measuring the depth to groundwater from the surveyed measuring point.

2. The water-level measurements will be made to the nearest one-hundredth of one foot with an electronic water-level indicator.

3. The electronic water-level indicator will be decontaminated between well locations using the methods described in Section 8 of this FSP.

4. Water-level measurements and other pertinent information (e.g., well designation) will be recorded as outlined in the QAPP.

5.6.2 Monitoring Well Groundwater Sample Collection

This section describes the methods to collect groundwater samples from permanent monitoring wells. Groundwater sample collection rationale for the groundwater RI is described in Section 6.2.1 of the RI/FS Work Plan. Groundwater samples will be analyzed for the analytes specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan.

General pre-sampling activities that will be performed during monitoring well groundwater sample collection include accessing the well, preparing the well for purging and sampling, and collecting initial measurements. To access the well, the protective casing will be unlocked and surficial soil will be cleaned from around the wellhead. Plastic sheeting will be placed around the well and secured at the corners. The depth to water in the well will be measured to the nearest one-hundredth of one foot with an electronic water-level indicator and the total depth of the well will be measured. Information pertinent to the purging and sampling activities will be recorded as outlined in the QAPP.

The monitoring wells will be purged and sampled using three well volume groundwater sampling procedures. Monitoring wells will be purged and sampled using a decontaminated, non-dedicated, variable speed, 2-inch diameter stainless steel submersible pump as follows:

- Disposable polyethylene tubing (½-inch diameter) will be connected to the pump and the pump and tubing will be gradually lowered so as to place the pump intake immediately above the well screen zone.

- The volume of standing water in the well will be calculated. A minimum of three well volumes will then be purged from the well. Field parameters (pH, conductivity, and temperature) will be measured initially and after each well volume is evacuated. Field parameters will be monitored with calibrated meters that will be calibrated daily according to manufacturer's instructions. After each field parameter has stabilized to within +/- 10 percent, the purge rate will be reduced to approximately 100 mL/min and the groundwater sample will be collected directly from the pump discharge (see Section 7).

- Once sampling is complete, the non-dedicated submersible pump will be gradually removed from the well. The well will be closed and locked, the submersible pump will be decontaminated (see Section 8 of this FSP), and

disposable equipment will be disposed. Purge and decontamination water will be containerized, transported, and disposed off-site as specified in Section 9 of this FSP.

6. Investigation-Derived Waste Sampling

In general, IDW will be containerized in Department of Transportation-approved 55-gallon drums. The groundwater quality data will be used to support IDW characterization for disposal purposes. If additional IDW characterization data are needed, liquid/water IDW samples will be collected from the 55-gallon drums by opening the drum, collecting a grab sample using a bailer, and decanting the sample directly into the sample containers. Samples will be analyzed by the laboratory for the parameters specified by the receiving/disposal facility.

7. Sample Collection, Labeling, Handling, and Analysis

This section describes sample collection, labeling, handling, and analysis.

7.1 Soil Samples

Soil sampling to be conducted as part of the RI includes the collection of soil samples from select areas of the Site (see RI/FS Work Plan for details). Soil samples will be collected from the appropriate two-foot interval using a decontaminated stainless steel spoon or trowel. The VOC sample will be immediately transferred directly into the laboratory-supplied sample bottles. All sample bottle caps will be secured snugly, but not over-tightened.

Samples (including QA/QC samples specified in the QAPP) will be properly labeled and identified, and the Sample/Core Log and the Chain-of-Custody Form will be completed. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols, and sample custody. Sample containers will be checked for proper identification/labeling and compared to the Chain-of-Custody Form for accuracy prior to packaging the sample for shipment. The Chain-of-Custody Form will be placed in a sealed plastic bag and taped to the underside of the cooler lid. The sample containers will be wrapped with a cushioning material to preclude sample container breakage during shipment and placed in a cooler. Sufficient amounts of bagged ice will be placed in the cooler to keep the soil samples at 4 degrees Celsius until arrival at the laboratory. The cooler will be sealed with packaging tape and custody seals will be placed in such a manner that any opening of the cooler prior to arrival at the laboratory can be visually detected.

Samples will be delivered by overnight carrier to the analytical laboratory following sample custody requirements specified in the QAPP. The laboratory will be prepared to receive the samples and perform preliminary extractions or analyses within the analytical method recommended holding times.

Soil samples will be analyzed by TestAmerica Laboratories, Inc., located in Shelton, Connecticut (see Attachment B-4 of QAPP). Analytes are specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan.

7.2 Groundwater Samples

Groundwater samples will be collected directly into the laboratory-supplied sample bottles. The flow of water from the sampling equipment will be adjusted to ensure slow, laminar flow so that no entrained air bubbles are present in VOC samples. Special care will be taken in filling and capping volatile organic analysis (VOA) vials so that headspace/air bubbles are not present in the groundwater samples. In addition, overflowing bottles will be avoided to prevent the loss of floating substances or preservatives that may have already been added to the bottle. All sample bottle caps will be secured snugly, but not over-tightened.

Samples (including QA/QC samples specified in the QAPP) will be properly labeled and identified, and the Low-Flow Groundwater Sampling Log or Water Sampling Log and Chain-of-Custody Form will be completed. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols, sample labeling, and sample custody. Sample containers will be checked for proper identification/labeling and compared to the Chain-of-Custody Form for accuracy prior to packaging any sample for shipment. The Chain-of-Custody Form will be placed in a sealed plastic bag and taped to the underside of the cooler lid. The samples will then be wrapped with a cushioning material to preclude sample container breakage during shipment and placed in a cooler. Sufficient amounts of bagged ice will be placed in the cooler to keep the groundwater samples at 4 degrees Celsius until arrival at the laboratory. The cooler will be sealed with packaging tape and custody seals will be placed in such a manner that any opening of the cooler prior to arrival at the laboratory can be visually detected.

Samples will be delivered by overnight carrier to the analytical laboratory following sample custody requirements specified in the QAPP. The laboratory will be prepared to receive the samples and perform preliminary extractions or analyses within the analytical method recommended holding times.

Groundwater samples will be analyzed by TestAmerica Laboratories, Inc., located in Shelton, Connecticut (see Attachment B-4 of QAPP). Analytes are specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan.

7.3 Soil Vapor and Sub-Slab Soil Vapor Samples

Soil vapor and sub-slab soil vapor samples will be collected directly into the laboratory-supplied SUMMA® canisters. Sample time duration will be monitored during sampling and the SUMMA® canister valve will be closed when the vacuum is between 5 and 10 inches of Hg.

Samples (including QA/QC samples specified in the QAPP) will be properly labeled and identified, and the Soil Vapor Sampling Log or Sub-Slab Soil Vapor Sampling Log and Chain-of-Custody Form will be completed. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols, sample labeling, and sample custody. SUMMA® canisters will be checked for proper identification/labeling and compared to the Chain-of-Custody Form for accuracy prior to packaging any sample for shipment. The Chain-of-Custody Form will be placed in a sealed plastic bag and placed in the canister shipping box. The canister shipping box will be sealed with packaging tape and custody seals will be placed in such a manner that any opening of the box prior to arrival at the laboratory can be visually detected.

Samples will be delivered by overnight carrier to the analytical laboratory following sample custody requirements specified in the QAPP. The laboratory will be prepared to receive the samples and perform analyses within the analytical method recommended holding times.

Soil vapor and sub-slab soil vapor samples will be analyzed by Air Toxics Ltd., located in Folsom, California (see Attachment B-5 of QAPP). Analytes are specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan.

8. Field Decontamination Procedures

Decontamination procedures for non-dedicated field equipment are presented in detail in this section and include decontamination procedures associated with non-dedicated sampling equipment and downhole drilling tools and equipment. In general, after decontamination is completed, items will be stored in a manner to preserve their decontaminated condition prior to use.

Soil sampling, groundwater sampling, and soil vapor sampling equipment requiring decontamination includes, but is not limited to, Geoprobe® Macro-Core® Soil Samplers, stainless steel spoons/trowels, Geoprobe® Screen Point Groundwater Samplers, Geoprobe® Groundwater Profilers, Geoprobe® Probe Rods, and non-dedicated pumps/appurtenances. Field decontamination of these items will require scrubbing with Micro-90® low-phosphate detergent (or equivalent) to remove all foreign material, followed by potable water and/or distilled/deionized water rinse. The equipment will be decontaminated before and between each use and prior to demobilization. All downhole drilling tools and equipment will be decontaminated using a high-pressure steam cleaner prior to the start of drilling activities, between each borehole, and prior to leaving the Site. Water quality probes and downhole measurement tools (i.e., tape measure, water-level indicators, etc.) will be decontaminated by rinsing with distilled water. Decontamination fluids will be containerized prior to off-site transportation and disposal as described in Section 9 of this FSP.

Disposable soil sample liners from soil sampling will be discarded as general trash after each use. Disposable tubing from groundwater sampling of temporary and permanent wells and disposable tubing from soil vapor sampling will be discarded as general trash after each use.

9. Waste Management and Disposal

Liquid IDW generated during sampling activities including, but not limited to, monitoring well purge water and decontamination water will be disposed as outlined in this section. Sampling procedures involving the collection of water samples obtained as direct grab samples will be performed in such a manner so as to not generate waste, other than disposable polyethylene tubing and PPE.

Liquid IDW (i.e., monitoring well purge water and decontamination water) will be containerized in 55-gallon drums, characterized in accordance with the requirements of the receiving/disposal facility, and transported off-site for disposal. IDW generated on-site will be staged at a designated area on a daily basis until such time as the waste is transported off-site for disposal.

10. References

New York State Department of Environmental Conservation (NYSDEC). 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation. December 2002.

New York State Department of Environmental Conservation (NYSDEC). 1998. Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook. June 1998.

U.S. Environmental Protection Agency (USEPA). 1993. Draft Field Methods Compendium, OER 9285.2-11. July 1993.

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Attachment A-1

Community Air Monitoring Plan

ARCADIS

Attachment A-1
Community Air Monitoring Plan
Target Rock Site
East Farmingdale, New York

Real-time air monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) will be conducted at the Target Rock Site (Site) during the Remedial Investigation (RI) program field activities to ensure that the downwind community is appropriately protected from potential airborne contaminants related to investigative work activities. Continuous VOC and particulate monitoring will be conducted during intrusive project activities such as soil boring and temporary monitoring well advancement. Periodic VOC monitoring will be conducted during non-intrusive project activities such as monitoring well sampling. All monitoring readings will be recorded and will be available for NYSDEC and NYSDOH personnel to review.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored using an intrinsically safe photoionization detector (PID). The PID is designed to measure trace quantities of VOCs in air and has a parts per million (ppm) sensitivity range. The PID will be calibrated each morning before field use.

VOCs will be monitored at the upwind perimeter of the work area (i.e., the exclusion zone) at the start of each workday and periodically thereafter to establish background conditions. VOCs will be monitored within the exclusion zone on a continuous basis and at the downwind perimeter of the exclusion zone on a periodic basis.

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

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

If the total organic vapor level exceeds 25 ppm above background at the downwind perimeter of the work area, activities will be shutdown. Work activities will not resume until the total organic

vapor level is below 25 ppm above background (per instantaneous readings) at the downwind perimeter of the work area and the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for a 15-minute average.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored at the upwind perimeter of the immediate work area (i.e., the exclusion zone) at the start of each workday and periodically thereafter to establish background conditions. Particulate concentrations will be monitored within the exclusion zone on a continuous basis and at the downwind perimeter of the exclusion zone on a periodic basis.

Real-time air monitoring for particulates will be conducted using equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. In addition, fugitive dust migration will be visually assessed during all work activities.

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

If downwind PM-10 particulate levels are greater than 150 ug/m^3 above the upwind level after implementation of dust suppression techniques, work will be stopped and the activities re-evaluated. If dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration, then work activities will resume.

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Appendix B

Quality Assurance Project Plan

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Curtiss-Wright Flow Control Corporation, Target Rock Division

Appendix B

Quality Assurance Project Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site Number 1-52-119

December 30, 2008

ARCADIS

Christopher D. Keen
Senior Scientist

Jane Kennedy
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for

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Project Manager/Hydrogeologist

Appendix B
Quality Assurance Project Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site # 1-52-119

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December 30, 2008

Tables

Attachments

1. Introduction

This Quality Assurance Project Plan (QAPP) has been prepared by ARCADIS on behalf of Curtiss-Wright Flow Control Corporation, Target Rock Division (Target Rock) as a component of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Target Rock Site (Site) in East Farmingdale, New York (NYSDEC Site Number 1-52-119) to address specific quality control (QC) checks and quality assurance (QA) auditing processes.

The overall QAPP objective is to ensure that data produced as a result of the various sampling and monitoring activities, including soil, groundwater, and soil vapor is of the highest quality and usable for the intended purpose. This QAPP has been prepared in accordance with the United States Environmental Protection Agency (USEPA) guidance entitled Guidance for Quality Assurance Project Plans EPA QA/G-5 (USEPA, 2002), The New York State Department of Environmental Conservation (NYSDEC) Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002), and considering requirements of the Order on Consent (Order). This QAPP presents project organization and responsibilities, and QA/QC protocols related to field sampling and analysis activities associated with various sampling and monitoring requirements. The procedures in this QAPP will be implemented to ensure that precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) of the data are documented, as applicable, and that data meet project requirements.

This QAPP has been prepared as a component of the Sampling and Analysis Plan (SAP), which is the umbrella document that consists of Appendices A through D of the RI/FS Work Plan. The SAP includes the following required elements:

- The Field Sampling Plan (FSP) (Appendix A) defines sampling and data gathering methods consistent with NYSDEC Draft DER-10 (NYSDEC, 2002) and the "Field Methods Compendium," OER 9285.2-11 (draft July 1993).

- This QAPP (Appendix B) describes the QA/QC protocols necessary to achieve the project data quality objectives.

- The Health and Safety Plan (HASP) (Appendix C) details procedures for protecting persons at and near the Site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The Citizen Participation Plan (CPP) (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC, 1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002). Various cross-references to other portions of the SAP are included, as appropriate, in the following Sections.

2. Site Description and Background

The Site is located at 1966E Broadhollow Road, East Farmingdale, Town of Babylon, Suffolk County, New York and is identified by Tax Map Number: District 0100, Section 031, Block 1, Lots 2.2 through 2.4. The approximately 11-acre Site contains two manufacturing buildings (east building and west building), each situated on 5-acre lots, and a 1-acre right-of-way. The west building is used for manufacturing and contains office space; the east building is used for shipping and receiving, valve testing, and contains additional manufacturing and office space. The areas of the Site not occupied by buildings are largely paved and used for parking. The Site is secured by a perimeter fence and automatic gate. The Site is situated on relatively flat topography on the western edge of an industrial area. Residential areas are located to the west and south of the Site. A commercial building is located to the north of the Site.

Target Rock manufactures valves used primarily for nuclear power applications. Manufacturing processes include machining and testing of valves. One of the elements of the manufacturing process is the non-destructive testing of the valves for minor cracks. Target Rock began manufacturing operations at the Site in 1982 and operations have been ongoing to the present.

Activities to be conducted at the Site consist of the RI of groundwater, soil, and soil vapor constituents of potential concern (COPCs). The following techniques will be used to support data collection to characterize groundwater, soil, and soil vapor impacts associated with previous Site operations.

- Soil borings and soil sampling.
- Temporary monitoring wells groundwater sampling.

- Temporary soil vapor and sub-slab soil vapor points sampling.
- Permanent monitoring wells groundwater sampling.

3. Project Organization and Responsibilities

The responsibilities of the key project personnel are detailed below.

- The Project Manager is responsible for the following: overseeing the implementation of the project tasks, overall project coordination, adherence to the project schedules, directing, reviewing, and assessing the adequacy of the performance of the Task Managers assigned to the project, implementing corrective action (if warranted), reviewing reports, and maintaining full and orderly project documentation. The Project Manager will review all documents and other correspondence concerning the activities performed pursuant to the NYSDEC Superfund project (i.e., all activities associated with the Site). The Project Manager is also responsible for the overall QA including technical adequacy of the project activities and reports and conformance to the scope of work.

- The Task Manager(s) is responsible for the following: field activity QA/QC, task coordination, adherence to the project schedules, directing, reviewing, and assessing the adequacy of the performance of the technical staff and subcontractors assigned to the project (if warranted), interacting with the Project Manager, preparing reports, and maintaining full and orderly project documentation.

- The project team members include the task managers, field hydrogeologists, sampling team/field technicians, engineers, risk assessors, and support staff (e.g., data processors, project assistants, and in-house experts in engineering, etc.) who are qualified to oversee/perform the work, as appropriate, and will be responsible for work in their respective specialty areas. Project team members will be on-site to supervise all activities specified in the RI/FS Work Plan.

- The Project QA Officer is responsible for performing systems auditing and for providing independent data quality review of project documents and reports.

- The Site Health and Safety Officer is responsible for implementing the site-specific health and safety directives in the Health and Safety Plan (HASP – see RI/FS Work Plan Appendix C) and for contingency response.

- The Data Validator is responsible for review of laboratory data for compliance with the QA objectives for analytical performance and the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability), and notifications to the Project Manager of any QC deficiencies.

A Project Organizational Chart is provided as Attachment B-1.

4. Quality Assurance/Quality Control – Field Sampling and Analysis Activities

The overall QA objective for this aspect of the project is to select and implement procedures for field measurements, sampling, and analytical testing that will provide data of known quality that is consistent with the intended use of the information. Generally, the specific field sampling and analysis activities to be conducted during this project which require QA/QC protocols include RI soil, groundwater, and soil vapor sampling (i.e., soil sampling, temporary and permanent monitoring well groundwater sampling, temporary soil vapor point sampling, temporary sub-slab soil vapor point sampling, and liquid waste characterization sampling).

QA/QC protocols will be used to ensure the PARCC parameters of the data collected during these field activities meets the objectives of the overall project. Specifically, data will be gathered or developed using procedures appropriate for the intended use of the data. The field measurements and laboratory analyses will be used to support one or more steps in the monitoring described above.

The QA/QC protocols for this aspect of the project will include laboratory analysis and validation procedures, field decontamination procedures, calibration and maintenance of field instruments, and QA/QC sampling procedures. The following sections outline the QA/QC protocols for each of these items.

4.1 Field QA/QC

To ensure that data collected in the field is consistent, accurate and complete, forms will be utilized for repetitive data collection, such as depth to water in wells, groundwater sampling, soil vapor sampling, etc. These field forms include a Soil

Sample/Core Log, Groundwater Sampling Form, Soil Vapor Sample Collection Log, Daily Log, and Water-Level Measurement Form, as applicable to a specific field task. Forms are provided in Attachment B-2.

Field QA/QC samples will be collected to assure quality control of soil, groundwater, and soil vapor samples. Analyses of QA/QC samples will enable data evaluation for precision, accuracy, and integrity. A QA/QC sample set includes one or more of the following: equipment rinsate blank, trip blank, field duplicate, and site-specific matrix spike/matrix spike duplicate (MS/MSD), as applicable. The QA/QC sample set will vary depending on the objective of the collected sample as well as the parameter or group of parameters specified for analysis. A summary of the QA/QC samples is provided in Table B-1. In general, blanks and duplicate samples will be used to verify the quality of the sampling results. Analyte-free water will be supplied by the laboratory for the preparation of equipment rinsate blanks. Trip blanks (prepared by the laboratory) will accompany the new, clean sample containers to the field. A brief description of these QA/QC samples follows.

4.1.1 Equipment Rinsate Blank

An equipment rinsate blank is a water sample that consists of laboratory-supplied analyte-free water that is poured through or over a decontaminated segment of sampling or other down-hole equipment to assess or document the thoroughness of the decontamination process. A rinsate blank will be collected from the decontaminated down-hole equipment by pouring analyte-free water over the equipment and into sample containers before using the equipment in sampling. Field blanks will be collected as specified in Table B-1. These QA/QC samples will be collected in connection with the collection of aqueous samples (associated with groundwater sampling) and soil samples and submitted for the appropriate chemical analysis (see Table B-1).

4.1.2 Trip Blank

A trip blank will contain laboratory supplied analyte-free water and will be transported to the Site and returned to the laboratory without opening. This will serve as a check for contamination originating from sample transport, shipping, and from Site conditions. A minimum of one trip blank per day per sampling team will be utilized during groundwater sampling. One (1) trip blank will be included in each cooler which contains samples for volatile organic compound (VOC) analyses. These QA/QC samples will be utilized in connection with the collection of aqueous samples

(associated with groundwater sampling) and soil samples for VOC analysis and submitted for the appropriate chemical analysis (see Table B-1).

4.1.3 Field Duplicate

The relative percent difference (RPD) in analytical results between samples and the field duplicates will be used to determine if the data reported by the laboratory meet precision, representativeness, and comparability requirements. The field duplicate samples will be assigned "blind" identifications; the correct sample identification number will be recorded on the Groundwater Sampling Form or Soil Vapor Sample Collection Log. One field duplicate sample per 20 groundwater samples will be collected during groundwater sampling activities. One field duplicate sample will be collected during soil vapor sampling activities. These QA/QC samples will be collected in connection with the collection of aqueous samples (associated with groundwater sampling) and soil vapor samples and submitted for the appropriate chemical analysis (see Table B-1). The precision goal for the RPD of field duplicates is 40 percent for aqueous samples and 50 percent for air samples.

4.1.4 MS/MSD Sample

Site-specific MS and MSD samples allow evaluation of potential site matrix interferences with the determination of target parameters. MS/MSD pairs that are collected and submitted to the laboratory will be spiked by the laboratory at the initiation of preparation with appropriate analytes and analyzed with the Site samples. The purpose of spiking and analyzing the samples is to evaluate any site-specific matrix interference on the analytical results. One MS/MSD sample set per matrix per 20 samples will be collected during groundwater and soil sampling activities. The laboratory established control limits will be utilized to evaluate precision and accuracy of matrix spike data.

4.1.5 Field Records

Proper documentation will consist of all field personnel maintaining records of all work accomplished including the items listed below (in addition to the information required on the forms provided in Attachment B-2):

- Date and time of work events.
- Purpose of work.

- Description of methods.
- Description of samples.
- Number and size of samples.
- Description of sampling point.
- Date and time of collection of sample.
- Measurement or Sample collector's first initial and last name.
- Field observations.
- Field measurements with portable instruments.

All information pertinent to field sampling activities will be recorded on the forms provided in Attachment B-2. Duplicates of field notes/forms will be prepared and kept in a secure place away from the Site.

If corrections to field documentation are necessary, a single line will be drawn through the original entry (so that the original entry can still be read) followed by writing the corrected entry alongside. The correction must be initialed and dated. Where necessary, corrected errors will include a footnote explaining the correction.

Field documentation will be retained in the project file for a period of 6 years. After 1 year the files may be removed to off-site secure storage.

4.2 Preparation and Preservation of Sample Containers

Pre-cleaned sample containers (bottles) or canisters (SUMMA® canisters) will be provided by the laboratory. Each sample container or canister will be provided with a label for sample identification purposes. The laboratory will maintain a record of all sample bottle lot numbers and canister numbers shipped to the client in the event of a contamination problem. Any preservative in the container must be identified. The laboratory will add sample preservatives to the bottles prior to sample bottle shipment to the client. Trip blanks will be transported from the laboratory to the Site in the same cooler as the VOC vials.

Sample container lids will not be mixed. All sample lids must stay with the original containers as provided by the supplier. Bottle lids (with any associated bottle) exhibiting cracks, splits, or chips shall be appropriately discarded.

SUMMA® canister flow controllers will not be mixed. All flow controllers (100 percent certified) must stay with the canister (100 percent certified) that they are assigned to by the laboratory.

Following sample collection, the information on the container or canister label will include a sample identification number, time, date and initials of the sample collector. All sample containers or canisters will be accompanied by a complete chain-of-custody (see Attachment B-3).

Table B-2 provides a summary of sample analytical methods, sample containers, sample canisters, holding times, and preservation procedures to be used.

4.3 Decontamination

Proper decontamination of all sampling equipment will minimize the potential for cross contamination of samples. Field decontamination procedures are provided in Section 8 of the FSP.

4.4 Sample Custody

To maintain and document sample possession, chain-of-custody procedures will be followed. A chain-of-custody form includes the signatures of individuals who have possession of the samples after collection in the field; an example chain-of-custody form is provided in Attachment B-3.

A sample is under custody if it is:

1. In one's actual possession; or
2. In one's view, after being in your physical possession; or
3. Was in one's physical possession and then was locked or sealed to prevent tampering; or
4. It is in a designated secure place restricted to authorized personnel.

Each person involved with the collection and handling of samples will understand and implement chain-of-custody procedures. A detailed discussion of the stages of possession (i.e., field collection, transfer, and laboratory custody) is presented below in the following sections.

4.4.1 Environmental Samples Chain-of-Custody

The field sampler initiates the chain-of-custody procedure in the field and is the first to sign the chain-of-custody form upon collection of samples. The field sampler is personally responsible for the care and custody of the samples until they are transferred and properly dispatched. Each sample will have sample labels completed (using waterproof ink), have proper preservation, and be packaged to preclude breakage or damage during shipment. Every sample will be assigned a unique identification number that is entered on the chain-of-custody form. Samples can be grouped for shipment using a single form.

4.4.2 Transfer of Custody and Shipments

All samples will be accompanied by a chain-of-custody record. When transferring the possession of samples, the individual(s) relinquishing and receiving will sign, date, and note the time of transfer on the chain-of-custody form. This record documents transfer of custody of samples from the sampler to another person or to the analytical laboratory.

Samples will be properly packed for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample cooler or shipping box. All analytical samples will be delivered to the laboratory within 48 hours of collection or earlier, as needed, to meet analyte holding times.

Whenever samples are split with a facility or government agency, a separate chain-of-custody record will be prepared for those samples and marked to indicate with whom the samples were split.

4.4.3 Field Chain-of-Custody

Sample custody, related to sampling procedures and sample transfer, is described below:

1) Chain-of-Custody form completed and placed in a plastic bag in the cooler or shipping box by field sampling personnel.

2) Samplers check for any external damage to the sample cooler (such as leaking) or shipping box.

3) Field sampling personnel seal cooler or shipping box with custody tape prior to shipment back to the laboratory.

4) If shipping by overnight courier, samplers sign the waybill for sending cooler or shipping box to the laboratory.

4.4.4 Laboratory Sample Receipt Custody

The laboratory utilized for chemical analysis will have standard operating procedures for documenting receipt and tracking of samples and compilation of sample data. The general laboratory sample receipt protocols are described below:

1) The laboratory receives cooler or shipping box and completes chain-of-custody.

2) The laboratory records sample condition (temperature [aqueous and soil samples], breakage [aqueous and soil samples], canister vacuum [soil vapor samples], paperwork discrepancies) at time of receipt.

3) The samples will be stored at the proper temperature prior to analysis.

4) It is the responsibility of the laboratory to properly dispose of samples in accordance with applicable state and federal requirements in accordance with the project retention requirements.

4.5 Sample Shipment

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also documents sample custody. Regulations for the packaging, marking, labeling, and shipping of hazardous materials are promulgated by the U.S. Department of Transportation (DOT) in 49 CFR 171 through 177. All transportation will be in accordance with applicable regulations.

4.6 Laboratory Analyses

All soil, groundwater, and soil vapor samples will be analyzed by a New York State Department of Health (NYSDOH)-approved laboratory.

Soil samples will be analyzed for Target Compound List (TCL) VOCs using the methods specified in Table B-2. Analytes are provided in Table B-3.

Groundwater samples will be analyzed for TCL VOCs using the methods specified in Table B-2. The analytical laboratory will also conduct a library search of up to 10 tentatively identified compounds (TICs) for the VOC analyses. Analytes are provided in Table B-3.

Table B-3 summarizes the list of parameters to be analyzed for in soil/solid and aqueous samples along with the respective contract required quantitation limits for the following groups of analytes: VOCs.

Soil vapor samples will be analyzed for the EPA Method TO-15 Volatile Organic Compound List (modified Air Toxics Ltd. TO-15 Low-Level compound list) using the methods specified in Table B-2. Analytes are provided in Table B-4.

Table B-4 summarizes the list of parameters to be analyzed for in soil vapor samples along with the respective target reporting limits for the following groups of analytes: VOCs.

The internal laboratory Standard Operating Procedures (SOPs) and QA/QC procedures are described in the individual Laboratory Quality Assurance Manual (QAM), which is an independent plan provided by the analytical laboratory. The Laboratory QAMs are provided in Attachments B-4 and B-5.

4.7 Electronic Data Management

Electronic data management provides the ability to track, display, and report sample locations, field information, and analytical results efficiently. Field data includes field instrument measurements, geologic and well construction information, and geographic coordinates. Laboratory analytical data will be provided as an electronic data deliverable (EDD) as well as a hard copy report to allow streamlined data management from generation through RI report preparation.

Geographic coordinates will be provided in hard copy and/or electronic format for entry into the database. A Microsoft Access-based data management system will be employed to manage environmental data electronically. Electronic data management augments data review and reporting processes by streamlining data entry and availability for evaluation while reducing the potential for entry errors.

4.7.1 Field Information

Field personnel will communicate the sample collection information accurately through consistent nomenclature for location IDs and sample IDs, as well as provide information correlating sample ID to sample location and the identification of field duplicates. Spatial data (geographic coordinates) for each sampling location will be determined as appropriate and incorporated into the database for use by the geographic information system (GIS). Consistent units for the x, y, and z coordinates will be used.

4.7.2 Laboratory Data

The analytical laboratories will provide EDDs that are compatible with the selected database. The laboratory EDD shall be prepared in accordance with the applicable requirements and will, at a minimum, include the following information:

- Laboratory name, laboratory work order or SDG number.
- Sample ID, laboratory sample ID, date sampled, time sampled, matrix, and percent moisture.
- Test method, analyte, analyte type, sample type, CAS number, chemical name, date and time prepared, date and time analyzed, result, laboratory qualifier, method detection limit (MDL), reporting limit (RL), and dilution factor.

The Data Validator will review 5 percent of electronic laboratory and field data to verify the results against the hard copy and check for transcription errors. A greater than 10 percent discrepancy rate will require additional review and verification. Electronic data will match the hard copy data for all results including significant figures. The data management staff will add any additional validation qualifiers as provided by the Data Validator.

The central database will be stored in a secure area with access limited to data management specialists designated by the Project Manager. The central database will allow electronic transfer of data to GIS/computer-aided design (GIS/CAD) systems and other final data user models and statistical programs. Data users may enter additional electronic data such as Standards, Criteria, and Guidance (SCGs) for comparison of the results. This data will be stored in separate tables in the database and linked to the actual results. Any data from outside sources will include a description of the data, a reference to the source, and the date updated. The outside data will be checked prior to use in order to verify that the most current values are used.

4.8 Laboratory Reporting

For soil and groundwater analytical samples associated with the RI, the laboratory will provide a NYSDEC Analytical Services Protocol (ASP) Category B deliverable for the sampling effort within two weeks of receipt of samples. For soil vapor analytical samples associated with the RI, the laboratory will produce an Air Toxics Ltd. Level IV electronic Comprehensive Validation Package (eCVP) for the sampling effort within two weeks of receipt of samples; the eCVP will contain all information needed for formal validation of the data. Additional documentation may be required from the laboratory based on the results of the data evaluation.

4.9 Electronic Data Retention

Electronic data and media retention policies will correlate with hard copy data retention at the laboratories, as well as other points of electronic data generation. Additionally, electronic data will be subject to back-up routines that will enable recovery of data that may become corrupted or lost due to instrument, computer, and/or power failures. Electronic media will be stored in climate-controlled areas to minimize potential for degradation of media or data. Storage areas must be access limited.

4.10 Data Validation

Data validation is the process in which analytical data generated by the laboratory are evaluated against a specific set of requirements and specifications, and determinations of data usability and limitations are made. The Data Validator examines the criteria pertaining to analytical data generated in accordance with this QAPP, analytical method performance criteria, the Laboratory QAM, and published data verification and validation guidelines to evaluate field and analytical data relative to:

- Technical requirements.
- Contractual requirements.
- Determination of compliance.
- Determination and action of how to define the usability or qualify the data.

Validation of the organic data will be performed following the QA/QC criteria set forth in the NYSDEC ASP, Revision 2005 (or most recent version) and DER-10 (NYSDEC, 2002), and the USEPA National Functional Guidelines for Organic Data Review (USEPA, 1999).

Groundwater associated with sampling of permanent and temporary monitoring wells, soil samples associated with soil borings, and waste characterization samples (liquid) will require a NYSDEC ASP Category B deliverable. Soil vapor associated with sampling of temporary soil vapor and sub-slab soil vapor points will require an Air Toxics Ltd. Level IV eCVP deliverable.

The data validation will include items required to support the data usability summary report (DUSR) and will include the following review elements:

- Data package completeness.
- Chain-of-custody forms execution.
- Methods performed.
- Holding time compliance.
- GC/MS Instrument Performance checks (Tuning).
- Instrument initial and continuing calibration.
- Blank evaluation for impacts to field samples.
- Surrogate recoveries.
- Laboratory control sample accuracy and precision (as applicable).

- Matrix spike/matrix spike duplicate precision and accuracy.
- Internal standards performance.
- Spot check for transcriptions between quantitation reports and Form Is.
- Field duplicate precision.

Validation will be performed by the Data Validator. The laboratory deliverables will be reviewed for accuracy, precision, completeness, and overall quality of data. All laboratory data will be reviewed for adherence to method-specific QA/QC guidelines and to the data quality requirements set forth in this QAPP. Data qualifiers will be appended to the reported results in accordance with the NYSDEC ASP, USEPA Region 2, and the USEPA National Functional Guidelines guidance documents.

If specific data quality issues are identified during data validation, the validation and review process may be expanded, as warranted, in order to address the specific data quality issue. Any additional validation performed will continue until the specific data quality issue is resolved.

The Data Validator will prepare a summary report of the items reviewed, identified QA/QC deficiencies, and the qualifications applied to the data. The validation report will be provided to the project team and will be maintained in the project files. Any qualifications of the data will be added to the electronic database.

4.11 Data Usability

The Data Validator for the project will review the analytical data for usability including determining if the data are accurate, precise, representative, complete, and comparable. The review of the analytical results will include items listed in Section 4.10. This review will be used to classify the data as valid, usable, or unusable. Valid data will indicate that all QA/QC review criteria have been met and are acceptable (as per details outlined in the preceding section). Data will be characterized as usable when QA/QC parameters are marginally outside acceptable limits (example: sample holding times were slightly exceeded) where the data may be questionable, but still usable within limitation. Unusable data will be data that are observed to have gross errors or analytical interference that would render the data invalid for any purpose. Any rejected data will be identified, as well as any recommendations for re-sampling, and included in the DUSR.

The DUSR will be prepared at the conclusion of validation. The DUSR and the laboratory analytical data report will be submitted as an appendix to the RI report.

4.12 Performance and System Audits

Performance and system audits will be conducted on a periodic basis, as appropriate, to ensure that the work is implemented in accordance with the approved project SOPs and in an overall satisfactory manner. Examples of audits that may be performed during the project activities are as follows:

- The field personnel will supervise and check, on a daily basis during sampling activities, that monitoring well integrity is intact, that field measurements are made accurately, that equipment is thoroughly decontaminated, that samples are collected and handled properly, and that all field work is accurately and neatly documented.

- On a timely basis, the data packages submitted by the laboratory will be validated as described in Section 4.10 of this QAPP.

- The Project Manager will oversee the field personnel and verify that the management of the acquired data proceeds in an organized and expeditious manner.

- Audits of the laboratory are performed on a regular basis by the laboratory quality manager and regulatory agencies. Audits are discussed in the Laboratory QAMs (Attachments B-4 and B-5).

4.13 Preventive Maintenance

All laboratory and field instruments and equipment used for sample analysis will be serviced and maintained only by qualified personnel. Procedures will be implemented to ensure that instruments are operating properly and that calibrations are correct prior to analysis and reporting of any sample parameters.

ARCADIS has established a program for the maintenance of field equipment to ensure the availability of equipment in good working order when and where it is needed, as indicated, in the following examples:

- An inventory of equipment, including model and serial number, quantity, and condition will be maintained. Each item will be tagged and signed out when in use and, its operating condition and cleanliness will be checked upon return. Routine checks will be made on the status of equipment, and spare parts will be stocked. An equipment manual library will also be maintained.

- The field personnel are responsible for making sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions before being taken to the field.

The laboratory also follows a well-defined program to prevent the failure of laboratory equipment and instrumentation. This preventive maintenance program is described in the Laboratory QAMs (Attachments B-4 and B-5).

5. References

New York State Department of Environmental Conservation (NYSDEC). 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation. December 2002.

New York State Department of Environmental Conservation (NYSDEC). 1998. Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook. June 1998.

U.S. Environmental Protection Agency (USEPA). 2002. Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/240/R-02/009. December 2002.

U.S. Environmental Protection Agency (USEPA). 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540-R-04-004. October 2004.

U.S. Environmental Protection Agency (USEPA). 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA540/R-99/008. October 1999.

U.S. Environmental Protection Agency (USEPA). 1993. Draft Field Methods Compendium, OER 9285.2-11. July 1993.

Table B-1. Quality Assurance/Quality Control Sample Summary, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Target Rock Site, East Farmingdale, New York.

Matrix	RI Activity	Sample ID	Parameters [1]	Frequency	Estimated Sample Quantity per Event [4]	Estimated Equipment Rinsate Blanks per Event *	Estimated Trip Blanks [2] per Event	Estimated Field Duplicates per Event **	Estimated MS/MSD [3] per Event
Aqueous	Temporary Monitoring Wells	AGW-1 to AGW-11	TCL VOCs	Once	29	5	5	2	2
Soil	Soil Borings	AGW-8 to AGW-10	TCL VOCs	Once	3 [5]	3	3	0	1
Soil Vapor	Temporary Soil Vapor Points	SV-1 to SV-9	TO-15 VOC List [6]	Once	9	0	0	1	0
Sub-Slab Soil Vapor	Temporary Sub-Slab Soil Vapor Points	SS-1 to SS-8	TO-15 VOC List [6]	Once	8	0	0	0	0
Aqueous	Permanent Monitoring Wells	TRMW-1 to TRMW-5	TCL VOCs	Once	5	1	1	1	1

1 Analyses will be performed in accordance with NYSDEC ASP by a NYSDOH-approved laboratory.
2 Trip blanks will be provided by the analytical laboratory and will accompany VOC samples as they are collected and during shipment. Trip blanks collected at a frequency of one per day. A trip blank will accompany the other samples collected the same day. The maximum number of samples per trip blank is 20.
3 MS/MSD analysis is performed on a site sample and therefore is not counted as separate samples. For MS/MSDs, triple sample volume will be provided. MS/MSD sample sets collected at a frequency of one per 20 samples of the same matrix and will accompany the associated site sample during shipment.
4 Sample count will depend on number of locations and number of samples collected per location.
5 A soil sample will be collected from the capillary fringe zone and submitted to the laboratory for analysis. Additional samples will be collected if PID readings above background concentrations are detected. In addition, any soil sample exhibiting a PID reading of 50 ppm or greater above background concentrations will be submitted to the laboratory for analysis.
6 EPA Method TO-15 Volatile Organic Compound List (Modified Air Toxics Ltd. TO-15 Low-Level Compound List). This list is consistent with the aqueous and soil VOC list.
* One field blank collected per day every time non-dedicated (i.e., disposable or reusable) sampling equipment (e.g., soil core liners, pumps) is used.
** A field (blind) duplicate will be collected at a frequency of one per 20 samples of the same matrix.
MS/MSD Matrix spike/matrix spike duplicate.
TCL VOC Target Compound List Volatile Organic Compounds.
NYSDEC New York State Department of Environmental Conservation.
ASP Analytical Services Protocol.

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Table B-2. Summary of Sample Containers/Canisters, Analytical Methods, Preservation, and Holding Times, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Target Rock Site, East Farmingdale, New York.

Matrix	Sampling Event	Parameters [1]	Analytical Laboratory Methodology	Sample Containers	Preservation	Holding Time From Date of Collection
Aqueous	TMWs and MWs	TCL VOCs	SW-846 Method 8260B	Two (2) 40-mL glass vials with Teflon-lined septa	Cool 4° C, HCl to pH <2	12 Days VTSR
Soil	Soil Borings	TCL VOCs	SW-846 Method 8260B	One (1) 2-oz. glass	Cool 4° C	12 Days VTSR
Soil Vapor	Soil Vapor and Sub-Slab Soil Vapor Points	TO-15 VOC List [2]	EPA Method TO-15	One (1) 6-L SUMMA® Canister	---	30 Days

1 Refer to Tables B-3 and B-4 for specific analyte lists for analyses of aqueous, soil, and soil vapor samples.
2 EPA Method TO-15 Volatile Organic Compound List (Modified Air Toxics Ltd. TO-15 Low-Level Compound List). This list is consistent with the aqueous and soil VOC list.
TCL VOC Target Compound List Volatile Organic Compounds.
TMW Temporary Monitoring Well.
MW Permanent Monitoring Well.
mL Milliliter.
L Liter.
C Celsius.
HCl Hydrochloric Acid.
oz. Ounce.
VTSR Validated Time of Sample Receipt at lab.

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Table B-3. Compound List and TRLs for Aqueous and Soil VOC Analysis, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Target Rock Site, East Farmingdale, New York.

Compound	Target Reporting Limits	
	Aqueous (ug/L)	Soil (ug/kg)
Dichlorodifluoromethane	5	10
Chloromethane	5	10
Bromomethane	5	10
Vinyl Chloride	5	10
Chloroethane	5	10
Trichlorofluoromethane	5	10
1,1-Dichloroethene	5	10
1,1,2-Trichloro-1,2,2-trifluoroethane	5	10
Acetone	10	20
Carbon disulfide	5	10
Methyl Acetate	5	10
Methylene chloride	5	20
trans-1,2-Dichloroethene	5	10
Methyl tert-Butyl Ether	5	10
1,1-Dichloroethane	5	10
cis-1,2-Dichloroethene	5	10
2-Butanone	10	10
Chloroform	5	10
1,1,1-Trichloroethane	5	10
Cyclohexane	5	10
Carbon tetrachloride	5	10
Benzene	5	10
1,2-Dichloroethane	5	10
Trichloroethene	5	10
Methylcyclohexane	5	10
1,2-Dichloropropane	5	10
Bromodichloromethane	5	10
cis-1,3-Dichloropropene	5	10
4-Methyl-2-pentanone	10	10
Toluene	5	10
trans-1,3-Dichloropropene	5	10
1,1,2-Trichloroethane	5	10
Tetrachloroethene	5	10
2-Hexanone	10	10
Dibromochloromethane	5	10
1,2-Dibromoethane	5	10
Chlorobenzene	5	10
Ethylbenzene	5	10
Xylenes (total)	5	10
Styrene	5	10
Bromoform	5	10
Isopropylbenzene	5	10
1,1,2,2-Tetrachloroethane	5	10
1,3-Dichlorobenzene	5	10
1,4-Dichlorobenzene	5	10
1,2-Dichlorobenzene	5	10
1,2-Dibromo-3-chloropropane	5	10
1,2,4-Trichlorobenzene	5	10

TRL	Target Reporting Limit.
VOC	Volatile Organic Compound.
ug/L	Micrograms per liter.
ug/kg	Micrograms per kilogram.

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Table B-4. Compound List and TRLs for Soil Vapor VOC Analysis, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Target Rock Site, East Farmingdale, New York.

Compound	Target Reporting Limits (ug/m^3)	(ppbv)
Freon 12	0.49	0.10
Chloromethane	0.21	0.10
Vinyl Chloride	0.26	0.10
Bromomethane	0.39	0.10
Chloroethane	0.26	0.10
Freon 11	0.56	0.10
Freon 113	0.77	0.10
1,1-Dichloroethene	0.40	0.10
Acetone	1.2	0.50
Carbon Disulfide	1.6	0.50
Methyl Acetate	1.5	0.50
Methylene Chloride	0.69	0.20
Methyl tert-butyl ether	0.36	0.10
trans-1,2-Dichloroethene	0.40	0.10
1,1-Dichloroethane	0.40	0.10
2-Butanone (Methyl Ethyl Ketone)	0.29	0.10
cis-1,2-Dichloroethene	0.40	0.10
Chloroform	0.49	0.10
1,1,1-Trichloroethane	0.54	0.10
Cyclohexane	0.34	0.10
Carbon Tetrachloride	0.63	0.10
Benzene	0.32	0.10
1,2-Dichloroethane	0.40	0.10
Trichloroethene	0.54	0.10
Methylcyclohexane	2.0	0.50
1,2-Dichloropropane	0.46	0.10
Bromodichloromethane	0.67	0.10
cis-1,3-Dichloropropene	0.45	0.10
4-Methyl-2-pentanone	0.41	0.10
Toluene	0.38	0.10
trans-1,3-Dichloropropene	0.45	0.10
1,1,2-Trichloroethane	0.54	0.10
Tetrachloroethene	0.68	0.10
2-Hexanone	2.0	0.50
Dibromochloromethane	0.85	0.10
1,2-Dibromoethane (EDB)	0.77	0.10
Chlorobenzene	0.46	0.10
Ethyl Benzene	0.43	0.10
m,p-Xylene	0.43	0.10
o-Xylene	0.43	0.10
Styrene	0.42	0.10
Bromoform	1.0	0.10
Cumene	0.49	0.10
1,1,2,2-Tetrachloroethane	0.69	0.10
1,3-Dichlorobenzene	0.60	0.10
1,4-Dichlorobenzene	0.60	0.10
1,2-Dichlorobenzene	0.60	0.10
1,2-Dibromo-3-chloropropane	4.8	0.50
1,2,4-Trichlorobenzene	3.7	0.50

TRL	Target Reporting Limit.
VOC	Volatile Organic Compound.
ug/m^3	Micrograms per cubic meter.
ppbv	Parts per billion by volume.

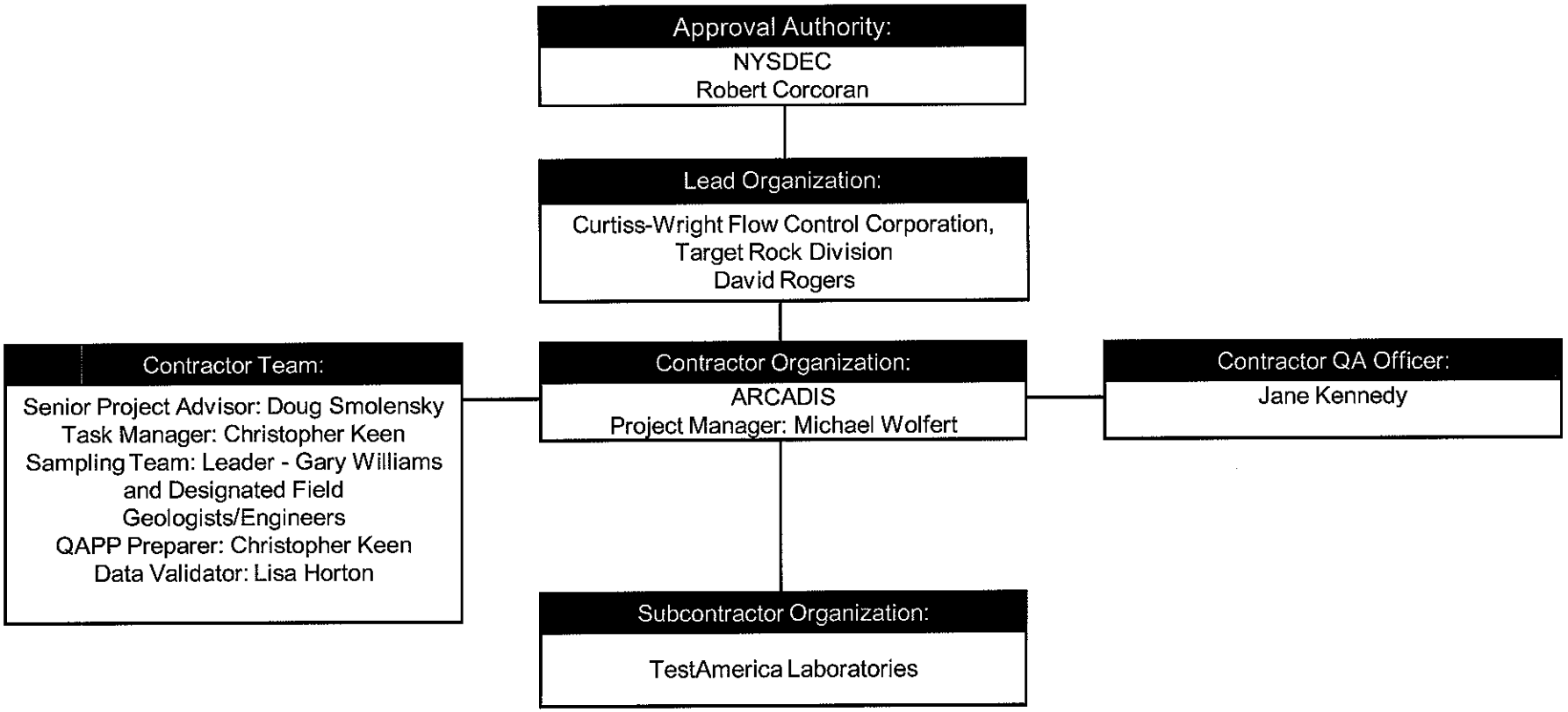
ARCADIS

Attachment B-1

Project Organizational Chart

ARCADIS

Project Organizational Chart
Target Rock Site
East Farmingdale, NY



ARCADIS

Attachment B-2

Field Forms

ARCADIS

Sample/Core Log

Boring/Well _____ Project Name/No. _____ Page ____ of ____

Site Location _____ Drilling Started _____ Drilling Completed _____

Total Depth Drilled _____ feet Hole Diameter _____ inches Type of Sample/ Coring Device _____

Length and Diameter of Coring Device _____ Sampling Interval _____ feet

Land Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Method _____ Drilling Fluid Used _____

Drilling Contractor _____ Driller _____ Helper _____

Prepared By _____ Hammer Weight _____ pounds Hammer Drop _____ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description	PID (ppm)

ARCADIS

Sample/Core Log (Cont.d)

Boring/Well ____________________ Page ____ of ____

Prepared by ____________________

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description	PID (ppm)

ARCADIS

Water Sampling Log

Project _____ Project No. _____ Page ____ of ____

Site Location _____ Date _____

Site/Well No. _____ Replicate No. _____

Weather _____ Sampling Time: Begin _____ End _____

Evacuation Data

Measuring Point _____

Sounded Well Depth (ft bmp) _____

Depth to Water (ft bmp) _____

Water Column in Well (ft) _____

Casing Diameter _____

Gallons in Well _____

Gallons Pumped/Bailed

Prior to Sampling _____

Sample Pump Intake

Setting (ft bmp) _____

Pumping Rate (gpm) _____

Evacuation Method _____

Sampling Method _____

Purge Time Begin _____ End _____

Field Parameters

Color _____

Odor _____

Appearance _____

	I	1V	2V	3V
pH (s.u.)				
Conductivity (mS/cm)				
(µmhos/cm)				
Temperature (°C)				
DO (mg/L)				
Turbidity (NTU)				
Time				
DTW (ft bmp)				

Remarks: _____

Constituents Sampled: See COC Sampling Personnel: _____

Well Casing Volumes

Gal./Ft.				
	$1^{1/4}$" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	$1^{1/2}$" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	mS/cm	Millisiemens per centimeter	VOC	Volatile Organic Compounds
°C	Degrees Celsius	s.u.	Standard units	umhos/cm	Micromhos per centimeter
ft	feet	NTU	Nephelometric Turbidity Units		
gpm	Gallons per minute	N/A	Not Applicable		
mg/L	Milligrams per liter	COC	Chain of Custody		

ARCADIS

Page ______ of ______

Water Level Record

Project Name/No. ____ Date ______________

Well(s)	Depth to Water (ft bmp)	Time	Remarks

ARCADIS

Page____ of ____

DAILY LOG

Borings(s)/Well(s) _____

Project Name/No. _____

Site Location _____

Prepared By _____

Date/Time	Description of Activities

AGM Form 02-6-86

ARCADIS

INSTRUMENT CALIBRATION FORM

Project _____

Project No. _____

Site Location _____

Date _____

Time _____

Prepared by _____

☐ pH/Cond/Temp Meter
Model
Serial No.

☐ Turbidity Meter
Model
Serial No.

☐ DO Meter
Model
Serial No.

☐ ORP Meter
Model
Serial No.

☐ Multi-Parameter Meter
Model
Serial No.

☐ PID
Model
Serial No.

Check appropriate box for equipment calibrated. If two similar items are calibrated, please note two checks under calibration successful

PID (ppm)	Value	Calibration Successful
Zero		
Span		

pH (SU)	Value	Calibration Successful
4.00		
7.00		
10.00		

Conductivity (mS)	Value	Calibration Successful
_____ mS		
_____ mS		
Other		

Turbidity (NTU)	Value	Calibration Successful
1 NTU		
10 NTU		
Other		
Other		

DO	Calibration Successful
100% Saturated Air	
Barometer Adjustment	
Elevation Adjustment	

* ORP (mV)	Calibration Successful
Hydroquinone (240) (Black)	
Zobel Solution (237) (yellow)	
Temperature Based Chart Calibration	
* Adjusted	

*** No adjustment on some meters just a probe check, others are adjustable**

ARCADIS
Infrastructure, environment, buildings

Soil Vapor Sample Collection Log

Sample ID:			
Client:		Boring Equipment:	
Project:		Sealant:	
Location:		Tubing Information:	
Project #:		Miscellaneous Equipment:	
Samplers:		Subcontractor:	
Sample Point Location:		Equipment:	
Sampling Depth:		Moisture Content of Sampling Zone:	
Time and Date of Collection:		Approximate Purge Volume:	

Canister Vacuum, Weather Information and PID Readings:

Time	Canister Vacuum (inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (inches of Hg)	PID (ppb)

SUMMA Canister Information:

Size (circle one): 1 L 6 L

Canister ID: _____

Flow Controller ID: _____

General Observations/Notes:

Approximating One-Well Volume (for purging):
When using 1¼-inch "Dummy Point" and a 6-inch sampling interval, the sampling space will have a volume of approximately 150 mL. Each foot of ¼-inch tubing will have a volume of approximately 10 mL.

ARCADIS

Attachment B-3

Chain-of-Custody Form

ARCADIS

Laboratory Task Order No./P.O. No. _____ **CHAIN-OF-CUSTODY RECORD** Page ____ of ____

Project Number/Name _____

Project Location _____

Laboratory _____

Project Manager _____

Sampler(s)/Affiliation _____

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE						Remarks	Total
										Total No. of Bottles/ Containers	

Sample Matrix: L = Liquid; S = Solid; A = Air

Relinquished by: _____	Organization: _____	Date ___/___/___	Time _____	Seal Intact? Yes No N/A
Received by: _____	Organization: _____	Date ___/___/___	Time _____	
Relinquished by: _____	Organization: _____	Date ___/___/___	Time _____	Seal Intact? Yes No N/A
Received by: _____	Organization: _____	Date ___/___/___	Time _____	

Special Instructions/Remarks: _____

Delivery Method: ☐ In Person ☐ Common Carrier _____ (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

AG 05-12/01

ARCADIS

Attachment B-4

TestAmerica Quality Assurance Manual

Quality Assurance Manual

TestAmerica Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Phone: 203.929.8140
Fax: 203.929.8142
www.testamericainc.com

Facility Distribution No. _____ **Distributed To:_____**

Title Page:

Quality Assurance Manual
Approval Signatures

Laboratory Director – Larry Decker	Date
Quality Manager - Marsha Culik	Date
Technical Director, **(Organics Manager)** - Kim Maturo	Date
Technical Director, **(Inorganics Manager)** - Dan Helfrich	Date
Technical Director, **(Organic- SV)** - Dawn May	Date
Technical Director, **(Wet Chemistry)** - Doreen Nemeth	Date
Client Service Manager, **(Project Mgt.)** - Paul Hobart	Date

SECTION 2

TABLE OF CONTENTS

LIST OF TABLES

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LIST OF APPENDICES

SOPs AND POLICIES REFERRED TO IN THE QA MANUAL

SOP/Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-003	Management of Change Procedure
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-005	Calibration Curves (General)
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CA-L-S-001	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CA-L-P-001	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-L-P-001	Record Retention
CW-F-P-002	Authorization Matrix
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-004	Controlled Purchases Policy

SECTION 3

INTRODUCTION
(NELAC 5.1 - 5.3)

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Connecticut'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. Each TestAmerica 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 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards and ISO/IEC Guide 17025 (1999). In addition, the policies and procedures outlined in this manual are compliant with the various accreditation and certification programs listed in Appendix 6. The relevant NELAC section is included in the heading of each QAM section.

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

- 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.
- EPA SW-846, *Test Methods for the Evaluation of Solid Waste, 3rd Edition,* September 1986; Update I, July 1992; Update II, September 1994; and Update III, December 1996.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- USEPA Contract Laboratory Program. *Statement of Work for Inorganics Analysis. Multi-Media, Multi-Concentration*. Document ILM04.0.
- USEPA Contract Laboratory Program. *Statement of Work for Organics Analysis. Multi-Media, Multi-Concentration.* Document Number OLMO3.1, August 1994, OLM04.2.
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th and 21st Edition.
- Nuclear Regulatory Commission (NRC) quality assurance requirements.

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by TestAmerica Connecticut 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 5 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

TestAmerica Connecticut analyzes thousands of environmental and industrial samples every month. Sample matrices vary among 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 and physical parameters. The Program also contains guidelines on maintaining documentation of analytical process, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all requests to provide analyses 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 water, industrial waste, and soil 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 **App 4 of the QAM.** The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet requirements. All methods performed by TestAmerica Connecticut 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 manual is reviewed annually by the QA Manager and laboratory personnel to assure that it reflects current practices and meets the requirements of TestAmerica Connecticut's clients and regulators. 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. The updates will be reviewed by the QA Manager, Laboratory Director/Manager, Technical Director(s), relevant operational staff and Corporate Quality Assurance (if a change is made to the Corporate template) and then formally incorporated into the document in periodic updates. The QAM is based on a Corporate QAM Template that is prepared and approved by the Chief Operating Officers (COOs) and Corporate Quality Assurance. This template is reviewed annually by the COOs, Corporate Quality, and each laboratory. Necessary changes are coordinated by the Vice President of Quality and Environmental Health & Safety (EHS) and distributed to each laboratory for inclusion in the laboratory specific QA Manuals.

Policies in the QAM that require immediate attention may be addressed through the use of Corporate QA/QC Policy Memoranda. QA/QC Policy Memoranda are published from time to time to facilitate immediate changes to QA/QC Policy. QA/QC Policy Memoranda supersede the QAM and all other SOPs (refer to Section 5.3). All policy memoranda are dated, archived and distributed by their placement into the front of the QAM between the signature page and Section 2. At a minimum, each policy memorandum is approved by the same authorized signatories as shown on the cover page of the QA Manual. In addition, Corporate QA/QC Policy

Memoranda are signed by the COOs and VP of Quality and EHS. The QA/QC Policy Memoranda are incorporated into the QAM during the periodic updates. Policy memorandum may also include an expiration date if appropriate. An example format can be found in Figure 3-1. A similar procedure is followed for local laboratory changes.

Laboratory-specific QAM changes are approved and documented through the Management of Change process (Refer to SOP No. CA-Q-S-003, Management of Change Procedure).

3.4.2 Control

This manual is considered confidential within TestAmerica and may not be altered in any manner by other than a duly appointed representative from TestAmerica. If the document has been provided to external users or regulators, it is for the exclusive purpose of reviewing TestAmerica Connecticut's quality systems and shall not be used in any other way without the written permission of an appointed representative of TestAmerica. The procedure for control of distribution is incorporated by reference to SOP for Document Control, CT-QAS-3.

The order of precedence in the event of a conflict between policies is outlined in Section 5.3 of this Quality Assurance Manual.

Figure 3-1.

Example - Format for a QA/QC Policy Memorandum

Corporate (or Laboratory) QA/QC Policy Memorandum # _____

Effective Date: _____ Expiration Date: When Appropriate QAM Section is Revised

Corporate: *(Only needed for Corporate Memorandum – Delete if Laboratory)*

COO - West	Date	Vice-President, QA and EHS	Date
COO - East	Date		

Local:

(List all that are on cover page of QAM) Technical Director Approval	Date	Quality Assurance Approval	Date
Laboratory Director/Manager Approval	Date		Date

1. **Purpose**

2. **Procedure**

3. **Attachments**

4. **References/Cross References**

SECTION 4

ORGANIZATION AND MANAGEMENT
(NELAC 5.4.1)

4.1 OVERVIEW

TestAmerica Connecticut is part of a national network of laboratories known as TestAmerica. This Quality Assurance Manual (QAM) is applicable to the TestAmerica Connecticut laboratory only.

TestAmerica Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
EPA ID - CT00023

The Corporate organization chart can be found in Figure 4-1 and the laboratory's organization chart can be found in Appendix 2. The locations of other TestAmerica labs are as follows:

Aerotech Environmental Laboratories (AEL)
TestAmerica Anchorage
TestAmerica Austin
TestAmerica Buffalo
TestAmerica Buffalo Grove
TestAmerica Burlington
TestAmerica Cedar Falls
TestAmerica Chicago
TestAmerica Corpus Christi
TestAmerica Dayton
TestAmerica Denver
TestAmerica Edison
TestAmerica Honolulu
TestAmerica Houston
TestAmerica Irvine
TestAmerica King of Prussia
TestAmerica Knoxville
TestAmerica Los Angeles
TestAmerica Mobile
TestAmerica Morgan Hill
TestAmerica Nashville
TestAmerica North Canton
TestAmerica Ontario
TestAmerica Orlando
TestAmerica Pensacola
TestAmerica Phoenix
TestAmerica Pittsburgh
TestAmerica Portland
TestAmerica Richland

TestAmerica San Francisco
TestAmerica Savannah
TestAmerica Seattle
TestAmerica Spokane
TestAmerica St. Louis
TestAmerica Tacoma
TestAmerica Tallahassee
TestAmerica Tampa
TestAmerica Valparaiso
TestAmerica Watertown
TestAmerica West Sacramento
TestAmerica Westfield

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 define each role in its relationship to the Quality Assurance Program. More extensive job descriptions are maintained by laboratory management.

4.2.1 Quality Assurance Program

The responsibility for quality lies with every employee of TestAmerica Connecticut. All employees have access to the QAM and are responsible for knowing the content of this manual and 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.

4.2.2 Chairman/Chief Executive Officer (CEO)

The Chairman/CEO is the Chairman of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. Together with the President/CEO of the Analytical Division, the Chairman/CEO establishes the overall quality standard and data integrity program for the company, providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.3 President/Chief Executive Officer (CEO)

The President/CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. Together with the Chairman/CEO, the President/CEO establishes the overall quality standard and data integrity program for the Analytical Division, providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.4 Chief Operating Officer (COO) – East and West

The COOs serve as the ranking executives for all respective analytical laboratory operational functions and report to the President/CEO of the Analytical Division. They are responsible for the daily management of all analytical laboratories, long-term planning and development of

technical policies and management plans. They ensure the attainment of corporate objectives through the selection, development, motivation, and evaluation of top management personnel. The COOs approve all operating budgets and capital expenditures. The COOs sign-off on the final QAM template that contains company policies for implementing the Quality Program.

4.2.5 General Manager (GM)

Each GM reports directly to a COO. Each GM has full responsibility for the overall administrative and operational management of their respective laboratories. The GM's responsibilities include allocation of personnel and resources, long-term planning, setting goals, and achieving the financial, business, and quality objectives of TestAmerica. The GM ensures timely compliance with corporate management directives, policies, and management systems reviews. The GM is 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.

4.2.6 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President of QA/EHS reports directly to the Chairman/CEO. With the aid of the Analytical Division and Non-Analytical Division Senior Management Teams, Laboratory Director/ Managers, Quality Directors, EHS Directors, QA Managers and EHS Coordinators, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and Environmental, Health and Safety Program within TestAmerica. Additional responsibilities include:

- Review of QA/QC aspects of Corporate SOPs, national projects and expansions or changes in services.
- Coordination/preparation of the Corporate QAM Template that is used by each laboratory to prepare its own laboratory-specific QAM.
- Maintenance of Corporate Policies, Quality Memorandums and SOPs. Maintenance of data investigation records that are reported to Corporate Management.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the Analytical Division and a summary of any quality related initiatives and issues.
- With the assistance of the Corporate Senior Management Teams and the EHS Directors, development and implementation of the TestAmerica Environmental, Health and Safety Program.

4.2.7 Quality Directors (Corporate)

The Quality Directors report to the VP-QA/EHS. Together with the VP-QA/EHS, the Quality Directors have the responsibility for the establishment, general overview and maintenance of the Analytical Division's Quality Assurance Program within TestAmerica. The Quality Directors are responsible for:

- Oversight of the QA/QC programs within each laboratory. This includes a final review of each laboratory-specific QAM and receipt of each laboratory's QA monthly report.
- Review of QA/QC aspects of national projects.

- Assistance with certification activities.

4.2.8 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-QA/EHS and VP-Client and Technical Services. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing 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 to make recommendations for policy enhancements to the CEOs, COOs, Laboratory Director/Manager or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will 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.

4.2.9 Vice President of Client and Technical Services

The Vice President (VP) of Client and Technical Services is responsible for offerings to clients including risk management, technical assistance, legal compliance and contract administration. The VP of Client and Technical Services provides support and direction to the Managers of these areas, and supports the COOs in decisions regarding long term planning, resource allocation and capital expenditures.

4.2.10 Director of Technical Services

The Director of Technical Services is responsible for establishing, implementing and communicating TestAmerica's Analytical Division'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.

4.2.11 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 the NELAC standard, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various TestAmerica facilities.

4.2.12 Environmental Health and Safety Directors (EHSDs) (Corporate)

The EHSDs report directly to the VP-QA/EHS. The EHSDs are responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations.
- Coordination/preparation of the corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP.
- 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.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

4.2.13 Laboratory Director

TestAmerica Connecticut'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.

Specific responsibilities include, but are not limited to:

- Provides one or more technical directors for the appropriate fields of testing. The name(s) of the Technical Director will be included in the national database. If the Technical Director 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 Technical Director to temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary 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.
- Captains the management team, consisting of the QA Manager, CSM and the Technical Director(s), as direct reports.

4.2.14 Quality Assurance (QA) Manager

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025.

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 (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 officers to accomplish specific responsibilities, which include, but are not limited to:

- 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.
- 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 are temporarily suspended following the procedures outlined in Section 13.
- Monitoring standards of performance in quality control and quality assurance.
- 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.

4.2.15 Supervisors

Supervisors (Technical Directors) report to the Laboratory Director. 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 (as documented in Section 8.1), 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 Personnel 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 Director, 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 and 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.

4.2.16 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 Director, 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 Director, 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.

4.2.17 Environmental Health and Safety Officer

The Safety Officer 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 Material Safety Data Sheet (MSDS) 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.

4.2.18 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.

4.2.19 Client Service Manager

The Client Service Manager reports to the Laboratory Director and serves as the interface between the laboratory's technical departments and the laboratory's clients. The staff consists of the Project Management team. With the overall goal of total client satisfaction, the functions of this position are outlined below:

- Technical training and growth of the Project Management team.
- Technical liaison for the Project Management team.

- Human resource management of the Project Management team.
- Responsible to ensure that clients receive the proper sampling supplies.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample progress in daily status meeting with agreed-upon due dates.
- Responsible for discussing with client any project-related problems, resolving service issues, and coordinating technical details with the laboratory staff.
- Responsible for staff familiarization with specific quotes, sample log-in review, and final report completeness.
- Monitor the status of all data package projects in-house to ensure timely and accurate delivery of reports.
- Inform clients of data package-related problems and resolve service issues.
- Coordinate requests for sample containers and other services (data packages).

4.2.20 Project Manager

The Project Manager reports directly to the Division Manager and serves as liaison between the laboratory and its clients. The Project Manager's responsibilities include:

- Ensure client specifications are met by communicating project and quality assurance requirements to the laboratory. Ensure client specific reporting and quality control requirements are met.
- Notify laboratory personnel of incoming projects and sample delivery schedules.
- Monitor the status of all projects in-house to ensure timely delivery of reports.
- Inform clients of project-related problems, resolving service issues and coordinating technical issues with the laboratory staff.
- Coordinate client requests for sample containers and other services.
- Schedule sample pick-ups from client offices or project sites and notifying the laboratory staff of incoming samples.
- Coordinate subcontract work.
- Assist clients in procuring the proper sampling supplies.
- Respond to client inquiries concerning sample status.
- Assist clients with resolution of problems concerning Chains-of-Custody.
- Prepare laboratory quotes and project bids.
- Review sample log-in sheets, when there is a question regarding a Chain of Custody issue.

4.2.21 Sample Custodian

The Sample Custodian reports to the Project Management Department. The responsibilities of the Sample Manager are outlined below:

- Direct the logging of incoming samples into the LIMS.
- Insure timely and correct shipment of sample containers to clients. Maintain accurate records of sample container shipments.

- Perform sample collection and sample pick-up
- Ensures sample containers are prepared for sampling
- Performs field tests and measurements and operates and maintains equipment used for those purposes.

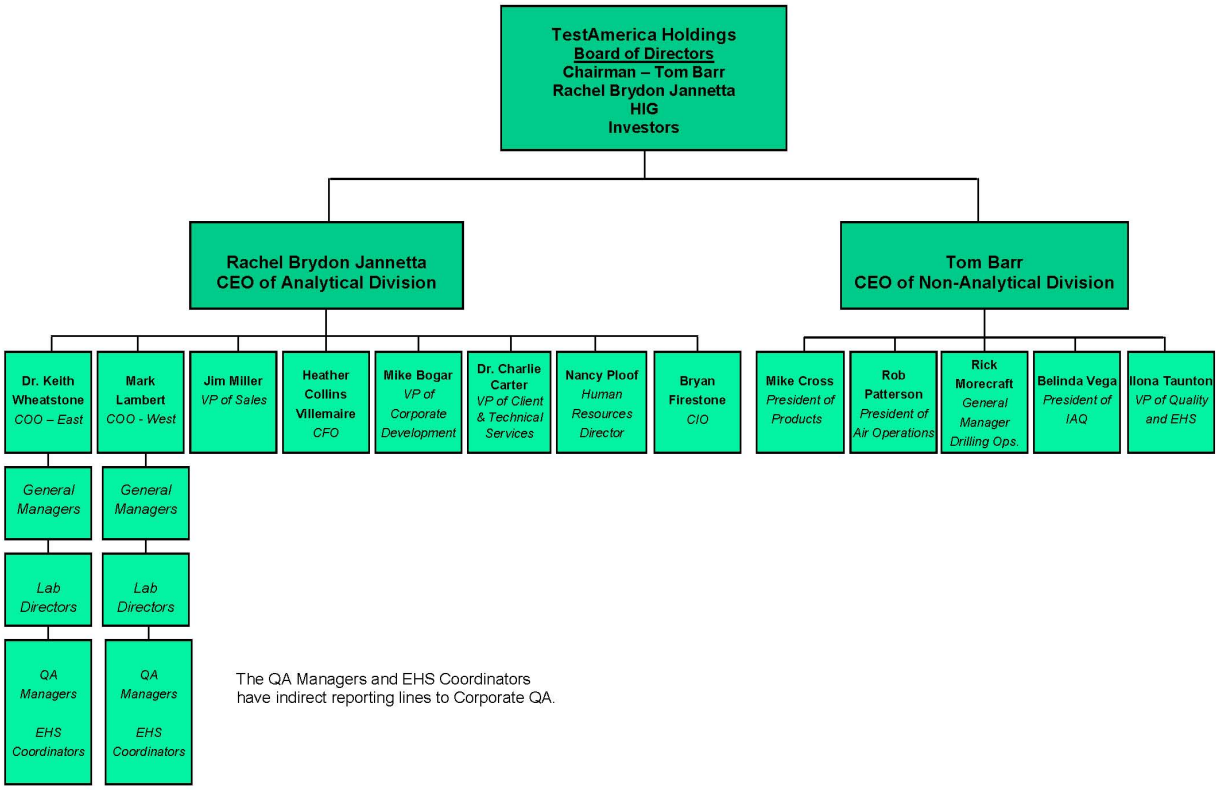
4.3 DEPUTIES

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

Key Personnel	Deputy	Comment
Laboratory Director Larry Decker	Kim Maturo	
QA Manager Marsha Culik	Patty Mercure	
Organic Technical Director Kim Maturo	Dawn May	
Metals Technical Director Dan Helfrich	Nestor Petronchak	
Wet Chemistry Technical Director Doreen Nemeth	David Madumadu	
EHS Coordinator Danielle Gayda	Dan Helfrich	

Figure 4-1.

Corporate Organization Chart



SECTION 5

QUALITY SYSTEM
(NELAC 5.4.2)

5.1 QUALITY POLICY STATEMENT

The management of TestAmerica and TestAmerica Connecticut are committed to providing data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols described in this manual.

In all aspects of the laboratory and business operations, management is dedicated in maintaining the highest ethical standards. An Ethics Policy sign-off can be viewed in Appendix 1. Training on ethical and legal responsibilities is provided annually and each employee signs off annually on the policy as a condition of employment.

It is TestAmerica's Policy to continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. The company recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.

TestAmerica Connecticut strives to provide clients with the highest level of professionalism and the best service practices in the industry.

Every staff member at TestAmerica Connecticut 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 (Policy No. CA-L-P-001) and employee ethics statements (Appendix 1).
- An Ethics and Compliance Officer (ECO).
- 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. (SOP No. CA-L-S-001)
- Procedures and guidance for recalling data if necessary (SOP No. CA-L-S-001).
- An effective external and internal monitoring system that includes procedures for internal audits (Section 16).

As an American Council of Independent Laboratories (ACIL) member, all TestAmerica laboratories adhere to the following ACIL Code of Ethics:

- 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 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 SUPPORTING DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents prepared by the laboratory and company management:

- Quality Assurance Manual (QAM) Template
- 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
- Corporate TestAmerica QA/QC Policy Memorandums (Refer to Section 3.4).
- Laboratory QA/QC Policy Memorandums (Refer to Section 3.4).

5.3.1 Order of Precedence

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

- TestAmerica QA/QC Policy Memorandum - Corporate
- Laboratory QA/QC Policy Memorandum
- Quality Assurance Manual
- Corporate SOPs and Policies
- Laboratory SOPs and Policies

- Other (Work Instructions (WI), memos, flow charts, etc.)

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. The calculation of precision is described in Section 25.

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. The calculation of accuracy is described in Section 25.

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, and by the degree to which approval from the US EPA or other pertinent regulatory agencies is obtained for any procedure for which significant modifications have been made.

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

A Quality Control Limit Summary table that summarize the precision and accuracy acceptability limits for analyses performed at TestAmerica Connecticut can be easily generated from the LIMS system under Management Reports-QA Limits.

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, TestAmerica Connecticut has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in Section 25.

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)]. TestAmerica Connecticut 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 Supervisor and QA Manager) and entered into the Laboratory Information Management System (LIMS). The TALS LIMS system maintains an archive of all limits used within the laboratory. All control limits are stored with in a LIMS Method limit Group. These are set up and under the control of the QA department. Any time a limit is updated a historical record with activation and expiration date is generated for the limit type. Archived limits can be exported to excel at any time by utilizing the “Historical” button in the Method Limit Group.
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 25. 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

Control charts are used to establish method performance of a given analysis and to monitor trends of QC results graphically over time. Once a data base of the laboratory results for a method/matrix/QC analyte combination is established, the acceptability of a given analysis of that QC parameter (and of the analytical batch to which it belongs) can be evaluated in light of the laboratory's normal performance. This is intended to help identify problems before they might affect data. Often, patterns of response that are not at all evident in sets of numbers are very distinct when the same values are viewed as a chronological graph.

Establishment of Limits

The purpose of using statistical control limits is to define, for each analyte in a given method/matrix/QC type combination, a range of expected values. This range encompasses the random variation that occurs normally in the laboratory and allows one to evaluate control samples in that context, rather than according to an arbitrary or external set of values. Limits for accuracy and precision are defined below:

Accuracy

As recoveries of a QC analyte in a given matrix are tabulated over time, a mean value for recovery is established, as is the standard deviation (s) of those recoveries. If the analysis is in statistical control (e.g., if the set of QC recoveries over time show random variation about the mean) approximately 99.7% of all recoveries for that QC will fall within three standard deviations (3s) of the mean. Thus, assuming that the mean itself is an acceptable level of recovery, the values corresponding to 3s above and 3s below the mean are defined as the Control Limits. Any single recovery outside these values is assumed to have resulted from some circumstance other than normal variation and shall be investigated.

Roughly 95% of points should fall within 2s of the mean. The values +2s and -2s are the Warning Limits. Any normal result has approximately a 1/20 chance of being between 2s and 3s from the mean, so a result in this region doesn't necessarily warrant corrective action, but attention should be paid to such points.

Precision

Precision is used to indicate matrix variability so that appropriate decisions can be made by the client when repeated analyses vary significantly. The coefficient of variation, expressed as a percentage (e.g., the %RSD) for the data set used to calculate accuracy control limits defines the control limit for precision. Duplicate analyses of the QC samples, such as duplicates or MS/MSD, should have an RPD less than or equal to this established precision control limit to be considered free of matrix interferences.

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 17). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL
(NELAC 5.4.3)

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 at each laboratory Facility:

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

The Corporate staff posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These are collectively termed "Official Documents" and encompass the Policies and Procedures that all facilities are required to employ. These official documents are only considered controlled when they are read on the company 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 official documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The following SOPs are used for local lab document control; CT-QAS-3, SOP for Document Control and CT-QAS-10, SOP for Document Coding.

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 nonconformance memos. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports. Discussion on records control is described in Section 15.

The maintenance of purchasing data is discussed in Section 9.

The maintenance of sales and marketing contracts is discussed in Section 7.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a control system for each document include a unique name and number, the number of pages of the item, the effective date, revision number and the

laboratory's name. The QA Manager or designee is responsible for the maintenance of the system and maintains the items either electronically on the server or hardcopy in the QA office.

Controlled documents are authorized by the QA Department and other management. In order to develop a new document, a supervisor submits either a hardcopy or 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 the official document on file. The official document is provided as needed to those using it. Controlled documents shall be available at all locations where the operational activity described in the document is performed (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 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.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

Procedures for Document control at TestAmerica Connecticut can be found in the flowing SOPs CT-QAS-3, SOP for Document Control and CT-QAS-10, SOP for Document Coding.

For changes to the QA Manual, refer to Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. 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 for the applicable revision.

For changes to SOPs, refer to SOP No. CT-QAS-008, Standard Operating Procedure for Generating SOPs.

Forms, worksheets, work instructions and information are organized by department in the QA office. These are tracked by excel spread sheet. Electronic versions are kept on the laboratory server. The procedure for the care of these documents is in SOP CT-QAS-3, SOP for Document Control.

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 as described in Section 15.

SECTION 7

REVIEW OF WORK REQUEST

7.1 OVERVIEW

TestAmerica Connecticut 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 TestAmerica'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 TestAmerica'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 regulatory and client 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 lab'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 TestAmerica'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 review process 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 complex or large projects, the proposed contract is given to the National Account Director, 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 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)***.***

- Legal & Contracts Director
- General Manager
- The Laboratory Client Service Manager
- Laboratory and/or Corporate Technical Directors
- Laboratory and/or 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 National Account Director, Legal Contracts Director, or local account representative 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 Legal & Contracts Director maintains copies of all signed contracts. The PM assigned to the project maintains a copy for the lab.

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 Regional Account Manager. A copy of the contract and formal quote will be filed with the laboratory PM and the Lab Director/Manager.

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 in a note book of pertinent conversations with the client. If need be, a follow up email is sent.

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, TestAmerica Connecticut assigns a PM 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.

PM's are the direct 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 the laboratory during status or supervisor meetings. 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 individual laboratory Department Manager. The modification that is implemented into the laboratory process may also be documented in the case narrative of the data report(s).

TestAmerica 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.

SECTION 8

SUBCONTRACTING OF TESTS
(NELAC 5.4.5)

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the corporate network. The phrase "work sharing" refers to internal transfers of samples between company 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 we must 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 the SOP on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process SOP (CA-C-S-001).

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 NELAC/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.

Project Managers (PMs), or Regional Account Executives (RAE) for the Export Lab are responsible for obtaining client approval prior to outsourcing 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.

Note: In addition to the client, some regulating agencies, such as the US Army Corps of Engineers and the USDA, require notification prior to placing such work.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM (or Regional Account Executive) 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 network 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 the company; (in JD Edwards): A listing of all approved subcontracting laboratories and supporting

documentation is available on the TestAmerica intranet site. Verify necessary accreditation for the requested tests prior to sending samples.

- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- NELAC or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All intra-company 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. Refer to SOP No. CA-C-S-001, Work Sharing Process.

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 begin the process of approving the subcontract 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).

8.2.1 The QA Manager must ensure that the Subcontracting Approval Form (Figure 8-1) has been completed and have supporting documentation on file prior to initiation of any work. A letter or e-mail is sent to the lab requesting the following information:

8.2.1.1 If a lab is NELAC or A2LA accredited,

8.2.1.1.1 Copy of necessary certifications verifying that the required approvals are current. Ensure that all needed analytes are included; some may not be accredit-able (if so, document). Certificate and scope of International Standard accreditation are required, when applicable.

8.2.1.1.2 Insurance Certificate. This is required by TestAmerica's Chief Financial Officer

8.2.1.1.3 USDA soil permit if available**

8.2.1.2 For Laboratories accredited by other agencies with an auditing program:

8.2.1.2.1 Copy of necessary certifications verifying that the required approvals are current. Ensure that all needed analytes are included; some may not be accredit-able (if so, document). Certificate and scope of International Standard accreditation are required, when applicable.

8.2.1.2.2 Insurance Certificate. This is required by TestAmerica's Chief Financial Officer

8.2.1.2.3 USDA soil permit if available**

8.2.1.2.4 Description of Ethics and Data Integrity Plan.

8.2.1.2.5 The most recent 2 sets of full proficiency testing (PT) results relevant to the analyses of interest and any associated corrective action.

8.2.1.2.6 State Audit with Corrective Action Response

8.2.1.2.7 Example final report to confirm format is compliant and provides the necessary information. (minimally, it must be determined that Batch QC results are included in the laboratory reports and data is appropriately qualified.

8.2.1.2.8 A copy of raw data associated with the first project is requested for internal review. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. If the QA manager is unfamiliar with the analysis being performed, notify Corporate QA for guidance on the review (it may need to be sent elsewhere for evaluation). This requirement can be skipped if an on-site visit of the laboratory is planned. (This requirement is effective as of the effective date of this section. Laboratories worked with previously [minimum of 6 months] are grandfathered in.)

8.2.1.2.9 DoD work includes additional requirements as described in Section 8.1 above.

8.2.1.3 For laboratories performing tests that are unaccredited or accredited by an agency without an audit program:

8.2.1.3.1 A copy of their Quality Assurance Manual (controlled if possible). Ensure data quality limits for relevant methods are acceptable and that training procedures are adequate.

8.2.1.3.2 Copy of necessary certifications (if available) verifying that the required approvals are current. Ensure that all needed analytes are included; some may not be accredit-able (if so, document). Certificate and scope of International Standard accreditation are required, when applicable.

8.2.1.3.3 Insurance Certificate. This is required by TestAmerica's Chief Financial Officer.

8.2.1.3.4 USDA soil permit if available**

8.2.1.3.5 Evidence of a current SOP per method. A copy of the first page and signature page of the SOP is acceptable. A table of contents including effective dates may also be acceptable. The SOP can be examined if an on-site audit is performed.

8.2.1.3.6 Description of Ethics and Data Integrity Plan.

8.2.1.3.7 The most recent 2 sets of full proficiency testing (PT) results relevant to the analyses of interest and any associated corrective action.

8.2.1.3.8 Example final report to confirm format is compliant and provides the necessary information. (minimally, it must be determined that Batch QC results are included in the laboratory reports and data is appropriately qualified.

8.2.1.3.9 Statement of Qualification (SOQ) or summary list of Technical Staff and Qualifications – position, education and years of experience.

8.2.1.3.10 DoD work includes additional requirements as described in Section 8.1 above.

8.2.1.3.11 A copy of raw data associated with the first project is requested for internal review. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. If the QA manager is unfamiliar with the analysis being performed, notify Corporate QA for guidance on the review (it may need to be sent elsewhere for evaluation). This requirement can be skipped if an on-site visit of the laboratory is planned. (This requirement is effective as of the effective date of this section. Laboratories worked with previously [minimum of 6 months] are grandfathered in.)

8.2.2 Once the information is received by the QA Manager, it is evaluated for acceptability and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site along with the associate documentation and notify the finance group for JD Edwards.

**USDA permit is required if soils less than three feet deep from New York, North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Texas, Oklahoma, New Mexico, Arizona, California, Hawaii, or outside the continental U. S. are to be analyzed. These samples require special shipping measures; check with the EHS Department. It may be necessary to heat-treat the samples before shipping if the subcontract laboratory does not have a USDA permit; however, some analytes/tests may be irrelevant after heat treatment.

8.2.3 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. The company does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.4 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contract Department. Any problems identified will be brought to Corporate QA attention.

- 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 must be posted using the Vendor Performance Report (Form No. CW-F-WI-009)**.**
- Information must 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 network laboratories and Corporate QA 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 Lab Directors/Managers, QA Managers and Sales Directors.

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 Legal & Contracts Director 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 is retained in the project folder. For network laboratories, certifications can be viewed on the company website.

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 Chain of Custody (COC). A copy of the original COC sent by the client must be included with all samples subbed within the network.

The PM will communicate with the subcontracted laboratory to monitor the status of the analyses, facilitate successful execution of the work and ensure the timeliness and completeness of the analytical report.

Non-NELAC accredited work must be identified in the subcontractor's report as appropriate. If NELAC 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 network work sharing laboratory may be transferred electronically and the results reported by the network 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/Manager may waive the full qualification of a subcontractor process temporarily to meet emergency needs. In the event this provision is utilized, Corporate QA must be informed, and the QA Manager will be required to verify adequacy of proficiency scores and certifications. The laboratory must also request a copy of the raw data to support the analytical results for the first project submitted to the subcontract laboratory unless the laboratory has NELAC accreditation. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. The QA Manager will request full documentation and qualify the subcontractor under the provisions above. The approval process should be completed within 30 calendar days of subcontracting.

Figure 8-1.
Example - 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: _____ Date: _____
(Printed Name)

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

SECTION 9

PURCHASING SERVICES AND SUPPLIES
(NELAC 5.4.6)

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, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Capital expenditures are made in accordance with the Controlled Purchases Procedure, CW-F-S-004. Only one quote is required where the item being purchased is a sole source product, Examples of sole source capital expenditures are laboratory test equipment, client specified purchases and building leases. A minimum of two quotes is required where the opportunity exists to source from more than one vendor. All documentation related to the purchase of capital items will be maintained in the individual CapEx files located in Corporate Purchasing. Data will be held in accordance with the record retention policy.

TestAmerica will enter into formal contracts with vendors when it is advantageous to do so. Contracts will be signed in accordance with the Authorization Matrix Policy, CW-F-P-002. Examples of items that are purchased through vendor contracts are laboratory instruments, consumables, copiers and office supplies. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. 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.

Non-capital expenditure items are purchased through the requisition and approval process in JD Edwards or through other TestAmerica authorized methods (approved web-sites, purchasing cards). Labs have the ability to select from the approved vendors in JD Edwards.

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

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents must 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 Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001.

9.3.1 Purchasing

The nature of the analytical laboratory demands that all material used in any of the procedures is 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.

The laboratory utilizes the JD Edwards One World software accessed thru the corporate intranet for materials requisitions. User names and passwords are distributed to authorized personnel. Orders are placed bi-weekly by the users and are approved by the Laboratory Director. Only corporate approved suppliers are allowed to be used.

Orders are reviewed by Corporate and placed to the suppliers.

9.3.2 Receiving

It is the responsibility of department supervisors to ensure that shipments are received properly. Once the ordered reagents or materials are received, the analyst or supervisor compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are kept with in each department and 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

There are many different grades of analytical reagents available to the analyst. All 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, it may be assumed that it is not significant in that procedure and, therefore, any grade reagent may 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 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 unless noted otherwise by the manufacturer or by the reference source method.

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

- Expiration dates can be extended if the dry chemical 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 is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical is compared to an unexpired independent source in

performing the method and the performance of the dry chemical is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The comparison studies are maintained with the QA Manager.

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. The minimum total pressure must be 110 psig or the tank must be replaced. 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 conductivity of less than 1.0 µmole-cm (or resistivity of greater than 1.0 megaohm-cm) at 25^{o}C. The conductivity is checked and recorded daily. If the water's conductivity is less than the specified limit, the Classical Chemistry Supervisor 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) 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 VOA vials must be certified clean and the certificates must be maintained. If uncertified VOA vials are purchased, all lots must be verified clean prior to use. This verification must be maintained.

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. Table 9-1 details specific storage instructions for reagents and chemicals. Section 22 discusses conditions for standard storage.

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 Laboratory Director. If they agree with the request the procedures outlined in 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, it is given a short name, such as MSC, added to the equipment list described in Section 21 that is maintained by the QA Department. IT must be notified so that can be linked for back-ups and uploads to LIMS. 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 (see Section 20). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department as specified in the laboratory's procedure for software verification. Software certificates supplied by the vendors are filed with IT department. 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 21. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Laboratory Director.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). The level of control used in the selection process is dependent on the anticipated spend 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 (CW-F-WI-009).

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 (CW-F-WI-007 – refer to Figure 9-1).

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 Laboratory Director are consulted with vendor and product selection that have an impact on quality.

Table 9-1.

Storage of Reagents and Chemicals

Chemical	Storage Requirements
Concentrated Acids and Bases	Stored in the original containers at room temperature. All organic acids must be stored separately from inorganic acids. Acids should not be stored with bases.
Bulk Dry Chemicals	Stored in the original containers at room temperature.
Working Solutions containing Organic Compounds	Stored as per manufacturers recommendations. They are generally stored refrigerated at 4°C± 2°C.
Working Solutions containing only Inorganics	Stored at room temperature; refrigeration as needed.
Flammable Solvents	Stored in solvent cabinets at room temperature.
Non-Flammable Solvents	Stored separately from the flammable solvents in cabinets at room temperature.

Figure 9-1
Example – JD Edwards Vendor Add Request Form

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

JD Edwards Vendor Add Request Form

Vendor name:	Lab location and individual making request:
Vendor address (remit to):	Vendor phone:
Vendor address (remit to):	Vendor fax:
Contact name:	Product / service provided:

Reason for Vendor Addition: Check all reasons that apply

☐ Cost Reduction	Estimated Annual Savings $
☐ Replace Current Vendor	Reason?
	Vendor being Replaced?
☐ New Product / Service	Describe:
☐ ISO Approved (Required for Aerotech / P&K only)	

Small Business:

Does this vendor help us to meet our small business objectives: _____

If yes, which category: _____

Personal and Ethical Considerations:

Is there any personal conflict of interest with a TestAmerica employee and the vendor listed above? _____

_____

Have ethical considerations been taken into account in your evaluation of this vendor?_____

_____

Can this product be sourced from another TestAmerica facility?_____

Please complete form and email to NCPurchasing@testamericainc.com or fax to (330) 966-9275.

I approve the addition of this vendor:

_____ _____

Purchasing Manager - Patrick Eckman Corporate Controller - Leslie Bowers

Form No. CW-F-WI-007

SECTION 10

SERVICE TO THE CLIENT
(NELAC 5.4.7)

10.1 OVERVIEW

TestAmerica Connecticut 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 discussed in Section 5. The laboratory has procedures to ensure confidentiality to clients (Section 16 and 26).

Note: ISO 17025/NELAC 2003 states that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request". This topic is discussed in Section 7.

10.2 SPECIAL SERVICES

The laboratory's standard procedures for reporting data are described in Section 26. When requested the following special services are provided:

- The laboratory will provide the client or the client's representative reasonable access to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- The laboratory will work with client-specified third party data validators as specified in the client's contract.
- The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

10.3 CLIENT COMMUNICATION

Project managers are an important communication link to the clients. The lab shall inform its clients of any delays in project completion as well as any non-conformances in either sample receipt (refer to Section 24) or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

The Laboratory Director and Department Supervisors are available to discuss any technical questions or concerns that the client may have.

10.4 REPORTING

The laboratory will work with the client to produce any special communication reports required by the contract.

10.5 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 11

COMPLAINTS
(NELAC 5.4.8)

11.1 OVERVIEW

TestAmerica Connecticut believes that effective client complaint handling processes have important business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that helps to continually improve processes and improving 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, 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 dealing with both external and internal complaints.

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 13 (Corrective Actions) and is documented following Corporate SOP, Complaint Handling and Service Recovery, S-C-002. Complaints are documented and tracked utilizing an excel spreadsheet located on the lab server. It is the laboratory's goal to provide a satisfactory resolution to complaints in a timely and professional manner.

11.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process and the documentation of the complaint.

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 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.

11.3 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 13.

11.4 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 17)

SECTION 12

CONTROL OF NON-CONFORMING WORK
(NELAC 5.4.9)

12.1 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 13).

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 supervisor for advice. The supervisor may elect to discuss it with the Laboratory Director or have a Project Manager contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 13. 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 20. 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 and 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 NELAC (or the analytical method) requirements and the reason. Data being reported to a non-NELAC state would need to note the change made to how the method is normally run.

12.2 RESPONSIBILITIES AND AUTHORITIES

SOP No. CA-L-S-001, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall, outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of the company'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, or QA Manager 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 corrective action procedures described in Section 13. 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, the QA Manager, and the Department Managers. 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) and Quality Director within 24 hours.

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/Manager, QA Manager, ECOs, COO's – East and West, General Managers and the Quality Directors – East and West 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.

12.3 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.

SOP No. CA-L-S-001 distinguishes between situations when it would be appropriate for the laboratory QA Manager and Laboratory Director/Manager (or his/her designee) 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 (Section 13) in lieu of the data recall determination form contained in SOP No. CA-L-S-001.

12.4 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 (Section 13).

On a monthly basis, 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.

12.5 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 12.2, Paragraph 5 above.

Prior to suspension/restriction, confidentiality will be respected, and the problem and the required corrective and preventive action will be stated in writing and presented to the Laboratory Director/Manager.

The Laboratory Director/Manager 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 13 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 General Manager 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/Manager 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, QA Manager, and Supervisor) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management should 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 as described in Section 13.

SECTION 13

CORRECTIVE ACTION
(NELAC 5.4.10)

13.1 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 system within LIMS. (refer to Figure 13-1).

13.2 DEFINITIONS

- **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 are contained in the method specific SOPs. 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 is not only a correction made to the immediate event, but a change in process, procedure or behavior that is required to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

13.3 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 investigation.
- 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 (see more on client complaints in Section 11).

13.3.1 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

- Isolated Reporting / Calculation Errors
- Client Complaints with Report Revisions
- Issues found while reviewing NCMs that warrant further investigation.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors

13.4 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.

13.4.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCM must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 13-1 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 Supervisor, Lab Director, or QA Manager (or QA designee) is consulted.

13.4.2 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 is used for this documentation.

13.4.3 Monitoring of the Corrective Actions

- The Department Supervisor and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions will be documented and re-evaluated until acceptable resolution is achieved. Department Supervisors are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is generated through the LIMS system. NCM are tracked and a monthly summary of all corrective actions can be generated and exported to excel for review to aid in ensuring that the corrective actions have taken effect.
- The QA Manager reviews monthly NCMs for trends. Highlights are included in the QA monthly report (refer to Section 17). 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.

13.4.4 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. (Section 16 includes additional information regarding internal audit procedures.)
- 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.

13.5 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 12 for information regarding the control of non-conforming work). The documentation of these procedures is through the use of an NCM.

For specific criteria and corrective actions refer to the analytical methods or specific method SOPs and summarized in Appendix 4 of this QAM.

Table 13-1 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, Appendix 4, QAM Sections 20 and 21, and SOP CA-L-S-001 (Internal Investigation of Potential Data Discrepancies and Determination for Data Recall). All corrective actions are reviewed at a minimum monthly 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 auto-generated emailed NCM and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

13.6 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, and not erased, deleted, made illegible, or otherwise 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.

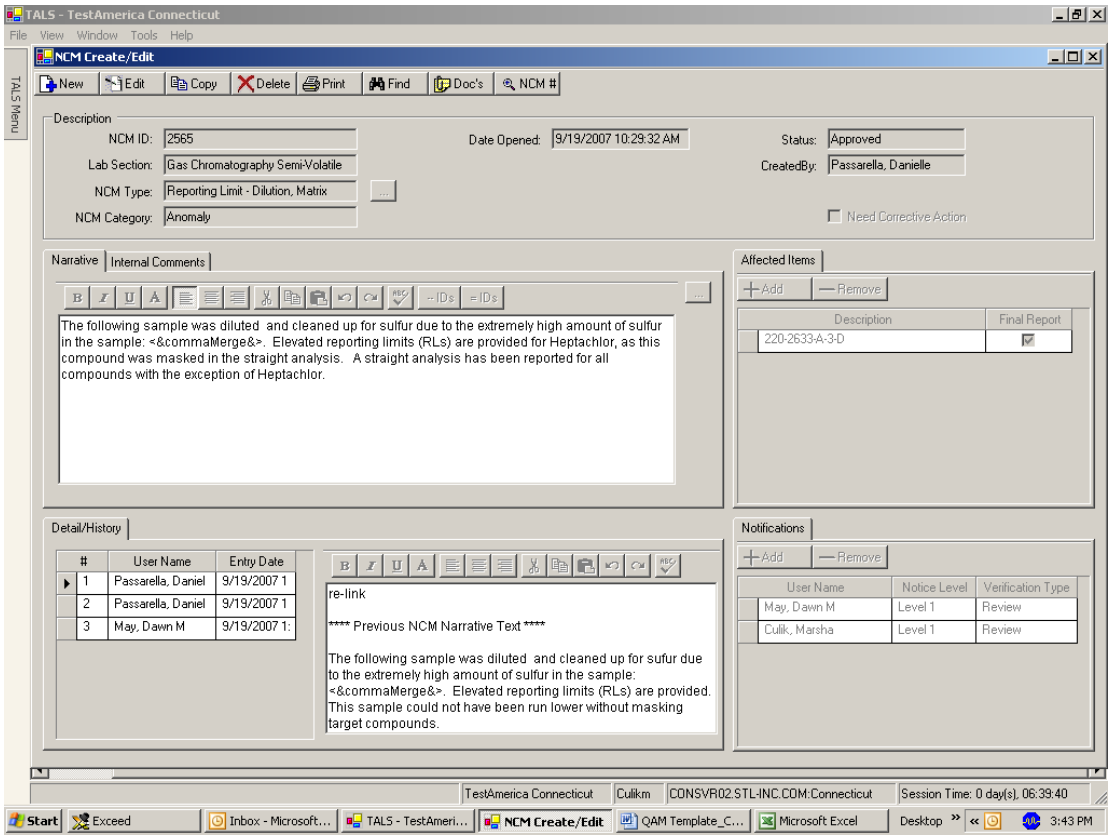
This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 13-1.
Example - Corrective Action Report

LIMS NONCONFORMANCE MEMO

Example Screens:



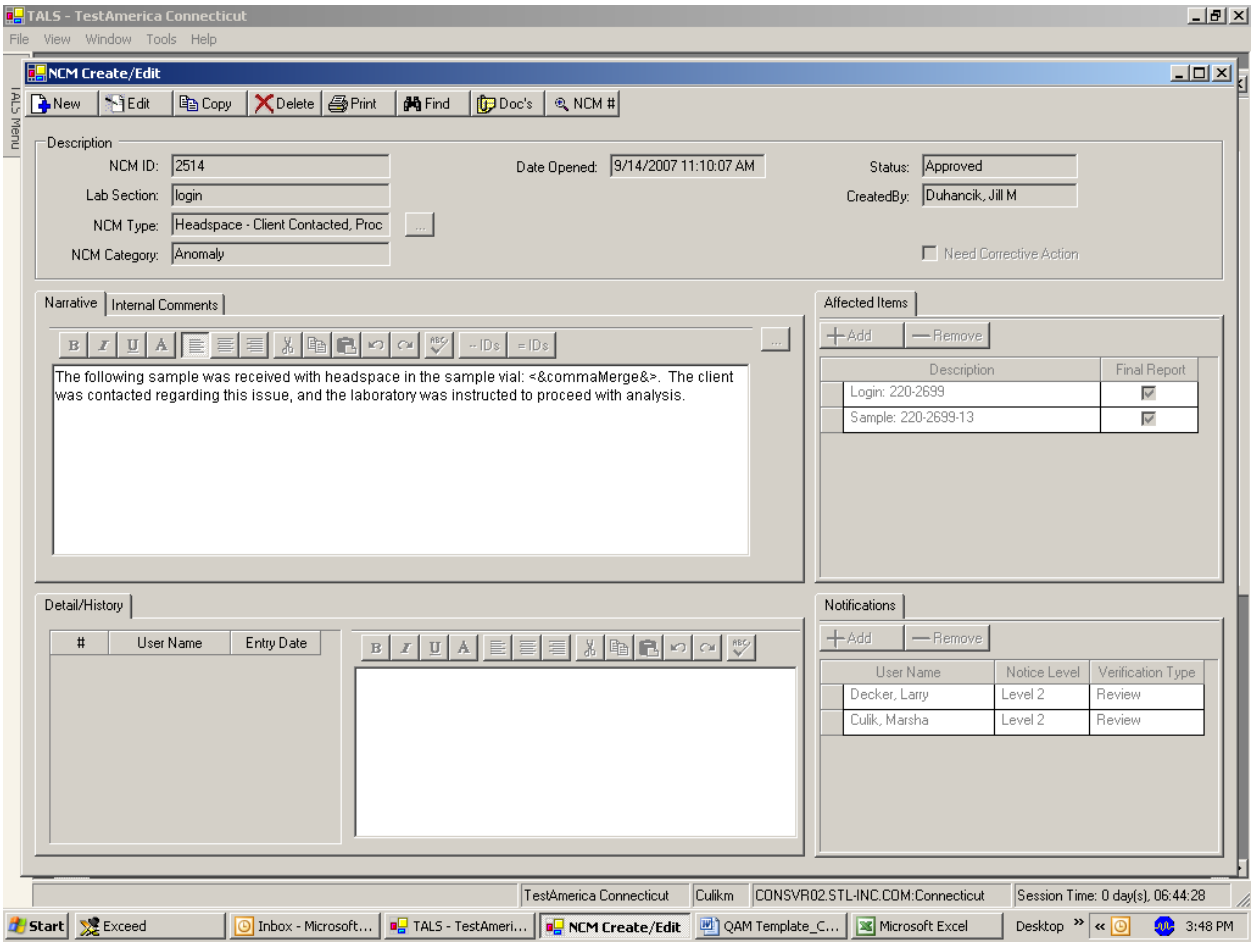

TALS - TestAmerica Connecticut
File View Window Tools Help
NCM Create/Edit
New Edit Copy Delete Print Find Doc's NCM #
Description
NCM ID: 2514
Lab Section: login
NCM Type: Headspace - Client Contacted, Proc
NCM Category: Anomaly
Date Opened: 9/14/2007 11:10:07 AM
Status: Approved
CreatedBy: Duhancik, Jill M
Need Corrective Action
Narrative
Internal Comments
The following sample was received with headspace in the sample vial: <&commaMerge&>. The client was contacted regarding this issue, and the laboratory was instructed to proceed with analysis.
Affected Items
Add Remove
Description
Final Report
Login: 220-2699
Sample: 220-2699-13
Detail/History
User Name Entry Date
Notifications
Add Remove
User Name
Notice Level
Verification Type
Decker, Larry
Level 2
Review
Culik, Marsha
Level 2
Review
TestAmerica Connecticut
Culikm
CONSVR02.STL-INC.COM:Connecticut
Session Time: 0 day(s), 06:44:28
Start
Exceed
Inbox - Microsoft...
TALS - TestAmeri...
NCM Create/Edit
QAM Template_C...
Microsoft Excel
Desktop
3:48 PM

Table 13-1.

General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < ½ RL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Supervisor)*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery/%RSD within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and/or recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Supervisor)*	- % 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/ % Difference 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 SOPs/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.
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in SOPs/LIMS.	- Batch must be re-prepared and re-analyzed. **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 /Standard Operating Procedures	- Individual sample must be repeated/reextracted. Place comment in LIMS.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
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.
Proficiency Testing (PT) Samples *(QA Manager, Department Manager/Supervisor)*	- 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.
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department Manager/ Supervisor, QA Manager, Corporate QA, Corporate Management)	- SOP CA-L-S-001, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CA-L-S-001.
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 17 for an example) (QA Manager, Lab Director/Manager, Department Supervisors/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.

Note:

1. Except as noted below for certain compounds, the method blank should be below the detection limit. Certain programs may require less than ½ the detection 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. 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.

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SECTION 14.0

PREVENTIVE ACTION
(NELAC 5.4.11)

14.1 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 continuous process improvement activity 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 TestAmerica Connecticut's commitment to its Quality Assurance (QA) program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the QA Metrics Report, internal or external audits, proficiency testing performance, client complaints, staff observation, etc..

The monthly Quality Assurance Metrics Report shows performance indicators in all areas of the 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 to help evaluate quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's Corrective Action process (Section 13) 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.

14.1.1 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, management review, and the Management of Change process (see below).

Note: There may be varying levels of formality and documentation during the preventive action process due to the simplicity/complexity of the action taken.

14.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the Annual Management Review (Section 17). A highly detailed recap is not required; a simple recount of success and failure within the preventive action program will provide management a measure for evaluation.

14.2 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: Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation. This process is discussed in further detail in SOP CA-Q-S-003, Management of Change.

SECTION 15.0

CONTROL OF RECORDS
(NELAC 5.4.12)

TestAmerica Connecticut maintains a record 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.

15.1 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 15-1. Quality records are maintained by the Quality Assurance (QA) Manager in a database, which is backed up as part of the regular network backup or archived in banker boxes. 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 department supervisors.

Table 15-1. Record Index[1]

Technical Records	Official Documents	QA Records	Project Records	Administrative Records
Retention: 5 Years from analytical report issue*	5 Years from document retirement date*	5 Years from archival* **Data Investigation:** 5years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)	5 Years from analytical report issue*	**Personnel:** 7 Years (HR Records must be maintained as per Policy CW-L-P-001) **Finance:** See Accounting and Control Procedures Manual
Raw Data Logbooks[2] Standards Certificates Analytical Records Lab Reports	Quality Assurance Manual (QAM)	Internal and External Audits/ Responses	Sample receipt and COC Documentation	Finance and Accounting
	Work Instructions	Certifications	Contracts and Amendments	EH&S Manual, Permits, Disposal Records
	SOPs	Corrective/Preventive Action	Correspondence	Employee Handbook
	Manuals	Management Reviews	QAPP	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)
		Method & Software Validation, Verification data	SAP	
		Data Investigation	Telephone Logbooks	Administrative Policies
	Policies		Lab Reports	Technical Training Records

[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 15-2.

All records are legible and stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss. Retention of records in hardcopy format are maintained on-site at the laboratory for at least 1 year after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five years unless other wise 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 15-2 have lengthier retention requirements and are subject to the requirements in Section 15.1.3. Policy CW-L-P-001 (Record Retention) provides additional information on record retention requirements.

15.1.1 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 15-3 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. The TALS LIMS contains all data reports electronically including external scanned raw data.

Table 15-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
NY Potable Water NYCRR Part 55-2	10 years

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

15.1.2 All records are held secure and in confidence. Records maintained at the laboratory are located electronically within the LIMS. Any hardcopy data is stored in the Data Management area. Records archived off-site are stored in a secure location. Logs are maintained for each storage box to note removal and return of records.

15.1.3 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, see section 20.12.1 'Computer and Electronic Data Related Requirements' for more information. More information on data archive can be found in the SOP for CONSVR1 Backup, Recovery and Archive and SOP for TARGET1_CT Backup, Recovery and Archive.

15.1.4 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 laboratory's copy of the chain of custody is stored with the invoice and the work order sheet generated by the LIMS. 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. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method. 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 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.

- Also refer to Section 20.13.1 ‘Computer and Electronic Data Related Requirements’**.**

15.2 TECHNICAL AND ANALYTICAL RECORDS

15.2.1 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 (refer to Section 15.1). 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 performance of each analysis and checking of results.

15.2.2 Observations, data and calculations are recorded at the time they are made and are identifiable to the specific task.

15.2.3 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 (previous discussions relate where most of this information is maintained – specifics may be added below):

- laboratory sample ID code**;**
- Date of analysis and time of analysis is 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 including cleanup, separation protocols, incubation periods, ID codes, volumes, weights, instrument printouts, meter readings, 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; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats**.**

15.3 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

15.3.1 Sample Handling Records

Sample handling and tracking is discussed in Section 24. 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.

15.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. See Table 15-1.

15.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

15.5.1 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 to the accrediting body upon request.

15.5.2 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.

15.5.3 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**.**

15.5.4 TestAmerica Connecticut has a record management system 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 analysis basis, and are numbered sequentially within a given analysis. No analysis has more than one active notebook at a time, so all data are recorded sequentially within a series of sequential notebooks. Standards are maintained in the LIMS – no logbooks are used to record that data**.**

15.5.5 Records are considered archived when moved off-site. Access to archived hard-copy information is documented with an access log and in/out records is used in archived boxes to note data that is removed and returned. 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**.**

15.5.6 In the event that the laboratory transfers ownership or goes out of business, TestAmerica Connecticut 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.

15.5.7 Records Disposal

15.5.7.1 Records are removed from the archive and disposed 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.

15.5.7.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

15.5.7.3 If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required. [Refer to Policy No. CW-L-P-001 (Records Retention).]

SECTION 16

AUDITS
(NELAC 5.4.13)

16.1 OVERVIEW

Audits measure laboratory performance and insure compliance with accreditation/certification and project requirements. Audits specifically provide management with an on-going assessment of the quality of results produced by the laboratory, including how well the policies and procedures of the QA system and the Ethics and Data Integrity Program are being executed. They are also instrumental in identifying areas where improvement in the QA system will increase the reliability of data. There are two principle types of audits: Internal and External. Internal audits are performed by laboratory or corporate personnel. External audits are conducted by regulators, clients or third-party auditing firms. In either case, the assessment to program requirements is the focus.

Table 16-1. Audit Types and Frequency

Internal Audits	**Description**	**Performed by**	**Frequency**
	Analyst & Method Compliance	QA Department or Designee	- 100% of all methods over a two year period. - 100% of all analysts annually.
	Instrument	QA Department or Designee	100% of all organic instruments and any inorganic chromatography instruments over a two year period.
	Work Order/ Final Report	QA Department or Designee	- 1 complete report each month.
	Support Systems	QA Department or Designee	- Annual for entire labs support departments & equipment (e.g., thermometers, balances), can be divided into sub-sections over the course of the year.
	Performance Audits (Double-Blind PTs)	Corporate QA, Laboratory QA Department or Designee	- As needed.
	Special	QA Department or Designee	- As Needed
External Audits	**Description**	**Performed by**	**Frequency**
	Program / Method Compliance	Regulatory Agencies, Clients, accreditation organizations	- As required by program and/or clients needs
	Performance Audits	Provided by a third party.	- As required by a client or regulatory agency. Generally provided semi-annually through the analysis of PT samples.

16.2 INTERNAL AUDITS

Annually, the laboratory prepares a schedule of internal audits to be performed throughout the year. As previously stated, these audits verify and monitor that operations continue to comply with the requirements of the laboratory's QA Manual and the Corporate Ethics Program. A

schedule of the internal audits is maintained by the QA Manager in the *Internal Audit Workbook*. An example can be found in Figure 16-1.

It is the responsibility of the QA Manager to plan and organize audits in consideration of the laboratory work load and the department personnel schedules so that all pertinent personnel and operations are thoroughly reviewed. When designees (other than QA department personnel & approved by the QA Manager), perform audits, the QA Manager shall insure that these persons do not audit their own activities except when it can be demonstrated that an effective audit will be carried out. In general, the auditor:

- is neither the person responsible for the process being audited nor the immediate supervisor of the person responsible for the project/process.
- Is free of any conflicts of interest.
- Is free from bias and influences that could affect objectivity.

Laboratory personnel (e.g., supervisors and analysts) may assist with both method and support system audits as long as the items listed in the above paragraph are observed. These audits are conducted according to defined criteria listed in the checklists of the *Internal Audit Workbook.* These personnel must be approved by the QA Manager; and must complete the audit checklists in their entirety. This process introduces analyst experience and insight into the laboratory's auditing program.

The auditor must review the previous audit report and identify all items for verification of corrective actions. A primary focus will be dedicated to the ability of the laboratory to correct root-cause deficiencies and that the corrective action has been implemented and sustained as documented.

16.2.1 Systems

An annual systems audit is required to ensure compliance to analytical methods and SOPs, the laboratory's Data Integrity and Ethics Policies, NELAC quality systems, client and State requirements. This audit is performed in portions throughout the year through method, analyst, instrument, work order/final report and support system audits. Audits are documented and reported to management within 1 week of their performance. Systems audits cover all departments of the facility, both operational and support. The multiple audits are compiled into one systems audit package at the end of the year (*Internal Audit Workbook*).

16.2.1.1 Method, Analyst, Instrument and Work Order/Final Report Audits

Procedures for the method compliance, analyst, instrument and work order/final report audits are incorporated by reference to SOP No. CA-Q-S-004, Method Compliance and Data Authenticity Audits. These audits are not mutually exclusive. For example, the performance of a method audit will also cover multiple analysts and instruments. The laboratory's goal is to annually review all analysts and instruments as described in SOP No. CA-Q-S-004. The laboratory will also audit all methods within a two year time period and audit a minimum of one Work Order/Final Report from receiving through reporting on a monthly basis.

16.2.1.2 Support Systems

Support system audits are performed to ensure that all departments & ancillary equipment are operating according to prescribed criteria. Support system audits include the review of both non-analytical and operational departments. Support equipment audits (e.g., metrology items) include the review of balance calibrations, weight calibrations; water quality testing, etc.. Non-analytical may include sample receiving and bottle preparation. These types of support audits ensure that the operations are being performed to support ethical data as well as ensuring the accuracy & precision of the utilized equipment.

These audits can be performed in portions throughout the year or in one scheduled session. However, the audit schedule must document that these aspects are reviewed annually. Many of the metrology systems are considered to be surveillance activities that can be monitored by QA personnel or delegated to specified department personnel. These surveillance activities are performed on a semi-annual basis unless issues warrant a greater frequency or previous audits continually showing no deficiencies allow the frequency to be reduced to once a year.

An example audit checklist can be found in Figure 16-2. Instructions for reporting findings are included in the *Internal Audit Workbook*. In general, findings are reported to management within 1 week of the audit and a response is due from management within 30 days.

16.2.2 Performance Audits

Corporate QA may arrange for double blind PT studies to be performed in the laboratories. Results are given to Management and Corrective actions of any findings are coordinated at each facility by the QA Managers and Laboratory Directors/Managers. These studies are performed on an as needed basis. They may be performed when concerns are raised regarding the performance of a particular method in specific laboratories, periodically to evaluate methods that may not normally be covered in the external PT program or may be used in the process of developing best practices. The local QA Manager may also arrange for PT studies on an as needed basis. (Refer to Section 16.3.2 for additional information on Performance Audits.)

16.2.3 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.

16.3 EXTERNAL AUDITS

TestAmerica facilities are routinely audited by clients and external regulatory authorities. 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. The 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. This time frame is generally 30 days.

TestAmerica Connecticut 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.

16.3.1 Confidential Business Information (CBI) Considerations

During on-site audits, on-site 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 2003 NELAC standards.

16.3.2 Performance Audits

The laboratory is involved in performance audits conducted semi-annually through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Water Supply for Drinking Water, Waste Water PT, Soil and Sludge.

- It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Further, 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.

- PTs generally do not have holding times associated with them. In the absence of any holding time requirement, it is recommended that the holding time begin when the PT sample is prepared according to the manufacturers instructions. Holding times should apply to full volume PT samples only if the provider gives a meaningful "sampling date". If this is not provided, it is recommended that the date/time of opening of the full volume sample be considered the beginning of holding time.

- Login will obtain the COC information from the documentation provided with the PTs with review by QA or other designated staff.

- Vials will be prepared as required in the instruction set provided with the samples. After preparation to full volume the sample may be spiked, digested, concentrated, etc., as would be done for any normal sample requiring similar analysis.

- PT samples will not undergo multiple preps, multiple runs, multiple methods (unless being used to evaluate multiple methods), multiple dilutions, UNLESS this is what would be done to

a normal client sample (e.g. if a client requests, as PT clients do, that we split VOA coeluters, then dual analysis IS normal practice).

- The type, composition, concentration and frequency of quality control samples analyzed with the PT samples shall be the same as with routine environmental samples.

- Instructions may be included in the laboratory's SOPs for how low level samples are analyzed, including concentration of the sample or adjustment of the normality of titrant. When a PT sample falls below the range of the routine analytical method, the low-level procedure may be used.

- No special reviews shall be performed by operation and QA, UNLESS this is what would be done to a normal client sample. To the degree that special report forms or login procedures are required by the PT supplier, it is reasonable that the laboratory WOULD apply special review procedures, as would be done for any client requesting unusual reporting or login processes.

- 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.

16.4 AUDIT FINDINGS

Internal or External Audit findings should be documented using the excel sheet supplied by QA (see Audit Workbook). The laboratory is expected to prepare a response to audit findings within 30 days of receipt of an audit report unless the report specifies a different time frame. The response may include action plans that could not be completed within the 30 day timeframe. This date must be with in a 90 day time frame of receipt of the audit report. In certain instances, an alternate completion date may set and agreed to by operations management and the QA Manager if corrective action is more complicated.

Responsibility for developing and implementing corrective actions to findings is the responsibility of the Department Supervisor where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report.

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.

The procedures must be in accordance to SOP No. CA-L-S-001, Internal Investigations of Data Discrepancies and Determination of Data Recall.

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.

Figure 16-1 **Internal Audit Workbook**

Laboratory: **TestAmerica Connecticut**

Last Updated: 7/16/2007

Internal Audit Schedule 2007

Item No.	Area Audited	Audit Type	Audit Cycle	Scheduled	Date Audited	Date Closed	Tab No.	Comments
1	Balances	System	6 mo	**September -07**			3	
2	Temperature Logs/ Thermometers	System	6 mo	**September -07**			4	
3	Sample Storage and Disposal	System	1 yr				5	
4	Maintenance Logs	System	6 mo				6	
5	Holding Blanks for Volatile Ref/Freezers (where required)	System	6 mo	**June 2007, Nov 2007**	6/20/2007	6/20/2007	7	
6	Lab Water Quality Testing	System	6 mo	**June 2007, Nov 2008**	8/30/2007		8	
7	Sample Control (Log In)	System	1 yr				9	
8	Shipping Procedures	System	1 yr				10	
9	Computer Operations (LIMS)	System	1 yr				11	
10	SOP Distribution System	System	1 yr	**July-07**	July 30,2007	July 30,2007	12	
11	Archiving of Paper Records	System	1 yr				13	
12	Statistical Process Control	System	1 yr				14	
13	Electronic Archiving	System	1 yr				15	
14	Data Review System	System	1 yr				16	
15	Final Report Generation	System	1 yr	**August-07**	8/24/2007		17	
16	Standards/Reagents	System	6 mo	**September -07**			18	
17	Manual Integration	System	1 yr				19	
18	Corrective Action System	System	1 yr	**July-07**	7/28/2007	7/28/2007	20	
19	Training Records	System	6 mo	**July 2007 Dec 2007**	7/30/2007	7/30/2007	21	check for improvement for those items IP
20	MDLs	System	1 yr	**August-07**	8/29/2007		22	
21	SOPs – Prep/Review/Update Process	System	1 yr	**July-07**	28-Jul-07		23	
22	Purchasing/Procurement	System	1 yr	**August-07**	8/29/2007	8/27/2007	24	

23	Pipette/Diluter/Dispenser Calibration Check	System	6 mo				25	
24	Subcontract Lab Approval	System	1 yr	**August-07**	8/24/2007		26	
25	Customer Complaint System	System	1 yr	**September-07**			27	
26	Methods	Method	2 yr		200.7-7/30/07		28	
	Checklist Pending							

Figure 16-2.

Example – Internal Audit System Checklist: Corrective Actions

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica <Location>

INTERNAL AUDIT - Corrective Actions

[Printed Name(s) or Date(s)]

(Summary Page)

Area Audited:
Auditor:
Date:
Persons Contacted During Audit:

Date Reported to Department Manager:
Reported To:

Date Reported to Lab Director/Manager:
Reported To:

Date Response Due:

Response Received and Accepted by QA Manager:

Associated Corrective Action Report Number(s):

Scheduled Follow-up:

Item	Requirement	Ref.	Y	N	NA	Evidence/Comments	Follow Up
1	Does the laboratory have a corrective action program in place?	5.4.10.1					
2	Does the laboratory have a current corrective action SOP or is this information in the QA Manual?	5.4.10.1					
3	Do all laboratory personnel have documented training and access to initiate corrective actions?	5.4.10.1					
4	Are causes clearly identified by department, staff name, scope of issue (how many reports affected)?	5.4.10.6					
5	Is a root cause for the issue identified?	5.4.10.2					
6	Is a corrective action (plan) clearly described?						
7	Was the corrective action fully implemented?						
8	Is documentation (if applicable) completed as specifed by the corrective action (training, revised SOP, etc)						
9	Has a follow-up assessment been conducted to verify the corrective action was successful?						
10	Are corrective actions reviewed on a regular basis by management?	5.4.10.6a 5					
11	Is there a defined distribution flow for corrective action notification, review, closure, and follow-up?	5.4.10.6a					
12	Are non-conformances reviewed on a regular basis and used, if necessary, to initiate root cause corrective actions?						
13	Does the lab have a documented procedure for QC corrective action (i.e., documented within each method / parameter SOP or in the QA Manual)?	4.10.1					
14	***Verify Corrective Actions from previous systems audits. List Items:***						
15							
16							
17							

Auditor Signature:_____

Primary Reference(s): Corporate SOP CA-Q-S-002, Acceptable Manual Integration Practices
NELAC Standard, June 2003
DoD Quality Systems Manual, Version 3, January 2006
EPA Manual for the Certification of Laboratories Analyzing Drinking Water

SECTION 17

MANAGEMENT REVIEWS
(NELAC 5.4.14)

17.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director/Manager for review and comments. The final report shall be submitted to the Department Supervisors as well as the appropriate Quality Director and General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. At a minimum, the report content will contain the items listed below. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

The TestAmerica QA Report template is comprised of a discussion of three key QA issues facing the laboratory and ten specific sections (Figure 17-1):

- **Metrics:** Describe actions or improvement activities underway to address any outlying quality metrics that have been reported in the monthly Quality System Metrics Table.
- **SOPs:** Report SOPs that have been finalized and report status of any outstanding SOP reviews.
- **Corrective Actions:** Describe highlights and the most frequent cause for report revisions and corrective/preventive action measures underway. Include a discussion of any recalls handled at the lab level as per Section 6.2.2 in the Investigation/Recall SOP (SOP: CA-L-S-001). Include a section for client feedback and complaints. Include both positive and negative feedback. Describe the most serious client complaints and resolutions in progress.
- **MDLs and Control Limits:** Report which MDLs/ MDL verifications are due. Report the same for Control Limits.
- **Audits:** Report Internal and External Audits that were conducted. Include all relevant information such as which methods, by whom, corrective actions needed by when and discuss unresolved audit findings.
- **Performance Testing (PT) Samples:** Report the PT tests that are currently being tested with their due dates, report recent PT results by study, acceptable, total reported and the month and year.
- **Certifications:** Report on any certification programs being worked on by due date, packages completed. Describe any issues, lapses, or potential revocations.
- **Regulatory Updates:** Include information on new state or federal regulations that may impact the laboratory. Report new methods that require new instrumentation, deletion of methods, changes in sampling requirements and frequencies etc…
- **Miscellaneous:** Include any issues that may impact quality within the laboratory. This section is also used to communicate the status on any Management of Change Request Forms (CRFs) that have missed targeted due dates.
- **Next Month:** Report on plans for the upcoming month.

- **Lab Director Comments Section:** This section gives the Laboratory Director the opportunity to comment on issues discussed in the report and to document plans to resolve these issues. Unresolved issues that reappear in subsequent monthly reports must be commented on by the Laboratory Director/Manager.
- **Quality System Metrics Table:** The report also includes statistical results that are used to assess the effectiveness of the quality system. Effective quality systems are the responsibility of the entire laboratory staff. Each laboratory provides their results in a template provided by Corporate QA (Figure 17-2).

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The VP-QA/EHS 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 Analytical Division Senior Management Team and General Managers.

17.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Department Managers, and QA Manager,) conducts an annual review 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. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director/Manager. 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 review uses information generated during the preceding year to assess the “big picture” by ensuring that routine quality actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review (refer to Section 17.1) 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 Management team 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.

The annual review includes the previous 12 months. Based on the annual review, 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)].

The QA Manual is also reviewed at this time and revised to reflect any significant changes made to the quality systems.

17.3 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 Corporate Data Investigation/ Recall SOP shall be followed (SOP No. CA-L-S-001). 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.

The Chairman/CEO, President/CEO, COOs and Quality Directors receive a monthly report from the VP of Quality and EHS summarizing any current data integrity or data recall investigations as described in SOP No. CA-L-S-001. The General Manager's are also made aware of progress on these issues for their specific labs.

Figure 17-1.

Example - QA Monthly Report to Management

LABORATORY: x
PERIOD COVERED: Month/Year
PREPARED BY: x DATE: Month Day, Year
DISTRIBUTED TO: xx (Include LD, GM, QA Director, etc…)

THREE KEY ISSUES FOR MONTH:
Include a discussion of three key issues that were focused in on this month.
1. x
2. x
3. x

---

1. METRICS
Describe actions or improvement activities underway to address any outlying quality metrics.

2. SOPs

See Tab for SOP specifics.

The following SOPs were finalized (or reviewed for accuracy): (See Tab)

The following SOPs are due to QA: xx

In QA to complete: xx

3. CORRECTIVE ACTION

Highlights: xx

Revised Reports:
Describe the most frequent cause for report revisions and corrective/preventive action measures underway.

Data Investigations/Recalls (Corporate Data Investigation/Recall SOP) :
Include a discussion of any recalls handled at the lab level as Corp SOP.

Client Feedback and Complaints:
Include both positive and negative feedback.

Describe the most serious client complaints) and resolutions in progress.

4. MDLs AND CONTROL LIMITS

MDLs Due:

Control Limits Due:

5. AUDITS

INTERNAL AUDITS

Discuss Any Outstanding Issues (or Attach Summary):

EXTERNAL AUDITS
Discuss Any Outstanding Issues (or Attach Summary):

6. PT SAMPLES

The following PT samples are now in house (Due Dates):
xx

7. CERTIFICATIONS

Certification Packages Being Worked On (Include Due Date):
x

Describe any issues, lapses, or potential revocations.

8. REGULATORY UPDATE
Include information on new state or federal regulations that may impact the laboratory – new methods that require new instrumentation, deletion of methods, changes in sampling requirements or frequencies, …

9. MISCELLANEOUS
Include any issues that may impact quality within the laboratory.

10. NEXT MONTH
Items planned for next month.

LAB DIRECTOR COMMENTS AND PLANNED CORRECTIVE ACTIONS:	
LAB DIRECTOR REVIEW:	DATE:

Figure 17-2.

Example - Laboratory Metrics Categories

Reports for month
Reports revised due to lab error
% Revised Reports
# of Data Recall Investigations
# of Reports Actually Recalled
Corrective Action Reports
Corrective Action Reports still open
Total Number of Unresolved Open Corrective Action Reports
% of Unresolved Open Corrective Action Reports
# Reports independent QA reviewed
% QA Data Review: Reports
# Technical staff (Analysts/technicians, including Temps)
# of Analyst work product reviewed year-to-date
# of Analytical instruments w/electronic data file storage capability
# of Analytical instruments reviewed for data authenticity year-to-date
% Analyst/Instrument Data Authenticity Audits
 # Client Complaints
 # Client Compliments
# of planned internal audits
# of planned internal method audits performed year-to-date
% Annual Internal Audits Complete
# of Open Internal Audit Findings Past Due
Total Number of External Audit Findings
# of Open External Audit Findings Past Due
% External Audit Findings Past Due
# of PT analytes participated and received scores
# of PT analytes not acceptable
% PT Cumulative Score
 # PT Repeat Analyte Failures Cumulative **(analyte failed more than once in 4 consecutive studies by PT Type) (only applies to failed analytes)**
SOPs

SOPs Reviewed/revised within 24 months
Methods **or Administrative procedures** without approved SOPs
SOP Status
Method certification Losses due to performance/audit issues
Hold Time Violations due to lab error
Date of Last Comprehensive Ethics Training Session
 # Staff that haven't Received Comprehensive Ethics Training (>30 Days From Employment Date)
MDL Status (Good, Fair, or Poor) >90%, >70%, <70%
Training Documentation Records (Good, Fair, or Poor)
LQM Revision/review Date
QAM Updated to New Integrated Template
Last Annual Internal Audit Date (Opened, Closed)
Last Management QS Review Date
#SOPs required for 12 month review cycle (DOD *or drinking water)*
#SOPs for 12 month cycle/revised within 12 months *(Includes QS and Methods Listed in QSM)*
12 month % SOP Status *(Includes QS and Methods Listed in QSM)*

SECTION 18

PERSONNEL
(NELAC 5.5.2)

18.1 OVERVIEW

TestAmerica'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 Appendix 2.

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.

18.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

TestAmerica makes every effort to hire analytical staff that posses 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. There are competent analysts and technicians in the industry who have not earned a college degree. 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).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, aseptic or 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., 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 Directors/Department Managers – **General**	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.

18.3 TRAINING

TestAmerica 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	Refer to EH&S Manual	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 20.

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.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in the SOP For Employee Training.

18.4 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, 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 an Ethics Policy No. CA-L-P-001 and an Ethics Statement/Agreement (Appendix 1). All initial and annual training is documented by signature on the signed Ethics Policy and Code of Ethical Conduct

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 (Appendix 1)
- 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 19

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS
(NELAC 5.5.3)

19.1 OVERVIEW

TestAmerica Connecticut is a 14,000 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, organic sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, metals sample analysis, and administrative functions.

19.2 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 effect 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.

Critical instrumentation such as GC/MS units, ICP's, AA's, data systems, gas chromatographs and LIMS are tied into an uninterruptible power supply system (UPS) to minimize instrument downtime and damage for short duration power interruptions.

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 (refer to Section 12).

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

19.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- The volatiles analysis laboratory containing GC/MS instrumentation has a separate air handling system which is maintained at a positive pressure at all times. The organic sample preparation laboratory has a separate HVAC system that creates negative pressure in the area. This design results in a contaminant-free environment for trace-level volatiles analysis.

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.

19.4 FLOOR PLAN

A floor plan can be found in Appendix 3.

19.5 BUILDING SECURITY

Building keys 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 *TestAmerica Connecticut*. 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 20.0

TEST METHODS AND METHOD VALIDATION
(NELAC 5.5.4)

20.1 OVERVIEW

TestAmerica Connecticut 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.

20.2 STANDARD OPERATING PROCEDURES (SOPs)

TestAmerica Connecticut 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 (refer to Section 6 on Document Control):

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for preparation, review, revision and control are incorporated by reference to SOPs: **CW-Q-S-002** (Writing a Standard Operating Procedure (SOP) and the lab SOP for Generating SOPs.
- 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.

20.3 LABORATORY METHODS MANUAL

20.3.1 For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP. Refer to the lab SOP, SOP for Generating SOPs, for content and requirements of technical and non-technical SOPs.

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.

20.4 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.

20.4.1 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.

In general, TestAmerica Connecticut follows procedures from the referenced methods shown below in 20.3.1.4.

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.

20.4.1.1 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*
- *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*
- *Statement of Work for Inorganics Analysis, ILM04.1, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Statement of Work for Organics Analysis, OLM04.2, USEPA Contract Laboratory Program, Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th 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.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *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.

20.4.2 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.

20.4.2.1 A demonstration of capability is performed whenever there is a change in instrument type, method or personnel.

20.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Department Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures (refer to Section 15, Control of Records).

20.4.2.3 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).
- The reporting limit is set at or above the first standard of the curve for the analyte.
- 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.*
- Refer to Section 12 (Control of Non-Conforming Work).

20.4.3 Initial Demonstration of Capability (IDOC) Procedures

20.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

20.4.3.2 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.

20.4.3.3 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).

20.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

20.4.3.5 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.

20.4.3.6 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.

20.4.3.7 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 20.4.3.3 above.
- Beginning with 20.4.3.3 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.

A certification statement (see Figure 20-1 as an example) 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.

20.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP/Methods Manual (Section 20.2) 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. The information included in the checklist below (Figure 20-2) is needed before samples are accepted for analysis by a new method.

20.6 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. (From 2003 NELAC Standard)

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.

20.6.1 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.

20.6.1.1 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.

20.6.1.2 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. The laboratory determinations of MDLs are described in Section 20.6.

20.6.1.3 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 level at which both the presence of an analyte and its concentration can be reliably determined. 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.

20.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

20.6.1.5 Determination of Range

Where appropriate, a determination of the applicable range of the method may be performed. In most cases, range is determined and demonstrated by comparison of the response of an analyte in a curve to established or targeted criteria. The curve is used to establish the range of quantitation and the lower and upper values of the curve represent upper and lower quantitation limits. Curves are not limited to linear relationships.

20.6.1.6 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.

20.6.1.7 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.

20.6.1.8 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.

20.7 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 20.7.10). 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

20.7.1 MDL's are initially performed for each individual instrument and non-microbiological method analysis. Unless there are requirements to the contrary, the laboratory will use the highest calculated MDL for all instruments used for a given method as the MDL for reporting purposes. This MDL is not required for methods that are not readily spiked (e.g. pH, turbidity, etc.). Titration and gravimetric methods where there is no additional preparation involved, the MDL is based on the lowest discernable unit of measure that can be observed.

20.7.2 MDL's must be run against acceptable instrument QC, including ICV's and Tunes. This is to insure that the instrument is in proper working condition and falsely high or low MDL's are not calculated.

20.7.3 Use only clean matrix which is free of target analytes (e.g.: Laboratory reagent water, Ottawa Sand) unless a project specific MDL is required in a field sample matrix.

20.7.4 The Reporting Limit (also may be referred to as Limit of Quantitation or LOQ) should generally be between 3 and 5 times the MDL. If the MDL is being performed during method development, use this guideline to determine the Reporting Limit for the analysis. If a sample is diluted, the reported MDL is adjusted according to the dilution factor.

20.7.5 If the MDL is < 1/10 of the spike concentration for more than 10% of the analytes in the method the MDL should be repeated (including extraction or digestion) using a lower spike level unless the % recovery is < 50% or > 150% of the "true value". Note: The concentration of the spike will be at a level below the calibration range.

20.7.6 The calculated MDL cannot be not greater than the spike amount.

20.7.7 If the most recent calculated MDL does not permit qualitative identification of the analyte then the laboratory may use technical judgment for establishing the MDL (e.g., calculate what level would give a qualitative ID, compare with IDL (20.7), spike at a level where qualitative

ID is determined and assign that value as MDL, minimum sensitivity requirements, Standard deviation of method blanks over time, etc.)

20.7.8 Each of the 7 spikes must be qualitatively identifiable (e.g., appear in both columns for dual column methods, characteristic ions for GCMS mass spectra, etc). Manual integrations to force the baseline for detection are not allowed.

20.7.9 The initial MDL is calculated as follows:

$$MDL = t_{(n-1,\ 1-a\ =\ 0.99)} \times (\text{Standard Deviation of replicates})$$

where $t_{(n-1,\ 1-a\ =\ 0.99)} = 3.143$ for seven replicates.

20.7.10 Subsequent to the initial MDL determination, periodic MDL verification, confirmation or determinations may be performed by the procedure in 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices (e.g., method blanks over time, single standard spikes that have been subjected to applicable sample prep processes, etc.). The procedures utilized must be documented in the MDL SOP, Sop for Conducting MDLs.

20.7.11 Because of the inherent variability in results outside of the calibration range, TestAmerica does not recommend the reporting of results below the lowest calibration point in a curve; however, it is recognized that some projects and agencies require the reporting of results below the RL. Any result that falls between the MDL and the Reporting limit, when reported, will be qualified as an estimated value.

20.7.12 Detections reported down to the MDL must be qualitatively identified.

20.7.13 MDLs and Reporting limits are adjusted in LIMs based on moisture content and sample aliquot size.

20.8 INSTRUMENT DETECTION LIMITS (IDL)

20.8.1 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.

20.8.2 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.

20.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

20.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

20.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at approximately 2-3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and 1-4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified or see section 20.6.7 for other options. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.). 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 (See 20.7.7). MDLs must be verified at least annually.

20.9.2 When a Reporting limit is established, it must be initially verified by the analysis of a low level standard or QC sample (LCS at 1-2 the reporting limit) and annually thereafter. Unless there are requirements to the contrary the acceptance criteria is ± 50%. The annual requirement is waved for methods that have an annually verified MDL.

20.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specified 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. These records are kept with the files associated with an instrument for later quantitation of the analytes.

For GC, HPLC and IC methods, there must be sufficient separation between analyte peaks so as to not misidentify analytes. In the mid-level standard, the distance between the valley and peak height cannot be any less than 25% of the sum of the peak heights of the analytes. This also applies to GCMS in the case where the two compounds share the same quantitation ion.

Note: Some analytes do not separate sufficiently to be able to identify or quantitate them as separate analytes (e.g. m-xylene and p-xylene) and are quantitated and reported as a single analyte (e.g. m,p-xylenes).

Once the analyst has determined that the instrument is in optimum working condition through calibration and calibration verification procedures, he or she uses a mid-range calibration or calibration verification standard to establish the retention times for each of the individual analytes in a method. The analyst makes three injections of the same standard over a 72-hour (24 hr period for 300.0) period, tabulating the retention times for each analyte for each of the three injections. The width of retention time window is normally the average absolute retention time ± 3 Standard Deviations. A peak outside the retention time window will not be identified by the computer as a positive match of the analyte of interest.

It is possible for the statistically calculated RT window to be too tight and need to be adjusted based on analyst experience. In these instances method default retention time windows may be used (e.g., for 8000 series methods a default of 0.03 minutes may be used, and EPA CLP 0.05

minutes is used). The same concept is applied when any peak outside of that window will not be identified by the computer as a positive match.

The calibration verification standard at the beginning of a run may be used to adjust the RT for an analyte. This is essentially re-centering the window but the size of the window remains the same. The RTs are verified when all analytes are within their RT windows and are properly identified.

20.11 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.

20.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

20.12.1 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.

20.12.2 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.

20.12.3 The 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). 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.

20.12.4 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 a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and

the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l.

20.12.5 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.

20.13 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.

20.13.1 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 the SOPs for back-up, recovery and archive for each of the servers. The laboratory is currently running the TALS LIMS system 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 TALS LIMS utilizes SQL server 2000 which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

20.13.1.1 **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.

  Note: "Commercial off-the-shelf software in use within the designed application range is considered to be sufficiently validated." *From NELAC 2003 Standard.* However, laboratory specific configurations or modifications are validated prior to use.

- In order to assure accuracy, all data entered or transferred into the LIMS data system goes through a minimum of two levels of review.
- The QA department performs random data audits to ensure the correct information has been reported.
- Changes to reports are documented within the LIMS system by identifying each revision and documenting the history.
- Analytical data file security is provided through three policies.
  - The first policy forbids unauthorized personnel from using laboratory data acquisition computers.
  - The second policy is the implementation of network passwords and login names that restrict directory access.

- The third layer is maintained through the LIMS and includes the use of username/password combinations to gain access to the LIMS system, the fact that all data in the LIMS is associated with the user to added/reviewed the data, and the restriction of review authority of data.

- All software installations will be in accordance with any relevant copyright licensing regulations.
- All software installed on any computer within the laboratory must be approved by the Information Technology Department regional support technician assigned to the laboratory Shrink-wrapped or otherwise sealed OEM software that is directly related to instrument usage does not need approval but the Information Technology department must be notified of the installation.
- Anti-virus software shall be installed on all servers and workstations. The anti-virus software shall be configured to check for virus signature file and program updates on a daily basis and these updates will be pushed to all servers and workstations. The anti-virus software will be configured to clean any virus-infected file if possible, otherwise the file will be deleted. Disks and CDs brought from any outside source that are not OEM software must be scanned for viruses before being accessed.

- **Interlab LIMS Permissions Policy**
  - PURPOSE - The purpose of this policy is to provide a mechanism for maintaining the integrity of information contained in each laboratory's LIMS while providing the necessary access for information sharing to staff at other laboratory facilities.
  - DEFINITIONS - Host Laboratory: The laboratory facility that 'owns' the LIMS system or 'hosts' a project/job.
  - POLICIES

    (a) All permissions for the laboratory's LIMS system must only be granted by a representative of that laboratory.
    - If someone outside of the host lab needs permissions for Project Management or other uses, they must go through the Lab Director or his/her designated representative.
    - Permissions must never be granted without the knowledge of the host laboratory.

    (b) Only laboratory analytical or QA staff from the home laboratory may have edit permissions for laboratory analysis data.

    (c) Any changes made in laboratory's LIMS system:
    - Must be documented and traceable.
    - If made by staff of an affiliate lab, written permission from the home lab to make the changes (email approval is sufficient) is required.
    - No corrections may be made in another laboratories system without their knowledge.

    (d) Data qualifiers in laboratory reports must only be corrected, edited, etc. by the staff at the host laboratory.

    (e) Full analytical data "View" only permissions may be granted to outside Project Management and Sales staff. ~~Query~~ Search permissions may also be granted so status may be checked.

    (f) All qualifiers must be approved by QA staff before adding to standard reference tables .

(g) Please contact Corporate QA or IT staff if you have any questions regarding implementation or interpretation of this policy.

20.13.1.2 **Ensure Information Availability:** Protection against loss of information or service through scheduled back-ups, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

- Insured by timely backup procedures on reliable backup media, stable file server network architecture, and UPS protection
- UPS Protection:
  - Each fileserver is protected by an appropriate power protection/backup unit. In the event of a power outage, there is approximately 15-25 minutes of up-time for the servers prior to shutdown. This allows for proper shutdown procedures to be followed with the fileservers.
- File Server Architecture
  - All files are maintained on multiple Windows 2000 or newer servers which are secured physically in the Information Technology area.
  - All supporting software is maintained for at least 5 years from the last raw data generated using that software. [Length of time is dependent on local regulations or client requirements (e.g., OVAP requires 10 years).]
- System Back-up Overview and Procedures
  - Data from both servers and instrument attached PC's are backed up and purged in compliance with the corporate back-up policy.
  - A Maintenance Plan has been defined to create a daily archive of all data within the LIMS database to a backup location. This backup is initiated automatically by either the database or back-up system.
  - Backup tapes will be stored in compliance with the corporate Data Backup Policy. Backup verifications are carried out in accordance with the corporate Data Backup Policy.
  - Instrument data back-ups are verified on a periodic basis by the QA department when performing electronic data audits. The audit takes place on data that has been moved to a back-up location ensuring that it has been moved.

20.13.1.3 **Maintain Confidentiality**: Ensure data confidentiality through physical access controls, and encryption of when electronically transmitting data.

- All servers are located in a secure area of the IT department area. Access to the servers is limited to IT staff members, lab director, Data Reporting Manager and TALS super users.
- The company website contains SSL (Secure Socket Layer) encryption for secure website sessions and data transfers.
- The reporting portion of the LIMS system requires a data reporting person to enter their unique password anytime they create a report that displays a signature on it (.PDF).
- Electronic documents such as PDF files and electronic data deliverables will be made available to clients via the secure web site. The logon page for this web site contains an agreement that the customer must accept before they will be logged on

which states that the customer agrees not to alter any electronic data made available to them.

- If electronic documents are made available outside of the web site, the customer must sign an agreement in advance that states they will not alter the data in any way.

20.13.2 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 spreadsheets, 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.

20.13.2.1 All raw data must be retained in the job 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.

20.13.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (• g/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (• g/kg) for solids. The units "mg/l" and "mg/kg" are the same as "parts per million (ppm)". The units "• g/l" and "• g/kg" are the same as "parts per billion (ppb)." For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%.

- Several environmental methods, such as color, turbidity, conductivity, use very specific, non-concentration units to report results (e.g., NTU, umhos/cm etc).

20.13.2.3 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 2 significant figures on the final report.

20.13.2.4 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.

20.13.2.5 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.

The following describes the general procedures which are employed at the TestAmerica Connecticut laboratory. More specific detail can be found in the standard operating procedures.

- Gas Chromatography

Data from the Gas Chromatographs is acquired through interfaces with a computer system either utilizing Perkin Elmer Turbo Chrom or Agilent Chemstation chromatography software. After acquisition, the data is automatically copied to the Thermo analytical systems Target software package for data processing and quantitation. Data is reviewed at the bench level by the analyst. The data is reviewed for chromatographic scaling and dilutions. Necessary reintegrations and rescalings are done using Target.

- GC/Mass Spectrometry

GC/MS data is acquired utilizing Agilent Chemstation computer systems with Enviroquant software. After acquisition, the data is automatically copied to the Thermo analytical systems Target software package for data processing and quantitation. This software allows for the comparison of sample non-target spectrum against reference library spectra. The most recent NIST/EPA mass spectral library supported by the system must be used. On column result data is then transferred to the LIMS system.

- Atomic Spectroscopy

ICAP metals are analyzed by a Thermo-Jarrel Ash 61E or 61E Purge. The raw data collected is transferred via a network system to the LIMS system. Mercury data is analyzed on the mercury analyzer and is transferred via a network system to the LIMS system.

20.13.3 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 13.
- 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 Department Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

20.13.4 Review / Verification Procedures

Review procedures are out lined in the SOP for Data Review 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 general review concepts are discussed below, more specific information can be found in the SOP.

20.13.4.1 The data review process at TestAmerica Connecticut 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 as indicated by the "login review" on each LIMS login.

20.13.4.2 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 either manually or by electronic uploads where the batches are processed and data qualifiers are added as set up by the method limit groups. To ensure data compliance, either the supervisor or 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, continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated Manual integrations are also reviewed which can be done electronically 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

20.13.4.3 Unacceptable analytical results must be investigated and may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

20.13.4.4 As a final review prior to the release of the report, the Reporting Department and /or 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, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

20.13.4.5 A visual summary of the flow of samples and information through the laboratory, as well as data review and validation, is presented in Figure 20-3.

20.13.5 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**.**

20.13.5.1 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.

20.13.5.2 Analysts shall not increase or decrease peak areas to 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 principals and policy and is grounds for immediate termination.

20.13.5.3 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.

20.13.5.4 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 20-1.
Example - Demonstration of Capability Documentation

Demonstration of Capability
Certification Statement

Laboratory Name: TestAmerica Connecticut Date:
Laboratory Address: 128 Long Hill Cross Road
Shelton, CT 06484

Method:_____
Matrix: _____

Analyst Name: _____

*Analyst Name: _____

We the undersigned certify that:

1. The analyst identified above, using the cited test method, which is in use at this facility for the analysis of samples under the National Environmental Laboratory Accreditation Program, have met the Initial Demonstration of Capability.
2. The test method was performed by the analyst identified on this certification.
3. Copies of the test method and SOP are available for all personnel on site.
4. The data associated with the DoC are true, complete and representative.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is available for review by authorized inspectors.

Laboratory Manager/Supervisor	Signature	Date
Quality Assurance Manager	Signature	Date

* second analyst if sample prepped by another person

Figure 20-2.

Example - New Method / Additional Analyte Checklist

New Method / Additional Analyte Checklist

The following items are **required** to be completed prior to the acceptance of client samples. Fill in any blanks that do not apply with "NA". Provide associated instrument QC when samples or QC samples are analyzed (includes run log).

New Method _____ Added Analytes _____

1_____ Standard Operating Procedure

- Note: For additional analytes, a **ROMD [or whatever an internal communication memo is named in your lab]** can be used to add the analytes, include RL and matrix.
  - _____ Analysis SOP
  - _____ Preparation SOP
  - _____ SOP for any other relevant process
  - _____ Pages from any applicable logbooks (instrument, standards, etc)

2_____Evaluation of Selectivity. As applicable: e.g. Retention Time Window Study, second column confirmation, Interelement correction checks, spectral or fluorescence profiles, etc.

3_____ Initial Calibration Curve (Include Tune verification or similar (e.g. degradation checks) if applicable)

4_____ Method Detection Limit (MDL) Study (summary and raw data)

- _____ Water
- _____ Soil
- _____ Other

5_____ Real Sample and MS, MSD ***(CA ELAP Requirement)***

- Tap Water for water only methods
- Local Soil sample for SW-846 methods (if applying for soil or soil/water)
- Local water sample may be used in lieu of tap water if it is a non- drinking water method
- Does not have to contain the target analytes

6_____ Reporting Limit Verification standard

- Spike a blank matrix at the RL and process through the entire method. MDL study should be able to be used if recovery is good. Note the spike level(s) and recovery(~~y~~ies)

7_____ Demonstration of Capability (DOC) per analyst (Precision and Accuracy (P&A) verification)

- 4 LCS for each matrix – most acceptance criteria are in the methods. The MDL study may be used if DOC criteria are met.
- Non-Standard methods – 3 x (1 LCS at LOQ-25%, 50%, 75% of the calibration range + Blank) prepared each day. (see NELAC Chpt 5, appendix C.3.3 (b))

8_____ Acceptable PT sample(s) if available

Notes: PT sample required for all new methods
PT sample required for all new analytes under NELAP

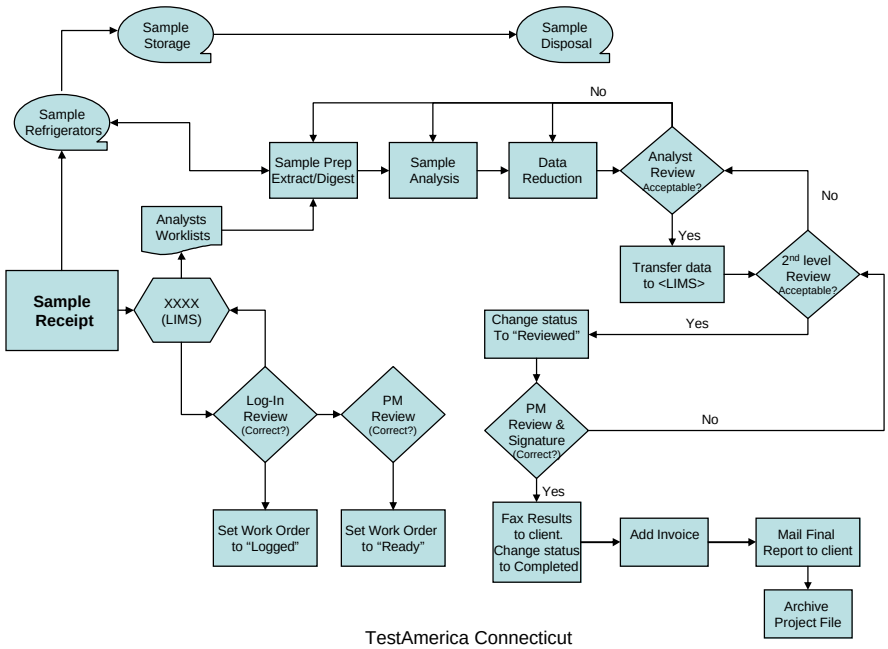
Submitted by _____ Date _____

9_____ Certification/Approval from Regulatory Agency where available.

QA Review / Acceptance _____ **Date** _____

Figure 20-3.

Work Flow



TestAmerica Connecticut
Workflow

SECTION 21

EQUIPMENT (AND CALIBRATIONS)
(NELAC 5.5.5)

21.1 OVERVIEW

TestAmerica 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 and Appendix 4 of the QAM. A list of laboratory equipment and instrumentation is presented in Table 21-1.

Equipment is only operated by authorized and trained personnel. Manufacturers instructions for equipment use are readily accessible to all appropriate laboratory personnel.

21.2 PREVENTIVE MAINTENANCE

21.2.1 TestAmerica Connecticut follows a well-defined 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.

21.2.2 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.

21.2.2.1 Calibrations, routine maintenance, and adjustments are part of the analysts' and Department Managers' responsibilities. However, service contracts may be in place for some instruments to cover any major repairs.

21.2.2.2 High purity gases, reagents, and spare parts are kept on hand to minimize repair time and optimize instrument performance.

21.2.3 Table 21-2 summarizes the schedule for 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.)

21.2.4 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.

21.2.4.1 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.

21.2.4.2 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.).

21.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed are filed with the Department Manager.

21.2.5 In addition, the maintenance records contain:

- The identification of the instrument/equipment **(**instrument's Serial Number and Model Number)
- The date the instrument/equipment was put into use.
- If available, the condition when the instrument was received (e.g. new, used, reconditioned).

21.2.6 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 (refer to Sections 12 and 13).

21.2.7 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 using the procedures outlined in Section 8.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

21.3 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, 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.

21.3.1 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 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.

21.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to $\pm$ 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.

21.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The NIST 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 thermometer has increments of 0.2 ºC, and has a range applicable to all 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 SOP for Thermometer Calibration CT-QAS-11.

21.3.4 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 > 0ºC and $\leq$ 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.

21.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware) are checked for accuracy at least quarterly. Glass micro-syringes are considered the same as Class A glassware.
The laboratory maintains a sufficient inventory of autopipettors, and dilutors of differing capacities that fulfill all method requirements.

These devices 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.

21.4 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 13).

Note: Instruments are calibrated initially and as needed after that and at least annually***.***

21.4.1 CALIBRATION STANDARDS

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. However, the general procedures are described below.

21.4.1.1 For each analyte and surrogate (if applicable) of interest, prepare calibration standards at the minimum number of concentrations as stated in the analytical methods. If a reference or mandated method does not specify the number of calibration standards, the minimum number is three, not including blanks or a zero standard. All of the standard solutions are prepared using Class A volumetric glassware, calibrated pipettes, and/or microsyringes and appropriate laboratory quality solvents and stock standards.

21.4.1.2 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to NIST whenever possible. Dilution standards are prepared from stock standards purchased from commercial suppliers. A standard record in LIMS is maintained for each department, containing concentration, date of receipt, date of standard preparation, any dilutions made, lot number, supplier, type of solvent and a unique code number to identify the standard.

21.4.1.3 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).

21.4.1.4 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 3 significant figures) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The lowest calibration standard must be at or below the reporting limit. The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

21.4.1.5 Given the number of target compounds addressed by some of the organic methods, it may be necessary to prepare several sets of calibration standards, each set consisting of the appropriate number of solutions at different concentrations. The initial calibration will then involve the analysis of each of these sets of the appropriate number of standards.

21.4.1.6 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). This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

21.4.2 CALIBRATION FOR ORGANIC METHODS (GC, HPLC, GC/MS)

21.4.2.1 Many of the organic analytical methods utilize an internal standard calibration (GCMS and some GC). Because of the complex nature of the multipeak chromatograms produced by the method, some instruments necessitate the use of external standard calibration (most GC and HPLC). Surrogate compounds are included in the calibration processes for all appropriate organic analyses. For more details on the calibration types listed below, refer to SOP No. CA-Q-S-005, Calibration Curves.

21.4.2.2 Once the operating parameters have been established according to the method, each instrument is calibrated for the appropriate method. The analyst prepares five or more standard solutions at various concentrations containing all of the analytes of interest, internal standards, and surrogates that are appropriate for the method. Note: There are a several EPA methods that have different requirements and are exceptions (e.g. EPA 547) where a minimum of 3 calibration standards are prepared and analyzed.

21.4.2.3 The standard solutions are introduced into the instrument in the same manner as samples are; whether it be by direct injection, by headspace analysis, or by purge and trap. The calibration factor (CF) for methods that use external standards, and the response factor (RF) for methods that use internal standards are calculated for the five standards.

- External standard calibration involves comparison of instrument responses from the sample to the responses from the target compounds in the calibration standards. Sample peak areas (or peak heights) are compared to peak areas (or heights) of the standards. The ratio of the response to the amount of analyte in the calibration standard is defined as the Calibration factor (CF).

- Internal standard calibration involves the comparison of instrument responses from the target compounds in the sample to the responses of specific standards added to the sample or sample extract prior to injection. The ratio of the peak area (or height) of the target compound in the sample or sample extract to the peak area (or height) of the internal standard in the sample or sample extract is compared to a similar ratio derived for each calibration standard. The ratio is termed the response factor (RF), and may also be known as a relative response factor in other methods.

In many cases, internal standards are recommended. These recommended internal standards are often brominated, fluorinated, or stable isotopically labeled analogs of specific target compounds, or are closely related compounds whose presence in environmental samples is highly unlikely. The use of specific internal standards is available in the method SOP.

Whichever internal standards are employed, the analyst needs to demonstrate that the measurement of the internal standard is not affected by method analytes and surrogates or by matrix interferences. In general, internal standard calibration is not as useful for GC and HPLC methods with non-MS detectors because of the inability to chromatographically resolve many internal standards from the target compounds. The use of MS detectors makes internal standard calibration practical because the masses of the internal standards can be resolved from those of the target compounds even when chromatographic resolution cannot be achieved.

When preparing calibration standards for use with internal standard calibration, add the same amount of the internal standard solution to each calibration standard, such that the concentration of each internal standard is constant across all of the calibration standards, whereas the concentrations of the target analytes will vary. The internal standard solution will contain one or more internal standards and the concentration of the individual internal standards may differ within the spiking solution (e.g., not all internal standards need to be at the same concentration in this solution). The mass of each internal standard added to each sample extract immediately prior to injection into the instrument or to each sample prior to purging must be the same as the mass of the internal standard in each calibration standard. The volume of the solution spiked into sample extracts should be such that minimal dilution of the extract occurs (e.g., 10 uL of solution added to a 1 mL final extract results in only a negligible 1% change in the final extract volume which can be ignored in the calculations).

An ideal internal standard concentration would yield a response factor of 1 for each analyte. However, this is not practical when dealing with more than a few target analytes. Therefore, as a general rule, the amount of internal standard should produce an instrument response (e.g., area counts) that is no more than 100 times that produced by the lowest concentration of the least responsive target analyte associated with the internal standard. This should result in a minimum response factor of approximately 0.01 for the least responsive target compound. Refer to SOP No. CA-Q-S-005, Calibration Curves, for specific calculations.

21.4.2.4 Policies regarding the use of calibration standard results for creating the calibration curve are as follows:

- A low calibration standard may be excluded from the calibration if the signal-to-noise ratio or spectral criteria are not suitable. The reporting level must be elevated to be the lowest calibration standard used for calibration.

- The upper calibration standard may be excluded if it saturates the detector or is obviously becoming non-linear. Any sample exceeding the upper standard used in the calibration must be diluted and re-analyzed.
- Mid-calibration standards may not be excluded unless an obvious reason is found, i.e., cracked vial, incorrectly made, etc. The failed standard should be re-run immediately and inserted into the initial calibration. If not useful, recalibration is required.

21.4.2.5 Percent RSD Corrective Action

Given the potentially large numbers of analytes that may be analyzed in some methods, it is likely that some analytes may exceed the acceptance limit for the RSD for a given calibration. In those instances, the following steps are recommended, but not required.

21.4.2.5.1 The first step is generally to check the instrument operating conditions. This option will apply in those instances where a linear instrument response is expected. It may involve some trade-offs to optimize performance across all target analytes. For instance, changes to the operating conditions necessary to achieve linearity for problem compounds may cause the RSD for other compounds to increase, but as long as all analytes meet the RSD limits for linearity, the calibration is acceptable.

21.4.2.5.2 If the RSD for any analyte is greater than the applicable acceptance criteria in the applicable SOP, the analyst may wish to review the results (area counts, calibration or response factors, and RSD) for those analytes to ensure that the problem is not associated with just one of the initial calibration standards. If the problem appears to be associated with a single standard, that one standard may be reanalyzed and the RSD recalculated. Replacing the standard may be necessary in some cases.

21.4.2.5.3 A third alternative is to narrow the calibration range by replacing one or more of the calibration standards with standards that cover a narrower range. If linearity can be achieved using a narrower calibration range, document the calibration linearity, and proceed with analyses. The changes to the upper end of the calibration range will affect the need to dilute samples above the range, while changes to the lower end will affect the overall sensitivity of the method. Consider the regulatory limits or action levels associated with the target analytes when adjusting the lower end of the range.

Note: When the purpose of the analysis is to demonstrate compliance with a specific regulatory limit or action level, the laboratory must ensure that the method quantitation limit is at least as low as the regulatory limit or action level.

21.4.2.6 Alternatively, the least squares regression may be used to determine linearity. A five point line must result in a correlation coefficient (r) of 0.990 or better using the least squares method to be considered acceptable. In many cases it may be preferred that the curves be forced through zero (not to be confused with including the origin as an additional data point, which is not allowed). **Note:** EPA method 8000B does not allow forcing through zero however the agency has revaluated this position and has since changed this stance to allow forcing

through zero. In addition, from EPA Method 8000C: "However, the use of a linear regression or forcing the regression through zero may NOT be used as a rationale for reporting results below the calibration range demonstrated by the analysis of the standards.").

21.4.2.7 Instead of a linear curve model (either Average RF or least squares regression), a second order curve (Quadratic) may be used (and preferred) as long as it contains at least six data points. As a rule of thumb, if there is a consistent trend in RFs (or CFs) in the calibration curve, either up or down, then quadratic curve fit may be indicated as the preferred calibration routine for that analyte. The coefficient of determination (COD or r^2) for the quadratic curve must be at least 0.99 for it to be considered acceptable. For more details on the calculations see Calibration Curve SOP CA-Q-S-005. Some limitations on the use of Quadratic Curve fits:

21.4.2.7.1 Care MUST be exercised to assure that the results from this equation are real, positive, and fit the range of the initial calibration.

21.4.2.7.2 They **may not** be used to mask instrument problems that can be corrected by maintenance. (Not to be used where the analyte is normally found to be linear in a properly maintained instrument).

21.4.2.7.3 They **may not** be used to compensate for detector saturation. If it is suspected that the detector is being saturated at the high end of the curve, remove the higher concentration standards from the curve and try a 1^{st} order fit or average RF.

21.4.3 Calibration for Inorganic Analyses

EPA Method 7000 from EPA SW-846 is a general introduction to the quality control requirements for metals analysis. For inorganic methods, quality control measures set out in the individual methods and in the *Standard Methods for the Examination of Water and Wastewater* (20th Edition) may also be included. Standard Operating Procedures for the analysis and the quality control documentation measures are kept in the appropriate lab reference binders.

In general, inorganic instrumentation is calibrated with external standards. Some exceptions would be Inductively Coupled Plasma (ICP), and Inductively Coupled Plasma Mass Spec (ICPMS). These analyses may use an internal standard to compensate for viscosity or other matrix effects. While the calibration procedures are much the same for inorganics as they are for organics, CF's or RF's are not used. The calibration model in 21.4.2.6 is generally used for most methods, however in some instances the model from section 21.4.2.7 may be used. A correlation coefficient (r) of 0.995 or greater must be used to accept a calibration curve generated for an inorganic procedure. Correlation coefficients are determined by hand-held scientific calculators or by computer programs [state what your lab uses] and documented as part of the calibration raw data. Coefficients of calibration curves used for quantitation must be documented as part of the raw data. Curves are not allowed to be stored in calculator memories and must be written on the raw data for the purposes of data validation.

21.4.3.1 "Calibrations" for titrimetric analyses are performed by standardizing the titrants against a primary standard solution. See specific methods in *Standard Methods for the Examination of Water and Wastewater* (20th Edition) for more information.

21.4.3.2 Spreadsheets that are used for general chemistry calculations must have all cells containing calculations locked to prevent accidental changes to the calculations.

21.4.3.3 Instrument technologies (e.g. ICP) with validated techniques from the instrument manufacturer or other methods using a zero point and single point calibration require the following:

21.4.3.3.1 The instrument is calibrated using a zero point and a single point calibration standard.

21.4.3.3.2 The linear range is established by analyzing a series of standards, one at the reporting limit (RL).

21.4.3.3.3 Sample results within the established linear range do not need to be qualified.

21.4.3.3.4 The zero point and single standard is run daily with each analytical batch.

21.4.3.3.5 A standard at the RL is analyzed daily with each analytical batch and must meet established acceptance criteria.

21.4.3.3.6 The linearity is verified at a frequency established by the manufacturer or method.

21.4.4 Calibration Verification

The calibration relationship established during the initial calibration must be verified at periodic intervals 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.

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, and is not appropriate nor permitted in SW-846 chromatographic procedures for trace environmental analyses.

21.4.4.1 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 or standard that can be injected within 12 hours of the beginning of the shift.

21.4.4.2 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.

21.4.4.3 The acceptance limits for calibration verifications can be found in each method SOP. As a rule of thumb: GCMS ± 20%, GC and HPLC ± 15%, Inorganics: ± 10 or 15%. Actual methods may have wider or tighter limits; see the method SOP for specifics.

21.4.4.4 If the response (or calculated concentration) for an analyte is within the acceptance limits of the response obtained during the initial calibration, then the initial calibration is considered still valid, and the analyst may continue to use the CF, RF or % drift values from the initial calibration to quantitate sample results.

21.4.4.5 If the response (or calculated concentration) for any analyte varies from the mean response obtained during the initial calibration by more than the acceptance criteria, then the initial calibration relationship may no longer be valid. If routine corrective action procedures fail to produce a second consecutive (immediate) calibration verification within acceptance criteria, then either the laboratory has to demonstrate performance after corrective action with two consecutive successful calibration verifications, or a new initial instrument calibration must be performed. However, sample data associated with an unacceptable calibration verification may be reported as qualified data under the following special conditions:

21.4.4.5.1 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.

21.4.4.5.2 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.

21.4.4.6 Verification of Linear Calibrations

Calibration verification for linear 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. Use the equations below to calculate % Drift or % Difference, depending on the procedure specified in the method SOP. 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.

The Percent Difference is calculated as follows:

$$\% \text{ Difference} = \frac{(CF(v) \text{ or } RF(v)) - (\text{Avg. CF or RF})}{(\text{Avg. CF or RF})} \times 100$$

Where: CF(v) or RF(v) = CF or RF from verification standard
Avg. CF or RF = Average CF or RF from Initial Calibration.

The Percent Drift is calculated as follows:

$$\% \text{ Drift} = \frac{\text{Result} - \text{True Value}}{\text{True Value}} \times 100$$

The Percent Recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Result}}{\text{True Value}} \times 100$$

21.4.4.7 Verification of a Non-Linear Calibration

Calibration verification of a non-linear calibration is performed using the percent drift or percent recovery calculations described in 21.4.4.6 above.

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.

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.

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 analytical 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).

21.5 POLICY ON 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 will not be reported as a TIC. If the compound is reported on the same form as true TICs, it must 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.

21.5.1 Use the following guidelines for making tentative identifications

21.5.1.1 Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.

21.5.1.2 The relative intensities of the major ions should agree within ± 20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

21.5.1.3 Molecular ions present in the reference spectrum should be present in the sample spectrum.

21.5.1.4 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

21.5.1.5 Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies.

The concentration of any non-target analytes identified in the sample (see above) should be estimated. The same formulae as calibrated analytes should be used with the following modifications: The areas A_x and A_{is} should be from the total ion chromatograms, and the RF for the compound should be assumed to be 1.

The resulting concentration should be reported indicating: (1) that the value is an estimate, and (2) which internal standard was used to determine concentration. Use the nearest internal standard free of interferences.

Note: The above guidelines above are from EPA SW846 III edition, method 8260B.
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.

21.6 POLICY ON 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.

21.6.1 The concentration of the BFB or DFTPP must be at or below the concentrations that are referenced in the analytical methods. Part of the purpose of the tune is to demonstrate sensitivity and analyzing solutions at higher concentrations does not support this purpose. Tune failures may be due to saturation and a lower BFB/DFTPP concentration may be warranted.

21.6.2 Tune evaluations usually utilize the "Autofind" function and are set up to look at the apex +/- 1 scan and average the three scans. Background correction is required prior to the start of the peak but no more than 20 scans before. Background correction cannot include any part of the target peak.

21.6.3 Other Options or if Auto Tune Fails:

21.6.3.1 Sometimes the instrument does not always correctly identify the apex on some peaks when the peak is not perfectly shaped. In this case, manually identify and average the apex peak +/- 1 scan and background correct as in 21.6.4 above. This is consistent with EPA 8260 and 8270.

21.6.3.2 Or the scan across the peak at one half peak height may be averaged and background corrected. This is consistent with Standard Methods 6200, EPA 624 and EPA 625.

21.6.3.3 Adjustments such as adjustments to the repeller and ion focus lenses, adjusting the EM Voltage, etc. may be made prior to tune verification as long as all of the subsequent injections in the 12 hour tune cycle are analyzed under the same MS tune settings and it is documented in the run sequence log and/or maintenance log that an adjustment was made. Excessive adjusting (more than 2 tries) without clear documentation is not allowed. Necessary maintenance is performed and documented in instrument log.

21.6.3.4 A single scan at the Apex (only) may also be used for the evaluation of the tune. For SW 846 and EPA 600 series methods, background correction is still required.

21.6.3.5 Cleaning the source or other maintenance may be performed and then follow steps for tune evaluation above. Note: If significant maintenance was performed, see methods 8000B or 8000C then the instrument may require recalibration prior to proceeding.

21.6.4 Tune evaluation printouts must include the chromatogram and spectra as well as the Tune evaluation information. In addition, the verifications must be sent directly to the printer or pdf file (no screen prints for DFTPP or BFB tunes). This ability should be built into the instrument software.

21.6.5 All MS tune settings must remain constant between running the tune check and all other samples. It is recommended that a separate tune method not be used, however a separate method may be used as long as the MS conditions between the methods are the same as the sample analysis method and tracked so any changes that are made to the analysis method are also made to the tune method.

Table 21-1.

Laboratory Equipment and Instrumentation

Instrument Type	Manufacturer	Model	Purchase Date	Autosampler	Method Performed
ICP	Thermo Jarrell Ash (61P) S/N 464790	61E Trace	1997	Yes	6010B, 200.7
Mercury Analyzer	Perkin Elmer S/N 1398	FIMS	1999	Yes	7471A, 7470, 245.1
GC/MS Semivolatiles	Agilent (U) S/N US33210086	6890/5973	2004	Yes	8270C, 625, SIM
	Agilent (Z) S/N US52430633	6890/5975	2005	Yes	8270C, 625, SIM
	Agilent (A) S/N US52420834	6890/5975	2006	Yes	8270C, 625, SIM
	Agilent (C) S/N US52430481	6890/5975	2006	Yes	8270C, 625, SIM
GC/MS Volatiles	Agilent (L) S/N 3240A18492	5890/5971	1992	Yes	8260B, 624
	Agilent (O) S/N 3203A41807	5890/5971	1991	Yes	8260B, 624 – waters
	Agilent (N) S/N 3133A37851	5890/5971	1991	Yes	8260B, 624
	Agilent (W) S/N U544621422	6890/5973	2005	Yes	8260B, 624 – soils
	Agilent (Y) S/N U544621422	6890/5973	2005	Yes	8260B, 624
	Agilent (v) S/N U540620567	6890/5973	2004	Yes	8260B, 624
GC Semivolatiles	Agilent (GC1C/D) S/N 3336A55482	5890II - Dual ECD	1994	Yes	8081, 8082, 608
	Agilent (GC4C/D) S/N 3033A33529	5890II - Dual ECD	1992	Yes	8082
	Agilent (GC7C/D) S/N CN10416081	6890-Dual micro ECD	2004	Yes	8081, 8082, 608
	Agilent (GC8C/D) S/N CN10630046	6890-Dual micro ECD	2006	Yes	8081, 8082, 608
	Agilent (GC2C/D) S/N 3033A32099	5890II – FID	1991	Yes	CTETPH 8015B (DRO)

Instrument Type	Manufacturer	Model	Purchase Date	Autosampler	Method Performed
	Agilent (GC3) S/N 3033A32563	5890 - FID	1991	Yes	8015B (DRO)
Ion Chromatograph	Lachat S/N A83000-1476	Quickchem 8000	1999	Yes	300.0, 9056 350.1, 351.2 9012, 335.4, 353.2, 420.2
TOC	Dohrmann	Phoenix 8000	2004	No	415.2, 9060
	Elementar Vario EL III	VArio EL	2005	Yes	415.2, 9060, Lloyd Kahn
TKN Digestion System	Scientific Instruments	AD-4020	1994	No	351.2, 351.3
UV/VIS	Thermo electron	Genesys 10	2006	No	7196A, 365.1 or Equiv.
UV/VIS	Buck Scientific (not in use)	HC 404	2000	No	418.1
PH Meter	Orion Research (not in use)	SA 720	1998	No	9040B, 9045C, 150.1
PH Meter	VWR	8025		No	9040B, 9045C, 150.1
Autotitrator (pH, Alkalinity, Conductance)	Man-Tech (ATZ)	PC 1300	2003	Yes	9040B, 9045C, 150.1, 2320B, 310.1, 310.2, 2510B, 9050A, 120.1
Dissolved Oxygen Meter	YSI	51A	1994	No	405.1
Turbidimeter	HACH	2100 N	1990	No	180.1
Conductivity	Cole-Parmer	1484-20	1996	No	120.1
Automated Distillation Apparatus	Westco S/N 1028	1075 Easy Dist	2003	No	350.1, 420.2, 9066
COD	HACH	45600	1991	No	410.4
Flash Point Apparatus	ERDCO	RT-00001		No	1020
Midi Distillation Setups	Andrews Galss	110-10-R	1995	No	9012A, 335.1, 335.3
TCLP Spinners	Dayton	3M137B/5K939B	1990	No	1311, 1312
GPC	ABC	Autoprep 1000	1999	Yes	8270, 8081, 8082
Selective Chemistry Analyzer	Thermo electron	Konelab Aqua 20	2004	Yes	350.1, 351.2, 353.2, 365.2
Solvent Evaporator	Horizon Technology	Speed-Vap III	2004	No	1664A
Colorimeter	Hach	DR/890		No	410.4

Table 21-2.

Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check tubing for wear Replace lamps Insert clean drying tube filled with Magnesium Perchlorate Fill reductant bottle with 10% Stannous Chloride	Daily As required Daily Daily
ICP	Check pump tubing Check liquid argon supply Check fluid level in waste container Check torch Check sample spray chamber for debris Clean and align nebulizer Check entrance slit for debris Replace pump tubing	Daily Daily Daily Daily Monthly As required Monthly As required
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Semi-annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Inspect line coils, heating baths and filters Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly
Agilent GC/MS	Clean injection ports Pump oil-level check Pump oil changing Ion source cleaning and filament replacement Replace electron multiplier Change exhaust trap absorbent Inspect and refill the calibration sample vial with PFTBA Vacuum fan grills and filters Change liners and septum Column replacement and conditioning Column cutting and reinstallation	As required Monthly Annually As required As required Every 6 months As required Every 6 months As required As required As required
Gas Chromatograph	 Septum replacement Check for loose/frayed wires and insulation Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	 As required As Required As Required As Required As Required
Instrument Auto samplers	Inspect and correct injector alignment Inspect syringe Change rinse and waste vials Replace syringe	After reseating Daily Daily As needed

Instrument	Procedure	Frequency
Purge and Trap concentrators/ Archon	Check purge flow Inspect line and valve temperatures Change and condition trap Adjust purge flow Rinse sample lines Bake out trap Replace lines and fittings Check syringe Check reagent water and waste bottles Autocalibrate robotic arm Replace inline filter	Daily Daily As required As required As required After each analysis, extend as needed As required Daily Daily As required As required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Balances	Class “S” traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least Annually
Conductivity Meter	0.01M KCl calibration Conductivity cell cleaning	Daily As required
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Daily conductivity check System cleaning Replace cartridge & large mixed bed resins	Daily As required As required
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	Calibration/check slope Clean electrode	Daily As required
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly
Water baths	Temperature monitoring Water replaced	Daily Monthly or as needed

Table 21-3.

Periodic Calibration

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using NIST weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by accredited person annually.	Daily	± 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 NIST weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by accredited person annually.	Daily	± 0.5%	Clean. Replace.
NIST Weights	Accuracy determined by accredited weights and measurement laboratory.	5 years	As per certificate.	Replace.
NIST-Traceable Thermometer	Accuracy determined by accredited weights and measurement laboratory.	5 years	As per certificate.	Replace.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 1.0°C	Replace
Minimum-Maximum Thermometers	Against NIST-traceable thermometer	Yearly	± 1.0°C	Replace
InfraRed Temperature Guns	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 1.0°C	Repair/replace

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Dial-type Thermometers	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 1.0°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again in two hours.	4.0 ± 2.0 °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. (Attach "Out of Service" sign, move items to functional unit.) Notify supervisor.
Incubator	Temperature checked using NIST-traceable thermometer.	When in use.	BOD: 20 ± 1.0°C	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, dispense into tared vessel. Record weight with device ID number.	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 de-monstrated if syringe was not received with a certifi-cate attesting to established accuracy.	± 1%	Not applicable.
Conductivity Meter	According to manufacturers recommendations	Each use.	Cell constant 10.00 ± 10%	Recalibrate.

SECTION 22

MEASUREMENT TRACEABILITY
(NELAC 5.5.6)

22.1 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. 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. The following definitions are provided by the American Association for Laboratory Accreditation (A2LA):

"Traceability is the property of a measurement result whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, each step in the chain having stated uncertainties." There are six essential elements:

- An unbroken chain of comparison
- A calculated measurement uncertainty for each step in the chain to allow for an overall uncertainty calculation
- Documentation of each step in each calibration report
- All steps in the chain are performed by individuals with evidence of technical competence and accredited by a recognized accreditation body
- Reference to International Standard (SI) units
- Recalibration at appropriate intervals to preserve traceability

Calibration is defined as "determining and documenting the deviation of the indication of a measuring instrument (or the stated value of a material measure) from the conventional 'true' value of the measurand."

Uncertainty is defined as "a parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measurand." Measurement of Uncertainty is discussed is Section 20 of this QA Manual.

22.2 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), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory. Refer to Section 21 for calibration of weights and thermometers.

22.3 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 A2LA or NVLAP 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. (Refer to Section 9 for additional information on purchasing). 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. 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 Table 9-1 in Section 9 for general storage requirements and Table 22-1 for additional storage information. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

22.4 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 within the departments. 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.

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.

22.4.1 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
- 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 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.

22.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date
- Standard ID (Generated from LIMS)
- Special Health/Safety warnings if applicable

22.4.3 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)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include a preparation date, 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 raw data.

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; and 3) according to Table 22-1.

Table 22-1.

Standard Sources and Preparation

Instrument	Source	How Received	Stock Storage	Preparation	Intermediate & Working Standard Storage	Frequency
ICP	SPEX; Environmental Express	1000 ppm Solutions	Room Temperature	Working standards from stock	Room Temperature	Weekly
GC	Supelco; Restek	Solutions	As Recommended by Manufacturer	Working standards from stock	As Recommended by Manufacturer	Yearly or as needed
TOC (Vario EL)	EM Science; Merck	Pure Reagent	Room Temperature	As received	N/A	Daily
TOC (Phoenix)	EM Science	Pure Reagent	Room Temperature	Working standards from stock	Refrigerate	Daily
Volatile Organics	Supelco; Restek	Ampoule/ Solutions	Freezer (-10^{o}C)	Working standards from stock	Refrigerate	Monthly; Gas, weekly
Semi-Volatile Organics	Supelco; Restek	Ampoule/ Solutions	As Recommended by Manufacturer	Working standards from stock	As Recommended by Manufacturer	Yearly or as needed
Ion Chromatography	ERA; SPC	Solutions	Refrigerate	Working standards from stock	Refrigerate	Biweekly
Lachat; Konelab	J.T. Baker	Pure Reagent	Room Temperature	Working standards from stock	Room Temperature	Daily, monthly

SECTION 23.0

SAMPLING
(NELAC 5.5.7)

23.1 OVERVIEW

TestAmerica Connecticut 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.

23.2 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. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

23.2.1 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

23.2.2 Preparing Container Orders

Bottle container orders are issued from project management upon final scheduling of a sampling event. The project manager will provide Sample Management with completed project information using the Lims bottle order system. All bottle orders are stored with in the LIMS for future reference.

When new lot number of bottles are utlized, the certificates of analysis are dated and placed in the folder for the bottle type. When the lot is used up, the ending date is also placed on the certificate. In this way it will be possible to determine what lot number (s) were used to prepare a bottle order.
For more information on the process, reference the SOP for Bottle order Preparation.

The laboratory also provides EnCore, TerraCore or other soil sampling devices when requested.

If containers are provided directly to the client from the manufacturer or from other sources, the laboratory will not be responsible for any of the above records.

If a client sends in sample containers that are not readily traceable to certification documentation, an NCM will be generated and it will be noted that the lab is not responsible for the cleanliness of the container.

23.3 FIELD QUALITY CONTROL (QC)

Common field quality control samples are defined in the following paragraphs. The frequency of field quality control samples should be specified in the site specific Quality Assurance Project Plan (QAPP) or by the client. TestAmerica provides trip blanks for VOC analysis with the sample containers for all volatile organic analyses. Blanks generated in the field will be analyzed along with the field samples (exception soil samples where the blank is aqueous).

23.3.1 Equipment Blank / Rinsate Blank - The equipment blank, sometimes referred to as a rinsate blank, is a sample of the water used to decontaminate sampling equipment. The source water should be as free of target analytes as possible. An aliquot of this water is poured over or through the sample collection device after decontamination, collected in a sample container, preserved with appropriate reagents, and returned to the laboratory. This serves as a check on sampling device cleanliness, and will also be affected by the site and sample handling conditions evaluated by the other types of blanks. The sampling time for the equipment blank should begin when the equipment is rinsed and the water is collected.

23.3.2 Field Blank - The field blank is water that is as free of target analytes as possible and from the same source as the equipment blank. The water is poured into a sampling container at the sampling site, preserved with the appropriate reagents, and returned to the laboratory. This serves as a check on reagent and environmental contamination. The sampling time for the field blank should be when the blank is prepared in the field.

23.3.3 Trip Blank - The trip blank pertains to volatile analysis only. This serves as a check on sample contamination originating from sample transport, sample container contamination, shipping and storage, or from certain site conditions. Trip blanks are often referred to as travel blanks. They are prepared using pre-cleaned sample containers. They are filled with organic-free water (the source of the organic free water is the same source of water used to prepare volatile standards, method blanks, LCS and sample dilutions), sealed and taken into the field with the empty containers which will be used for sampling. The recommended frequency is one trip blank per cooler (in duplicate or triplicate), per volatiles method. Unless otherwise specified, the sampling time for the trip blank is the time of receipt at the laboratory (When the “Trip” ends).

23.3.4 Field Duplicates - Field duplicates are replicate samples collected from the same sampling point or location during a field collection event. This control sample is used to demonstrate the ability of both the sampling and analytical process to generate data of acceptable precision.

23.4 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. 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 receipt compared to the time of sampling regardless of how long the holding time is.

23.4.1 Semi-Volatile - Holding times for sample preparation for semi-volatile organics are measured from the sampling date (and time where applicable) until the day (and time where applicable) solvent contacts the sample. If a sample is to be extracted on the day of expiration, the actual time of extraction must be recorded on the sample preparation worksheet. Holding times for analysis are measured from the date (and time where applicable) of initiation of extraction to the time of injection into the gas chromatograph.

23.4.2 Volatiles - Holding times for volatile organics are measured from the date (and time where applicable) of sampling to the date and time of injection into the gas chromatograph.

23.4.3 Inorganics - For inorganic and metals analysis, the preparation/digestion/distillation must be started within the maximum holding time as measured from the sampling date (and time where applicable).

23.5 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the following tables are derived from the source documents for the methods. If method required holding times (refer to Tables 23-1 to 23-7) 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.

23.6 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. In that regard the following guidelines apply to analysts:

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 procedure for subsampling can be found in the SOP for Compositing, Homogenization and Subsampling Environmental Samples.

Tables 23-1 to 23-7 detail holding times, preservation and container requirements, and sample volumes for SDWA and NPDES methods. The sample volumes are intended to be a minimal amount to perform the method, the containers that are used may be of larger size. ***Please note****: the holding times are program specific and different programs may have different holding times for equivalent methods (e.g., there are difference in Holding times for many Organic analytes between SDWA and NPDES. RCRA methods may also be different.)*

Table 23-1.
Holding Times, Preservation and Container Requirements: Drinking Water (SDWA)

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[23]	Chemical	HOLDING TIME[3]	SAMPLE VOLUME
Asbestos	Plastic/Glass	4ºC	None	48 hours[5]	1 L
Coliforms (Total and Fecal)	Plastic/Glass[20]	10ºC	$Na_2S_2O_3$	30 hours[21]	120 mL
Cyanide	Plastic/Glass	4ºC	NaOH to pH >12 Ascorbic acid[9] or Sodium arsenite[9]	14 days	500 mL
Fluoride	Plastic/Glass	None	None	None	250 mL
Heterotrophic Plate Count	Plastic/Glass[20]	10ºC	$Na_2S_2O_3$	8 hours (24 hours[22])	120 mL
Mercury	Plastic/Glass	None	HNO_3 to pH<2	28 days	250 mL
Metals[4]	Plastic/Glass	None	HNO_3 to pH<2[24]	6 months	250 mL
Nitrate	Plastic/Glass	4ºC	None	48 hours[6]	250 mL
Nitrate-Nitrite	Plastic/Glass	None	H_2SO_4 to pH<2	28 days	250 mL
Nitrite	Plastic/Glass	4ºC	None	48 hours	250 mL
THMs Only	Glass[8]	4ºC	$Na_2S_2O_3$[9] HCl to pH <2 may also be used.	14 days	3 X 40 mL
Volatile Organic Compounds	Glass[8]	4ºC	HCl to pH <2 $Na_2S_2O_3$[9] or Ascorbic acid[9]	14 days	3 X 40 mL
EDB, DBCP, 1,2,3-TCP (EPA 504.1)	Glass[8]	4ºC	$Na_2S_2O_3$	14 days	3 X 40 mL
Organochlorine Pesticides/PCBs (EPA 505)[10]	Glass[8]	4ºC	$Na_2S_2O_3$	14 days[11]	3 X 40 mL
Nitrogen and Phos. Pesticides (EPA 507)	Glass-Amber[8]	4ºC	$Na_2S_2O_3$	14 days[12]	1 L
Total PCBs (EPA 508A)	Glass-Amber[8]	4ºC	None	14 days[13]	1 L
Pesticides and PCBs (EPA 508.1)[14]	Glass-Amber[8]	4ºC	HCl to pH <2 $Na_2S_2O_3$[9]	14 days[13]	1 L

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[23]	Chemical	HOLDING TIME[3]	SAMPLE VOLUME
Chlorinated Acids (EPA 515.1)	Glass-Amber[8]	4ºC	$Na_2S_2O_3$	14 days[12]	1 L
Semivolatiles (EPA 525.2)	Glass-Amber[8]	4ºC	HCl to pH <2 $Na_2S_2O_3$[9]	14 days[13]	1 L
N-Methylcarbamoyloxamines and N-Methcarbamates (EPA 531.1)	Glass[8]	4ºC	$Na_2S_2O_3$, Monochloroacetic Acid buffer to pH<3	28 days	3 X 60 mL
Glyphosate (EPA 547)	Glass[8]	4ºC	$Na_2S_2O_3$	14 days	3 X 60 mL
Endothall (EPA 548)	$Na_2S_2O_3$	4ºC	None	7 days[15]	1 L
Diquat/Parquat (EPA 549.1)	Glass-Amber[8] (Silanized or PVC amber)	4ºC	H_2SO_4 to PH <2 $Na_2S_2O_3$[9]	7 days[16]	1 L
Chlorinated Disinfection Byproducts, Chlorinated Solvents, and Halogenated Pesticides/Herbicides (EPA 551)	Glass[8]	4ºC	Phosphate Buffer and Ammonium Chloride[19]	14 days[17]	3 X 60 mL
Haloacetic Acids (EPA 552.1)	Glass-Amber[8]	4ºC	Ammonium Chloride	28 days[18]	250 mL

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
4. All metals except Hg.
5. Instructions for containers, preservation procedures and holding times as specified in Method 100.2 must bed adhered to for all compliance analysis including those conducted with Method 100.1.
6. If the sample is chlorinated, the holding time for an un-acidified sample kept at 4°C is extended to 14 days.
7. Nitrate-Nitrite refers to a measurement of total nitrite.
8. With Teflon lined septum.
9. If chlorinated add reagent prior to acidification (for Cyanide, add before NaOH).

Key to Table

10. Heptaclor has a 7 day hold time
11. 14 days until extraction. 24 hours after extraction.
12. 14 days until extraction. 28 days after extraction.
13. 14 days until extraction. 30 days after extraction.
14. For cyanazine, cool to 4^{o}C only.
15. 7 days until derivitation. 1 day after derivatation.
16. 7 days until extraction. 21 days after extraction.
17. 14 days until extraction. 14 days after extraction.
18. 28 days until extraction. 48 hours after extraction.
19. Sodium Sulfite may be used as a dechlorinating agent in some instances. Verify with laboratory prior to sampling.
20. Sterilized. Plastic must be Polypropylene.
21. 40 CFR part 141.74 regulations to avoid filtration or disinfection state 8 hours (DW compliance testing). Most facilities are using either disinfection or filtration so the 8 would not apply in most cases.
22. 40 CFR part 141.74 regulations for Disinfection By-Product rule state 8 hours (DW compliance testing) where SM 9215 allows up to 24 hours if sample is stored between > 0 and $\leq$ 4^{o} C
23. For samples with a temperature requirement of 4^{o}C, a sample temperature of just above the water freezing temperature to < 6^{o}C is acceptable.

24 Acid preservation may be omitted for shipping and laboratory will acidify at least 24 hours prior to analysis.

Table 23-2
Holding Times, Preservation and Container Requirements: NPDES – Bacteria, Protozoa, Toxicity Tests

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp.	PRESERVATION[2,3] Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Total, Fecal, and E.coli Coliforms	Plastic/Glass	10ºC	0.0008 % $Na_2S_2O_3$[6]	6 hours	100 mL
Fecal Streptococci	Plastic/Glass	10ºC	0.0008 % $Na_2S_2O_3$[6]	6 hours	100 mL
Enterococci	Plastic/Glass	10ºC	0.0008 % $Na_2S_2O_3$[6]	6 hours	100 mL
Cryptosporidium	LPDE Plastic	0-8ºC	None	96 Hours	500 mL
Giardia	LPDE Plastic	0-8ºC	None	96 Hours	500 mL
Toxicity – Acute/Chronic	Plastic/Glass	$\leq$ 6ºC[5]	None	36 Hours	2 L

Key to Table

1. Plastic should be Polypropylene or other sterilizable plastic.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4^{o}C until compositing and sample splitting is completed.
3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
5. Samples must not be frozen. Sufficient ice should be placed with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present, when samples arrive, it is necessary to measure the temperature of the samples and confirm that the $\leq$ 6^{o}C temperature has not been exceeded.
6. Should only be used in the presence of residual chlorine.

Table 23-3
Holding Times, Preservation and Container Requirements: NPDES - Inorganic

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp[14].	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Acidity	Plastic/Glass	≤ 6ºC	None	14 days	100 mL
Alkalinity	Plastic/Glass	≤ 6ºC	None	14 days	100 mL
Ammonia	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH<2	28 days	400 mL
BOD 5 Day	Plastic/Glass	≤ 6ºC	None	48 hours	1000 mL
Boron	Plastic[5]	None	HNO_3 to pH<2	6 months	200 mL
Bromide	Plastic/Glass	None	None	28 days	100 mL
CBOD 5 Day	Plastic/Glass	≤ 6ºC	None	48 hours	1000 mL
COD	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH<2	28 days	100 mL
Chloride	Plastic/Glass	None	None	28 days	50 mL
Chlorine, Residual	Plastic/Glass	None	None	15 min.[6]	200 mL
Color	Plastic/Glass	≤ 6ºC	None	48 hours	50 mL
Cyanide –Total[16,17]	Plastic/Glass	≤ 6ºC	NaOH to pH >12, 0.6 g ascorbic Acid[7]	14 days	100 mL
Cyanide, Amenable[16,17]	Plastic/Glass	≤ 6ºC	NaOH to pH >12, 0.6 g ascorbic Acid[7]	14 days	100 mL
Fluoride	Plastic	None	None	28 days	300 mL
Hardness	Plastic/Glass	None	HNO_3 to pH<2[8]	6 months	100 mL
Hexavalent, Chromium	Plastic/Glass	≤ 6ºC	Ammonium sulfate buffer pH = 9.3 - 9.7	28 dys / 24 hrs[15]	200 mL
Hydrogen Ion (pH)	Plastic/Glass	None	None	15 min.[6]	200 mL
Kjeldahl and organic Nitrogen	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH <2	28 days	500 mL
Mercury[11]	Plastic/Glass	None	HNO_3 to pH<2	28 days	200 mL
Metals[9,10]	Plastic/Glass	None	HNO_3 to pH<2[18]	6 months	200 mL
Nitrate	Plastic/Glass	≤ 6ºC	None	48 hours	100 mL
Nitrate-Nitrite	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH <2	28 days	100 mL
Nitrite	Plastic/Glass	≤ 6ºC	None	48 hours	100 mL
Oil and Grease	Glass	≤ 6ºC	H_2SO_4 or HCl to pH <2	28 days	1 L

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp[14].	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Organic Carbon (TOC)	Plastic/Glass	≤ 6ºC	H_2SO_4 or HCl to pH <2[12]	28 days	250 mL
Orthophosphate	Plastic/Glass	≤ 6ºC	Filter within 15 min.	48 hours	250 mL
Oxygen, Dissolved Probe	Glass[13]	None	None	15 min.[6]	200 mL
Oxygen, Winkler	Glass[13]	None	Fix on site and store in dark.	8 hours	300 mL
Phenols	Glass	≤ 6ºC	H_2SO_4 to pH <2	28 days	500 mL
Phosphorus, Elemental	Glass	≤ 6ºC	None	48 hours	250 mL
Phosphorus, Total	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH <2	28 days	250 mL
Residue, Total	Plastic/Glass	≤ 6ºC	None	7 days	1 L
Residue, Filterable	Plastic/Glass	≤ 6ºC	None	7 days	1 L
Residue, Non-Filterable	Plastic/Glass	≤ 6ºC	None	7 days	1 L
Residue, Settleable	Plastic/Glass	≤ 6ºC	None	48 hours	1 L
Residue, Volatile	Plastic/Glass	≤ 6ºC	None	7 days	1 L
Silica	Plastic[5]	≤ 6ºC	None	28 days	250 mL
Specific Conductance	Plastic/Glass	≤ 6ºC	None	28 days	250 mL
Sulfate	Plastic/Glass	≤ 6ºC	None	28 days	250 mL
Sulfide	Plastic/Glass	≤ 6ºC	Zinc acetate plus NaOH to pH>9	7 days	500 mL
Sulfite	Plastic/Glass	None	None	15 min.[6]	200 mL
Surfactants	Plastic/Glass	≤ 6ºC	None	48 hours	1 L
Temperature	Plastic/Glass	None	None	N/A	100 mL
Turbidity	Plastic/Glass	≤ 6ºC	None	48 hours	1 L

Key to Table

1. Plastic should be Polyethylene.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at ≤ 6ºC until compositing and sample splitting is completed.

Key to Table

3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
5. May also be collected in quartz or PFTE Plastic.
6. For compliance testing, the analysis must be performed in the field at the time of analysis. If transported to the laboratory for analysis, the analysis will be performed as soon as practical and reported qualified.
7. Should only be used in the presence of residual chlorine. (Alternatively, sodium aresenite may be used)
8. H_2SO_4 to a pH <2 is also acceptable.
9. Except Mercury and Hexavalent Chromium.
10. For dissolved metals, samples must be filtered on site before adding HNO_3 preservative (or before shipping to laboratory).
11. Samples collected for determination of trace level mercury (100 ng/L) using EPA 1631 must be collected in tightly capped fluoropolymer or glad bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. Samples collected for dissolved trace level mercury should be filtered in the laboratory. However, if circumstances prevent overnight shipping, samples should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. Samples that been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.
12. Phosphoric acid (H_3PO_4) may also be used.
13. Should have glass lid or top.
14. Aqueous samples must be preserved at • 6 °C unless otherwise indicated, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ‘‘• °C’’ is used in place of the ‘‘4 °C’’ and ‘‘<4 °C’’ sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the • 6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).
15. Holding time is 24 hours if pH adjustment is not performed.
16. 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 (with sulfide treatment by laboratory) and qualify the results in the final report.
17. 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.
18. Acid preservation may be omitted for shipping and laboratory will acidify at least 24 hours prior to analysis.

Table 23-4
Holding Times, Preservation and Container Requirements: NPDES - Organic

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[15]	Chemical	HOLDING TIME[3]	SAMPLE VOLUME
Purgeable Halocarbons	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5]	14 days	40 mL
Purgeable Aromatic Hydrocarbons	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5], HCl to pH<2	14 days[6]	40 mL
Acrolein and Acrylonitrile	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5], adjust pH to 4-5[7]	14 days	40 mL
Phenols[9]	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[8]	1 L
Benzidines[9]	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[8, 11]	1 L
Phthalate esters[9]	Glass[4]	≤ 6ºC	None	7 days[8]	1 L
Nitrosamines[9,12]	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5,13]	7 days[8]	1 L
PCBs[9]	Glass[4]	≤ 6ºC	None	1 year[8]	1 L
Nitroaromatics and Isophorone[9]	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5,13]	7 days[8]	1 L
Polynuclear Aromatic Hydrocarbons[9]	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5,13]	7 days[8]	1 L
Haloethers[9]	Glass[4]	≤ 6ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[8]	1 L
Chlorinated Hydrocarbons[9]	Glass[4]	≤ 6ºC	None	7 days[8]	1 L
CDD/CDFs[9] – Aqueous: Field/Lab Preservation	Glass	≤ 6ºC	pH <9, 0.0008 % $Na_2S_2O_3$[5]	1 year	1 L
CDD/CDFs[9] – Solids/Mixed Phase/ - Field Preservation	Glass	≤ 6ºC	None	7 days	1 L
CDD/CDFs[9] – Tissue – Field Preservation	Glass	≤ 6ºC	None	24 hours	
CDD/CDFs[9] – Solids/Mixed Phase/Tissue - Lab Preservation	Glass	< -10ºC	None	1 year	1 L
Pesticides[9]	Glass	≤ 6ºC	pH 5-9 [14]	7 days[8]	1 L

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at $\leq 6^{o}C$ until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
4. With Teflon lined septum.
5. Should only be used in the presence of residual chlorine. Ascorbic may be used instead.
6. Samples receiving no pH adjustments must be analyzed within 7 days. If 2-chlorovinylethylether is a target analyte, the sample should not be acidified.
7. The pH adjustment is not required if acrolein is not being measured. Samples for acrolein receiving no pH adjustment must be analyze within three days of sampling.
8. 7 days until extraction, 40 days after extraction. (PCB only – 1 year after extraction)
9. When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more categories, the sample may be preserved by cooling to $\leq 6^{o}C$ reducing residual chlorine with 0.0008 % sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9. Samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine) and footnotes 10 and 11(re the analysis of Benzidine).
10. If 1,2-diphenylhydrazine is likely to be present, adjust pH to of the sample to 4.0 $\pm$ 0.2 to prevent rearrangement to benzidine.
11. Extracts may be stored up to 30 days before analysis if storage temperature is $< 0^{o}C$.
12. For the analysis of diphenylnitrosamine, add 0.008 % $Na_2S_2O_3$ and ajust pH to 7-10 with NaOH within 24 hours of sampling.
13. Store in dark.
14. The pH adjustment may be performed upon receipt in the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin , add 0.0008 % $Na_2S_2O_3$.
15. Aqueous samples must be preserved at • 6 °C unless otherwise indicated, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ‘‘• °C’’ is used in place of the ‘‘4 °C’’ and ‘‘<4 °C’’ sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the • 6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

Table 23-5.
Holding Times, Preservation and Container Requirements: NPDES - Radiological

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.	Chemical	HOLDING TIME[3]	SAMPLE VOLUME
Alpha, Beta, Radium	Plastic/Glass	None	HNO_3 to pH<2	6 months	1 L

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4^oC until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater).
3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.

Table 23-6.
Holding Times, Preservation and Container Requirements: RCRA - Aqueous

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp.[12]	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Chloride	Plastic/Glass	4ºC	None	28 days	100 mL
Cyanide -Total	Plastic/Glass	4ºC	NaOH to pH >12[5]	14 days	250 mL
Cyanide -Amenable	Plastic/Glass	4ºC	NaOH to pH >12[5]	14 days	250 mL
Hydrogen Ion (pH)	Plastic/Glass	4ºC	None	24 hours[11]	100 mL
Nitrate	Plastic/Glass	4ºC	None	48 hours	28 days
Oil and Grease	Glass	4ºC	HCl	28 days	1 L
Organic carbon (TOC)	Plastic/Glass	4ºC	pH to <2[6] Store in dark	28 days	28 days
Sulfate	Plastic/Glass	4ºC	None	28 days	400 mL
Sulfide	Plastic/Glass	4ºC	Add Zn Acetate	7 days	400 mL
Chromium VI	Plastic/Glass	4ºC	None	24 hours	250 mL
Mercury	Plastic/Glass	None	HNO_3 to pH<2	28 days	250 mL
Other Metals	Plastic/Glass	None	HNO_3 to pH<2	6 months	250 mL
Acrolein and Acrylonitrile	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7] Adjust pH to 4-5[13]	14 days	1 L
Benzidines	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7]	7 days[8]	1 L
Chlorinated Hydrocarbons	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7]	7 days[8]	1 L
Dioxins and Furans	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7]	7 days[8]	1 L
Haloethers	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7]	7 days[8]	1 L
Nitroaromatics and cyclic ketones	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7], store in dark	7 days[8]	1 L
Nitrosomines	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7], store in dark	7 days[8]	1 L
Organochlorine Pesticides	Glass[10]	4ºC	None	7 days[8]	1 L
Organophosphorus Pesticides	Glass[10]	4ºC	Adjust pH[9]	7 days[8]	1 L
PCBs	Glass[10]	4ºC	None	7 days[8]	1 L
Phenols	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7]	7 days[8]	1 L

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp.[12]	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Phthalate Esters	Glass[10]	4ºC	None	7 days[8]	1 L
Polynuclear Aromatic Hydrocarbons	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7], store in dark	7 days[8]	1 L
Purgeable Hydrocarbons	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7] Adjust pH <2[2]	14 days	40 mL
Purgeable Halocarbons	Glass[10]	4ºC	0.0008 % $Na_2S_2O_3$[7]	14 days	40 mL
Total Organic Halides (TOX)	Glass[10]	4ºC	Adjust pH to <2 with H_2SO_4	28 days	1 L
Radiological Tests (Alpha, Beta, Radium)	Plastic/Glass	None	HNO_3 to pH<2	6 months	250 mL

Key to Table

1. Plastic should be Polyethylene.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
5. If oxidizing agents are present, add 5 mL 0.1 N $NaAsO_2$ or 0.06 g of ascorbic acid per L. See Cyanide SOP for additional information about other interferences.
6. Adjust pH to <2 with H_2SO_4, HCl, or solid $NaHSO_4$. Free Chlorine must be removed prior to adjustment.
7. Free Chlorine must be removed by the appropriate addition of $Na_2S_2O_3$.
8. 7 days until extraction. 40 days after extraction.
9. Adjust pH to 5-8 using NaOH or H_2SO_4.
10. With Teflon lined septum.
11. Holding Time is listed as “As Soon as Possible” in SW 846. Per EPA MICE, the recommended maximum holding time for pH in water is 24 hours and pH in soil is 7 days. There are no mandated regulatory requirements.
12. For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to $\leq$ 6°C is acceptable.
13. Based on guidance from EPA MICE, if samples are received without pH adjustment, the holding time is 7 days.

Table 23-7.
Holding Times, Preservation and Container Requirements: RCRA – Non-Aqueous

PARAMETER	CONTAINER [1]	PRESERVATION Temp.[7]	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Chloride	Glass	4ºC	None	28 days	50 g
Cyanide -Total	Glass	4ºC	None	14 days	50 g
Cyanide -Amenable	Glass	4ºC	None	14 days	50 g
Hydrogen Ion (pH)	Glass	4ºC	None	7 days[6]	50 g
Nitrate	Glass	4ºC	None	N/A	50 g
Oil and Grease	Glass	4ºC	None	28 days	50 g
Sulfide	Glass	4ºC	Add Zn Acetate, zero headspace	7 days	50 g
Chromium VI	Glass	4ºC	None	30 days	50 g
Mercury	Plastic/Glass	None	None	28 days	50 g
Other Metals	Plastic/Glass	None	None	6 months	50 g
Acrolein and Acrylonitrile	Glass[4]	4ºC	None	14 days	50 g
Benzidines	Glass[4]	4ºC	None	14 days[3]	50 g
Chlorinated Hydrocarbons	Glass[4]	4ºC	None	14 days[3]	50 g
Dioxins and Furans	Glass[4]	4ºC	None	14 days[3]	50 g
Haloethers	Glass[4]	4ºC	None	14 days[3]	50 g
Nitroaromatics and cyclic ketones	Glass[4]	4ºC	None	14 days[3]	50 g
Nitrosomines	Glass[4]	4ºC	None	14 days[3]	50 g
Organochlorine Pesticides	Glass[4]	4ºC	None	14 days[3]	50 g
Organophosphorus Pesticides	Glass[4]	4ºC	None	14 days[3]	50 g
PCBs	Glass[4]	4ºC	None	14 days[3]	50 g
Phenols	Glass[4]	4ºC	None	14 days[3]	50 g
Phthalate Esters	Glass[4]	4ºC	None	14 days[3]	50 g
Polynuclear Aromatic Hydrocarbons	Glass[4]	4ºC	None	14 days[3]	50 g

PARAMETER	CONTAINER [1]	PRESERVATION Temp.[7]	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Purgeable Hydrocarbons	Glass[4]	4ºC	None	14 days[5]	50 g
Purgeable Halocarbons	Glass[4]	4ºC	None	14 days[5]	50 g
Total Organic Halides (TOX)	Glass[4]	4ºC	None	28 days	50 g

Key to Table

1. Plastic should be Polyethylene.
2. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
3. 14 days until extraction. 40 days after extraction.
4. With Teflon Lined Septum
5. See Volatile SOP for more detailed preservation requirements.
6. Holding Time is listed as "As Soon as Possible" in SW 846. Per EPA MICE, the recommended maximum holding time for pH in water is 24 hours and pH in soil is 7 days. There are no mandated regulatory requirements.
7. For samples with a temperature requirement of $4^{o}C$, a sample temperature of just above the water freezing temperature to $\leq 6^{o}C$ is acceptable.

Table 23-8.
Holding Times, Preservation and Container Requirements: Air Samples

PARAMETER	CONTAINER [1]	PRESERVATION Temp.	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Volatile Organics	Summa Cannister	None	None	30 days	6L or 1L
Volatile Organics	Tedlar Bag	None	None	72 hrs[3,4]	1 L

Key to Table

1. Plastic should be Polyethylene.
2. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
3. Holding Time is based on SW 846 Method 0040 "SAMPLING OF PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS FROM COMBUSTION SOURCES USING TEDLAR® BAGS". Some states specifically enforce this holding time (e.g. Florida, New Jersey) and others have not specified this information in their regulatory requirements.
4. The holding time is 72 hours unless the laboratory has a documented validation study that indicates a longer HT is acceptable for the analytes of interest.

SECTION 24

HANDLING OF SAMPLES
(NELAC 5.5.8)

Sample management procedures at TestAmerica Connecticut ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

24.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and can be 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 24-1.

24.1.1 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 24-1). 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.

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. Samples are only considered to be received by lab when personnel at the laboratory 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. Airbills from the courier are stored in log-in folder. Tracking numbers are entered into the LIMS in the cooler receipt comments field.

24.1.2 Legal / Evidentiary Chain-of-Custody

All samples at TestAmerica Connecituct are treated in the same manner for legal/evidentiary purposes. The External COC and any other shipping records are retained in a job folder. The sample custodian or designee will also initiate and completely fill out all pertinent information on the top of the internal chain-of -custody form (Figure 24-2) for laboratory use by analysts and place in the binder in the Sample Control area. Disposal of samples is tracked through the LIMS.

24.2 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.

24.2.1 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 the LIMS sample Receipt check list and brought to the immediate attention of the Project Manager. 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.

24.2.1.1 Inspection of samples include a check for:

- Complete documentation to include sample identification, location, date and time of collection, collector's name, preservation type, sample type and any additional comments concerning the samples.
- Complete sample labels to include unique identification in indelible ink.
- Use of appropriate sample containers (see Section 23)

- Adherence to holding times as specified in the test method and/or summarized in Section 23.
- Adequate sample volume for required analyses (see Section 23).
- Damage or signs of contamination to sample container. Volatile vials are also inspected for headspace

24.2.1.2 Check and record the temperature of the samples, temperature blanks, that require thermal preservation.

- Samples shall be deemed acceptable if arrival temperature is just above freezing and less than or equal to 6.0° C. Samples that are hand-delivered immediately after collection may not be at the required temperatures; however, if there is evidence that the chilling process has begun, such as the arrival on ice, the samples shall be considered acceptable. This will be documented on the COC and in an NCM.

- If the samples were shipped in ice and solid ice is still present and in direct contact with samples, report the samples as "received on ice." Direct contact means samples must be surrounded by ice cubes or crushed ice. Ice present in a plastic bottle or other container does not constitute direct contact. Samples shipped with only “blue ice” may not be reported as “received on ice”.

24.2.1.3 Verify sample preservation as specified in the test method. Check for correct pH as specified in the test method. The results are documented on the preservation log. In the case of volatiles it is recorded after analysis in the injection log.

24.2.1.4 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.

24.2.1.5 If samples are received without a COC, TestAmerica will provide a generic COC form to be completed by the client when the samples are brought to the laboratory. The client is always provided with a copy of the completed COC form for their records.

24.2.1.6 If analyses with short holding times are requested, the dates and times are inspected to ensure that holding times have not already expired.

24.2.1.7 Samples received after normal working hours are left in their coolers and placed in a cold storage location, walk-in refrigerator. The person receiving the samples must record the date and time received, perform radiological screening, the presence or absence of ice and custody seals, the temperature of samples, and initials.

24.2.1.8 Any deviations from the checks described in Section 24.2.1 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 criteria (Section 24.3) 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.

24.2.2 Sample Log-in

All samples that are received by the laboratory are logged into the LIMS to allow the laboratory to track and evaluate sample progress. Each days receipt of samples that are logged in together is assigned a unique login number. Within each login, each sampling point (or sample) receives a unique number. Sample numbers are generated sequentially over time, and are not re-assigned. A sample may be composed of more than one bottle since different preservatives may be required to perform all analyses requested. Even if multiple containers are received for a single sample, each container is uniquely identified. The LIMS generates sample labels that are attached to each bottle for a given sample.

Each job/set of samples is logged into LIMS with a minimum of the following information:

- Client Name, Project Name, Address, Phone, Fax, Report to information, invoice to information (most of this information is “default information” that is stored in the LIMS).
- Date and time sampled;
- Date and time received;
- Job and/or project description, sample description;
- Sample matrix, special sample remarks;
- Reporting requirements (i.e., QC level, report format, invoicing format);
- Turn-around-time requirements;
- Parameters (methods and reporting limits or MDLs are default information for a given parameter)

24.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 24-3) 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 and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method;
- sample holding times must be adhered to;
- all samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time;
- Apparent tampering of cooler and/or samples.
- Temperature specifications not met.

- 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. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

24.4 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 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 every two weeks.

After sample receipt and log-in samples are transfered to the appropriate storage refrigerators or locations as outlined in the Sop for Storing Samples. All sample storage refrigerators and the walk-in cooler are located in the sample control room. Each refrigerator and walk-in cooler section is uniquely identified and labeled.

Under no circumstances are standards to be stored in the sample storage area, in order to insure against potential sample contamination.

In certain instances it may be necessary to freeze soil samples to extend holding times. This may only be done with prior approval from the client.

Samples are retained for 30days after invoice prior to disposal. The removal of each sample from the sample storage area for disposal is the responsibility of the sample custodian.

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.

24.5 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. Samples should be received into the lab as outlined in the SOPs for sample receiving.

If samples are received with additional paperwork indicating samples are from foreign sources then the samples must be handled and disposed of accordingly. Foreign source samples must be identified as needing special handling upon disposal by placing a green sticker on the top of the jar lid. Mixed waste radiological samples are identified with an orange sticker.

Foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

24.6 SAMPLE SHIPPING

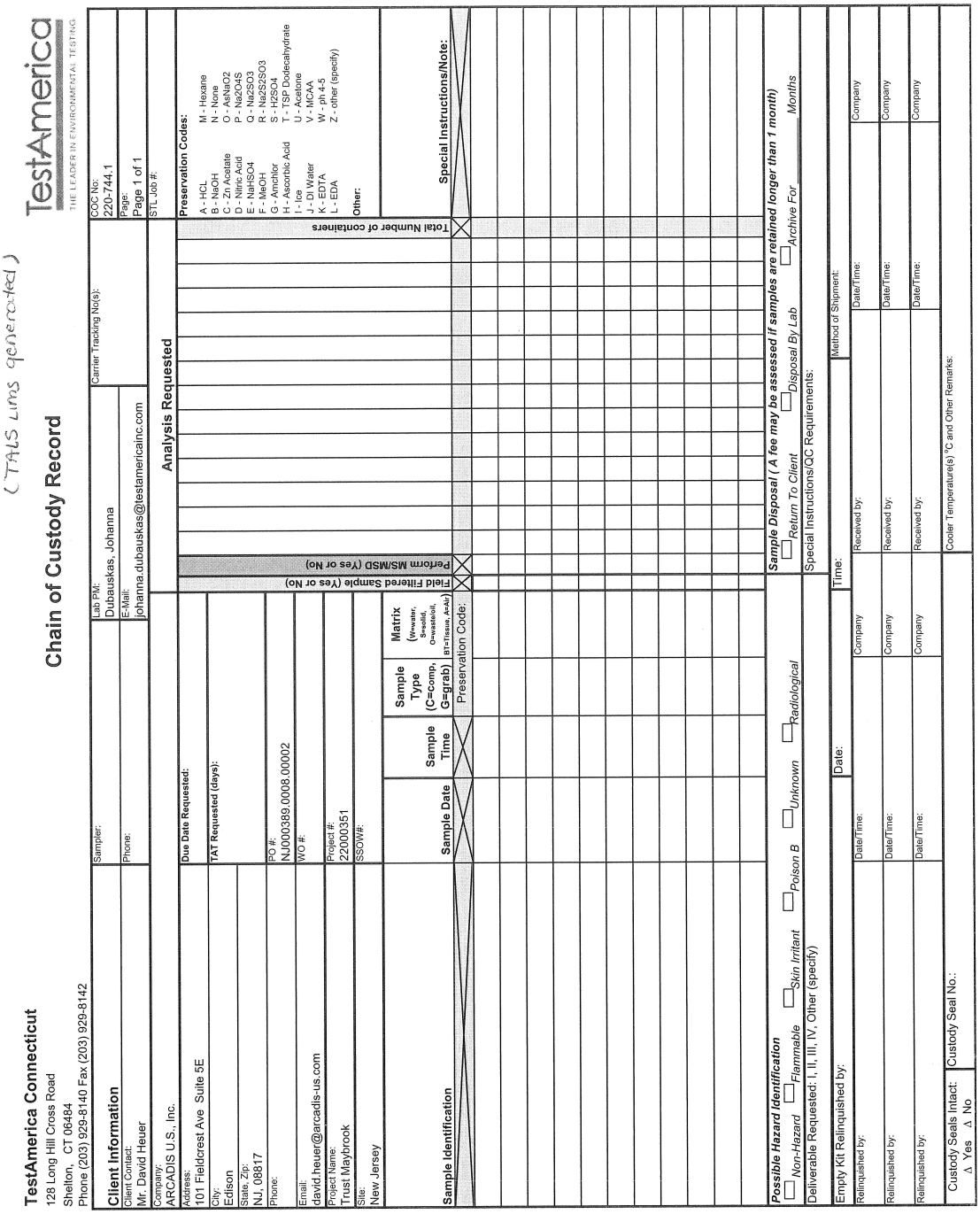
In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. 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.

24.7 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: SOP for Sample Disposal. All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than three 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.

Figure 24-1.

Example: Chain of Custody (COC)



TestAmerica Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Phone (203) 929-8140 Fax (203) 929-8142

CTALS LIMS generated)

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information
Client Contact: Mr. David Heuer
Company: ARCADIS U.S., Inc.
Address: 101 Fieldcrest Ave Suite 5E
City: Edison
State, Zip: NJ, 08817
Phone:
Email: david.heuer@arcadis-us.com
Project Name: Trust Maybrook
Site: New Jersey

Sampler:
Phone:
Lab PM: Dubauskas, Johanna
E-Mail: johanna.dubauskas@testamericainc.com
Carrier Tracking No(s):

COC No: 220-744.1
Page: Page 1 of 1
STL Job #:

Due Date Requested:
TAT Requested (days):
PO #: NJ000389.0008.00002
WO #:
Project #: 22000351
SSOW#:

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2SO3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - ph 4-5, Z - other (specify), Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	Total Number of containers	Special Instructions/Note:
			Preservation Code:					

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

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months

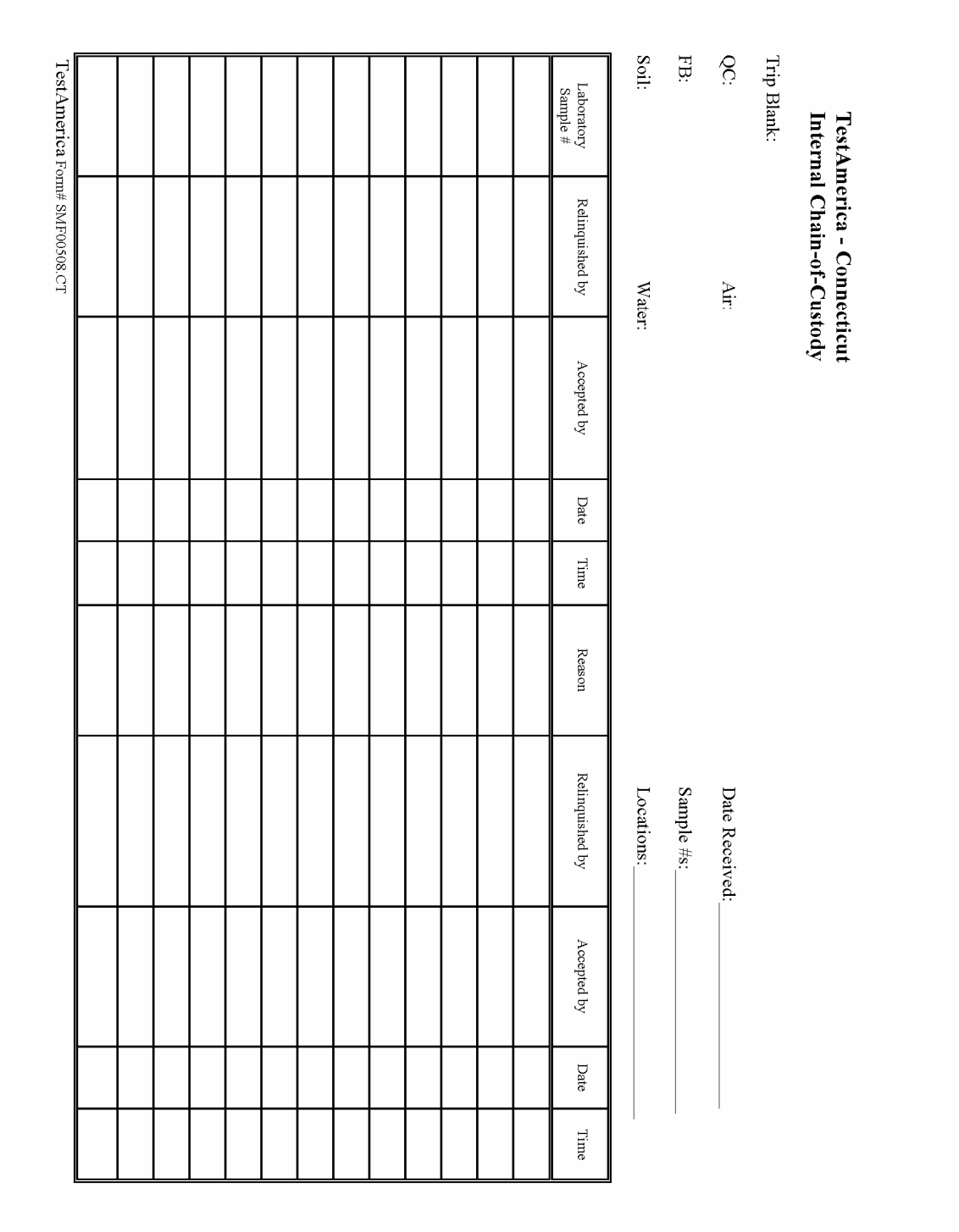
Deliverable Requested: I, II, III, IV, Other (specify)
Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No
Custody Seal No.:
Cooler Temperature(s) °C and Other Remarks:

Figure 24-2.

Example: Internal Chain of Custody (COC)



TestAmerica - Connecticut
Internal Chain-of-Custody

Trip Blank:

QC: Air: Date Received:

FB: Sample #s:

Soil: Water: Locations:

Laboratory Sample #	Relinquished by	Accepted by	Date	Time	Reason	Relinquished by	Accepted by	Date	Time

TestAmerica Form# SMF00508.CT

Figure 24-3.

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.

Samples are 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 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.

- Compromised receipt is documented and client contacted for instructions.
- If the client decides to proceed with analysis, the "compromised" sample receipt is documented in the report.
- A Sample Receipt checklist in the Lims systems is used to document any problems during sample receipt.

SECTION 25.0

ASSURING THE QUALITY OF TEST RESULTS
(NELAC 5.5.9)

25.1 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 21, 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. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

25.2 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.

25.3 NEGATIVE CONTROLS

25.3.1 **Method Blanks** are used to assess preparation and analysis for possible contamination during the preparation and processing steps.

25.3.1.1 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.

25.3.1.2 The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).

25.3.1.3 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.

25.3.1.4 Evaluation criteria and corrective action for method blanks is defined in the specific standard operating procedure for each analysis. Generally, corrective action is taken if the concentration of a target analyte in the blank is at or above the reporting limit as established by the method or regulation:

- The source of contamination is investigated

- Measures are taken to minimize or eliminate the source of the contamination
- Affected samples are reprocessed or the results are qualified on the final report.

25.3.2 **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.

25.3.3 **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.

25.3.4 **Trip Blanks** are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses. A trip blank 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. Trip Blanks are also sometimes referred to as Travel Blanks.

25.3.5 **Field Blanks** 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)

25.3.6 **Equipment Blanks** 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)

25.3.7 **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 (refer to section 24.4).

25.3.8 **Field blanks**, equipment blank and trip blanks, when received, are analyzed in the same manner as other field samples. When known, blanks 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".

25.4 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) 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 and appendix 4.

25.4.1 Method Performance Control - Laboratory Control Sample (LCS)

25.4.1.1 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.

25.4.1.2 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 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.

25.4.1.3 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.).

25.4.1.4 As stated in the opening of this section, the LCS goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).

25.4.1.5 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.

25.4.1.6 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.

25.4.1.6.1 For methods that have 1-10 target analytes, spike all components.

25.4.1.6.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

25.4.1.6.3 For methods with more than 20 target analytes, spike at least 16 components.

25.4.1.6.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

25.4.1.6.5 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.

25.4.1.7 **Accuracy Calculation**: Percent Recovery (%R) Calculation (applies to LCS, CCV, Surrogates, and Matrix Spikes.

$$\%R = \frac{AV}{TV} \times 100$$

Where: AV = Analyzed Value
TV = True Value

25.5 SAMPLE MATRIX CONTROLS

25.5.1 Matrix Spikes (MS)

25.5.1.1 The Matrix spike is 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.

25.5.1.2 An MS is essentially a sample fortified with a known amount of the test analyte(s). 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.

25.5.1.3 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. 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, a representative number of the listed components (see LCS analytes 25.4.1.6 above) may 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.

25.5.1.4 The percent recovery calculation for matrix spikes is essentially the same as the calculation shown in 25.2.1.7 except that:

AV = Sp – Sa

Where: Sp = Spike result
Sa = Sample result

25.5.2 Surrogate Spikes

25.5.2.1 Surrogate Spikes 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.

25.5.2.2 Surrogate compounds 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 (also refer to Section 25.5). 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.

25.5.3 Duplicates

25.5.3.1 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. Duplicate samples are usually analyzed with methods that do not require matrix spike analysis. 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.

25.5.3.2 Precision Calculation (Relative Percent Difference - RPD)

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

Where: S=Sample Concentration
D=Duplicate Concentration

25.5.4 Internal Standards

25.5.4.1 In most organic analyses, internal standards are spiked into all environmental and quality control samples (including the initial calibration standards). An internal standard is also used with some metals analyses. It is added to sample extracts after the extraction (post-prep). The acceptance criteria in most methods are 50% to 200% of the responses in the mid-point of the corresponding calibration curve. Consult the method-specific SOPs for details on the internal standard compounds, calculations and acceptance criteria.

25.5.4.2 When the internal standard recoveries fall outside these limits, if there are not obvious chromatographic interferences, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets internal standard recovery criteria, the second run is reported (or both are reported if requested by the client).

25.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

25.6.1 Each individual analyte in the LCS, MS, or Surrogate Spike are evaluated against the control limits as published in the test method. Where there are no established acceptance criteria, the laboratory calculates control limits with the use of control charts or, in some cases, utilizes client project specific or regulatory mandated 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.

25.6.2 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 (e.g. EPA SW846 8000 series methods). Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

25.6.2.1 The lab should consider the effects of the spiking concentration control limits, and to avoid censoring of data. The acceptance criteria for recovery and precision are often a function of the spike concentration used. Therefore, caution must be used when pooling data to generate control limits.

25.6.2.2 Not only should the results all be from a similar matrix, but the spiking levels should also be approximately the same (within a factor of 2). Similarly, the matrix spike and surrogate results should all be generated using the same set of extraction, cleanup and analysis techniques. For example, results from solid samples extracted by ultrasonic extraction are not mixed with those extracted by Soxhlet.

25.6.2.3 The laboratory should try and avoid discarding data that do not meet a preconceived notion of acceptable performance. This results in a censored data set, which, when used to develop acceptance criteria, will lead to unrealistically narrow criteria. For a 99% confidence interval, 1 out of every 100 observations likely will still fall outside the limits. For methods with long analyte lists this may mean occasional failures every batch or two. While professional judgment is important in evaluating data to be used to develop acceptance criteria, specific results are not discarded simply because they do not meet one's expectations. However, data points shall be discarded if they were the result of human or mechanical error or sample concentration exceeded spike level by > 4x.

25.6.3 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).

25.6.3.1 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).

25.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method.

25.6.3.3 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.

25.6.3.4 The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

25.6.3.5 If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

25.6.4 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.

25.6.4.1 Control limits are generated within the LIMS system. Once these are reviewed, the control limits are stored with in a LIMS Method limit Group. The TALS LIMS system maintains an archive of all limits used within the laboratory. These are set up and under the control of the QA department. Any time a limit is updated a historical record with activation and expiration date is generated for the limit type. Archived limits can be exported to excel at any time by utilizing the “Historical” button in the Method Limit Group.

25.6.5 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:

25.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

25.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

25.6.5.3 Or, for NELAC and Departement Of Defense (DOD) work, there are an allowable number of Marginal Exceedances (ME):

- <11 analytes – 0 marginal exceedances are allowed.
- 11 – 30 Analytes – 1 marginal exceedance is allowed
- 31-50 Analytes – 2 marginal exceedances are allowed
- 51-70 Analytes – 3 marginal exceedances are allowed
- 71-90 Analytes – 4 marginal exceedances are allowed
- > 90 Analytes – 5 marginal exceedances are allowed

25.6.5.3.1 Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (NELAC).

25.6.5.3.2 Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.

25.6.5.3.3 Though marginal excedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

25.6.6 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 Appendix 4 and in Section 13.

25.6.7 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).

25.7 METHOD DETECTION LIMITS (MDLs)

MDLs, calculated as described in Section 20.7, are updated or verified annually, or more often if required by the method.

25.8 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

25.8.1 The laboratory has written procedures to assure the accuracy of the test method including calibration (see Section 21), use of certified reference materials (see Section 22) and use of PT samples (see Section 16).

25.8.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 20.

25.8.3 Use of formulae to reduce data is discussed in the method standard operating procedures and in Section 21.

25.8.4 Selection of appropriate reagents and standards is included in Section 9 and 22.

25.8.5 A discussion on selectivity of the test is included in Section 5.

25.8.6 Constant and consistent test conditions are discussed in Section 19.

25.8.7 The laboratories sample acceptance policy is included in Section 24.

SECTION 26.0

REPORTING RESULTS
(NELAC 5.5.10)

26.1 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 a conflict between the client requested formats and accreditation requirements or data usability information, accreditation requirements and data usability information will take precedence over client requests. 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 20.

26.2 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, reviewed, and signed by the appropriate signatory. At a minimum, the standard laboratory report shall contain the following information:

26.2.1 A report title (e.g. Analytical Report) with a “results” column header.

26.2.2 Each report cover page is printed with the company logo, and also includes the laboratory name, address and telephone number.

26.2.3 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 page # of ##. Where the first number is the page number and the second is the total number of pages.

26.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.
- Any additional addenda to the report must be treated in a similar fashion so it is a recognizable part of the report and cannot accidentally get separated from the report (eg. Sampling information).

26.2.5 The name and address of client and a project name/number, if applicable.

26.2.6 Client project manager or other contact

26.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

26.2.8 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.

26.2.9 Date reported or date of revision, if applicable.

26.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

26.2.11 Practical quantitation limits or reporting limit.

26.2.12 Method detection limits (if requested)

26.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

26.2.14 Sample results.

26.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

26.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 26.2.4 – Item 3 regarding additional addenda). NCMs are generated within LIMS and pulled into the job narrative.

26.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

26.2.18 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory.

26.2.19 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.

26.2.20 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.

26.2.21 The laboratory includes a cover letter.

26.2.22 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.

26.2.23 When Soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

26.2.24 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

26.2.25 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, and that a complete report will follow once all of the work has been completed.

26.2.26 Any out of network subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All in-network subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

26.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Connecticut 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 26.2 above.
- Level II is a Level I report plus QC summary information, including results for the method blank, Surrogate recoveries where applicable, 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 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.

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.

26.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica’s services. TestAmerica Connecticut offers a variety of EDD formats including but not limited to, Environmental Restoration Information Management System (ERPIMS),NJ Haz Site, Standard Excel, Dbase, GISKEY, and EQuis.

EDD specifications are submitted to the IT department by the Data Reporting Department for review. 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.

26.4 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. Refer to Appendix 7 for a list of the laboratory's standard footnotes and qualifiers.

26.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

26.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications, including identification of test results derived from any sample that did not meet NELAC sample acceptance requirements such as improper container, holding time, or temperature.

26.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

26.4.4 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.

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.

26.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If TestAmerica Connecticut 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 the TestAmerica network are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

26.6 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.

26.6.1 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 facsimile is strictly prohibited. If you have received this communication in error, please notify the sender. Thank you for your professional consideration and cooperation.

26.7 FORMAT OF REPORTS

The format of reports are designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

26.8 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 13).

The revised report is stored in the LIMS server under the Job Deliverables and identified with the revision number.

When the report is re-issued, a notation of "Revision # " 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.

26.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

26.9.1 Sample Reanalysis Policy

Because there is a certain level of uncertainty with any analytical measurement a sample 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 arrangements for reanalysis protocols can be established.

- 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 Manager or Laboratory Director if unsure.

26.9.2 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.

26.9.3 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
ETHICS POLICY No. CA-L-P-001

Refer to CA-L-P-001 for complete policy.

TestAmerica
EMPLOYEE ETHICS STATEMENT

I understand that TestAmerica is committed to ensuring the highest standard of quality and integrity of the data and services provided to our clients. I have read the Ethics Policy of the Company.

- *With regard to the duties I perform and the data I report in connection with my employment at the Company, I agree that:*
- *I will not intentionally report data values that are inconsistent with the actual values observed or measured.*
- *I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations.*
- *I will not intentionally misrepresent another individual's work as my own or represent my own work as someone else's.*
- *I will not intentionally misrepresent any data where data does not meet Method or QC requirements. If it is to be reported, I will report it with all appropriate notes and/or qualifiers; I shall not modify data (either sample or QC data) unless the modification can be technically justified through a measurable analytical process, such as one deemed acceptable to the laboratory's Standard Operating Procedures, Quality Assurance Manual or Technical Director. All such modifications must be clearly and thoroughly documented in the appropriate laboratory notebooks/worksheets and/or raw data and include my initials or signature and date.*
- *I shall not make false statements to, or seek to otherwise deceive, members of Management or their representatives, agents, or clients/customers. I will not, through acts of commission, omission, erasure, or destruction, improperly report measurement standards, quality control data, test results or conclusions.*
- *I shall not compare or disclose results for any Performance Testing (PT) sample, or other similar QA or QC requirements, with any employee of any other laboratory, including any other TestAmerica laboratory, prior to the required submission date of the results to the person, organization, or entity supplying the PT sample.*
- *I shall immediately inform my supervisor or other member of management regarding any intentional or unintentional reporting of my own inauthentic data. Such report shall be given both orally and in writing to the supervisor or other member of management contacted and to the local Quality Assurance Manager. The Quality Assurance Manager will initial and date the information and return a copy to me. I shall not condone any accidental or intentional reporting of inauthentic data by other employees and will immediately report its occurrence. If I have actual knowledge of such acts committed by any other employees, and I do not report such information to designated members of Management, it shall be considered as serious as if I personally committed the offense. Accordingly, in that event, I understand that I may be subject to immediate termination of employment.*
- *I understand that if any supervisor, manager, or representative of TestAmerica management instructs, requests, or directs me to perform any of the aforementioned improper laboratory practices, or if I am in doubt or uncertain as to whether or not such laboratory practices are proper, I will not*

comply. In fact, I must report such event to all appropriate members of Management including, but not limited to, the Lab Director, all supervisors and managers with direct line reporting relationship between me and the Lab Director, and the local Quality Assurance representative, excluding such individuals who participated in such perceived improper instruction, request, or directive. In addition, I may contact Corporate Quality Assurance / Ethics Compliance Officer(s) for assistance.

- *I understand the critical importance of accurately reporting data, measurements, and results, whether initially requested by a client, or retained by TestAmerica and submitted to a client at a later date, or retained by TestAmerica for subsequent internal use;*
- *I will not share the pricing or cost data of Vendors or Suppliers with anyone outside of the TestAmerica family of companies.*
- *I shall not accept gifts of a value that would adversely influence judgment.*
- *I shall avoid conflicts of interest and report any potential conflicts to the management (e.g. employment or consulting with competitors, clients, or vendors).*
- *I shall not participate in unfair competition practices (e.g. slandering competitors, collusion with other labs to restrict others from bidding on projects).*
- *I shall not misrepresent certifications and status of certifications to clients or regulators.*
- *I shall not intentionally discharge wastes illegally down the drain or onto the ground.*
- *I understand that any attempt by management or an employee to circumvent these policies will be subject to disciplinary action.*

As a TestAmerica employee, I understand that I have the responsibility to conduct myself with integrity in accordance with the ethical standards described in the Ethics Policy. I will also report any information relating to possible kickbacks or violations of the Procurement Integrity Act, or other questionable conduct in the course of sales or purchasing activities. I will not knowingly participate in any such activity and will report any actual or suspected violation of this policy to management.

I understand that if my job includes supervisory responsibilities, I shall not instruct, request, or direct any subordinate to perform any laboratory practice which is unethical or improper. Also, I shall not discourage, intimidate, or inhibit an employee who may choose to appropriately appeal my supervisory instruction, request, or directive which the employee perceives to be improper, nor retaliate against those who do.

The Ethics Policy has been explained to me by my supervisor or at a training session, and I have had the opportunity to ask questions if I did not understand any part of it. I understand that any violation of this policy subjects me to disciplinary action, which can include termination of my employment. In addition, I understand that any violation of this policy which relates to work under a government contract or subcontract could also subject me to the potential for prosecution under federal law.

EMPLOYEE SIGNATURE _____ Date _____

Supervisor/Trainer: _____ Date _____

TestAmerica
CONFIDENTIALITY AND PROPRIETARY INFORMATION AGREEMENT

TestAmerica and their predecessors, in their businesses, have developed and use commercially valuable technical and non-technical information and to guard the legitimate interests of TestAmerica and its clients, it is necessary to protect certain information as confidential and proprietary.

I, _____ , understand and acknowledge that during the term of my employment by TestAmerica, I will be privy to and entrusted with certain confidential information and trade secrets of TestAmerica and its clients.

Confidential information and trade secrets include, but are not limited to: customer and client lists; price lists; marketing and sales strategies and procedures; operational and equipment techniques; standard operating procedures; business plans and systems; quality control procedures and systems; special projects and technological research, including projects, research and reports for any government entity or client; client's plans and processes; client's manner of operation; the trade secrets of clients; client's data; vendor or supplier pricing; employee lists and personal information, and any other records, data, files, drawings, inventions, discoveries, applications, or processes which are not in the public domain.

I agree as follows:

1. I will not in any way, during the term of my employment, or at any time thereafter, except as authorized in writing by the Legal Department of TestAmerica or the client where client data is involved, disclose to others, use for my own benefit, remove from TestAmerica's premises (except to the extent off-site work is approved by my supervisor), copy or make notes of any confidential information and/or trade secrets of TestAmerica or its clients, excepting only that information which may be public knowledge. Technical and business information of any previous employer or other third party which I may disclose to TestAmerica shall be limited to that which was acquired legitimately and disclosed to me without restriction as to secrecy.

2. I agree that all inventions (whether or not patentable) conceived or made by me during the period of my employment by TestAmerica shall belong to TestAmerica, provided such inventions grow out of my work for TestAmerica and are related to the business of TestAmerica. I agree to disclose and assign such inventions to TestAmerica. In California, this provision shall not apply to any invention which qualifies fully under Section 2870 of the California Labor Code.

3. On termination of my employment from TestAmerica, I will deliver to TestAmerica all documents, records, notes, data, memoranda, files, manuals, equipment and things of any nature which relate in any way to confidential information and/or trade secrets of TestAmerica or its clients and which are in my possession or under my control.

4. I agree that during the period of my employment and for one (1) year from and after the termination (for any reason) of my employment with TestAmerica, I shall not directly or indirectly (without first obtaining the written permission of TestAmerica), recruit for employment, or induce to terminate his or her employment with TestAmerica, any person who is an active employee of TestAmerica on the last day of my employment with TestAmerica.

5. I acknowledge that if I were to breach any provision of this Confidentiality Agreement, money damages will be inadequate, and I hereby agree that TestAmerica shall be entitled, where appropriate, to specific performance and/or injunctive relief (i.e. to require me to comply with this Agreement). I further acknowledge that the willingness of TestAmerica to hire me or to continue my employment constitutes full and adequate consideration for the agreements, and obligations to which I have agreed as set forth in this document.

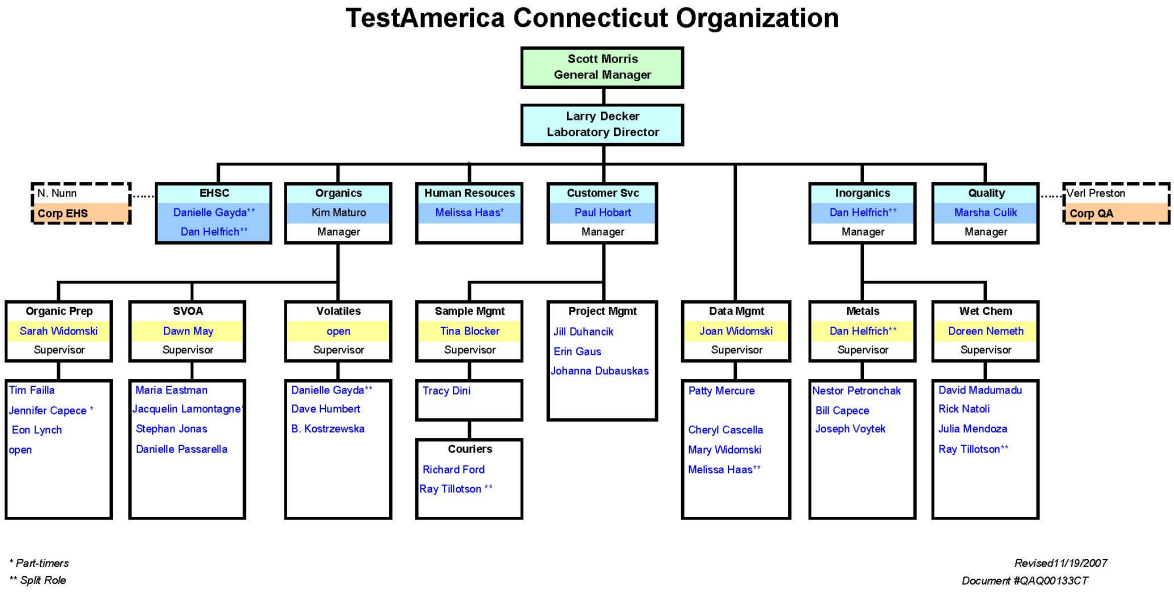
I have executed this Agreement, intending to be legally bound.

_____	_____	_____
Printed Name	*Signature*	*Date*

Appendix 2.

Example Laboratory Organization Chart

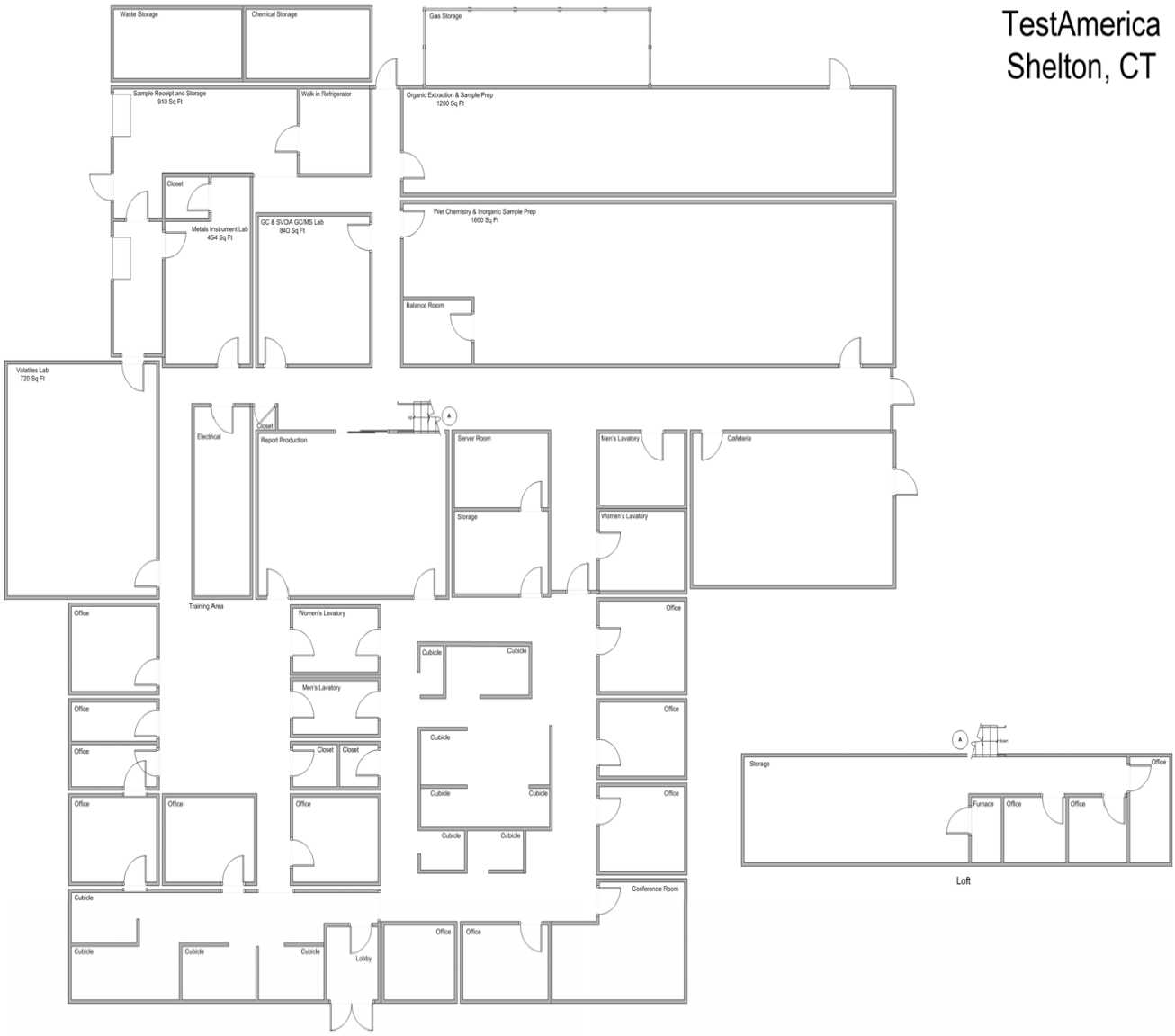
(The most current chart can be obtained from the QA Manager or Lab Director/Manager)



Appendix 3.

Laboratory Floor Plan

TestAmerica
Shelton, CT



Appendix 4: Summary of Calibration and QC Procedures for GC Organics

Method	QC Check	Frequency	Acceptance Criteria[3]	Corrective Action[4]
SW8081 SW8082	Minimum five-point initial calibration for all target analytes[2]	Initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	RSD of CF of each analyte • 20% Linear – $r^2 \geq 0.990$, r • 0.990	Correct problem then repeat initial calibration
	Initial calibration verification (ICV) must be from a 2nd source	Once immediately following initial calibration	All target analytes within 25% of expected value	Correct problem then repeat initial calibration
	Continuing calibration verification (CCV)	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 15% of expected value and within the RT Window.	Correct problem then repeat initial CCV (re-calibrate if necessary) and re-analyze all samples since last successful CCV.
	Breakdown check (Endrin and DDT)[1]	Before sample analysis	Degradation ≤15% for either Endrin or DDT.	Inlet/column maintenance; repeat breakdown check and re-analyze all samples since last successful breakdown check.
	Method blank	One per analytical prep batch, not to exceed 20 samples in a batch.	No analytes detected ≥ ½ RL	Correct problem then re-prep[6] and analyze method blank and all samples processed with the contaminated blank
	LCS for all analytes, must be from a 2nd source.	One per prep batch, not to exceed 20 samples in a batch.	See LIMS Control Limits	Re-prep[6] and analyze the LCS and all samples in the affected analytical batch
	Surrogate(s)	Every sample, spike, standard, and method blank	See LIMS Control Limits	Check system, re-inject, re-extract[6]
	MS/MSD, must be from a 2nd source.	One per batch per matrix,	See LIMS Control Limits	None (LCS is used to determine if data is acceptable).
	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis. If the relative % difference of results between the 2 columns is greater than 40%, a comment should be placed in LIMS.
	Retention time window calculated for each analyte (see section 9 for how to calculate RTWs).	System set-up, with each new column or major instrument maintenance. Update the mid-RTW at the start of the run or daily.	Each analyte of the LCS, MS/MSD and CCV must be within the calculated RTW.	Correct the problem and re-process or re-analyze samples. If questions, see the supervisor or technical director.
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Department Manager.

1 --8081A only
2 – Method 8082, a five-point calibration is only analyzed for Aroclors 1016 and 1260.
3 - This is a summary of the acceptance criteria, refer to the method SOP for specific or more information.
4 - All abnormalities must be noted on the data, the benchsheet, and in LIMS.
5 - Report all target compounds identified in the method blank above the MDL.
6 - If unable to re-extract the samples because of insufficient sample volume or holding time has expired, then NCM is generated in LIMS.

Appendix 4: Summary of Calibration and QC Procedures for GC Organics

Method	QC Check	Frequency	Acceptance Criteria[3]	Corrective Action[4]
EPA608	Minimum three-point (preferably five) initial calibration for all target analytes	Initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	RSD of CF of each analyte • 20% Linear – $r^2 \geq 0.990$, r • 0.990	Correct problem then repeat initial calibration
	Initial calibration verification (ICV) must be from a 2nd source.	Immediately following initial calibration	All analytes within 25% of expected value	Correct problem then repeat initial calibration
	Continuing calibration verification (CCV)	Before sample analysis	All analytes within **15% of expected value** and within the RTW. 608 must be within 15% of the true value.	Correct problem then repeat initial CCV (re-calibrate if necessary) and re-analyze all samples since last successful CCV.
	Breakdown check (Endrin and DDT)[1]	Before sample analysis	Degradation ≤15% for either Endrin or DDT.	Inlet/column maintenance; repeat breakdown check and re-analyze all samples since last successful breakdown check.
	Method blank	One per analytical prep batch	No analytes detected ≥ ½ RL or MDL, whichever is greater[6]	Correct problem then re-prep[7] and analyze method blank and all samples processed with the contaminated blank
	LCS (QC check standard) must be from a 2nd source.	One per prep batch	See LIMS Control Limits	Re-prep[7] and analyze the LCS and all samples in the affected analytical batch
	Surrogate(s)	Every sample, spiked sample, standard, and method blank	See LIMS Control Limits	Check system, re-inject, re-extract[7]
	MS	One per batch per matrix, 10%,	See LIMS Control Limits	All target compounds should be reported, and any compounds that are outside criteria must be within criteria in the LCS.
	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis. If the relative % difference of results between the 2 columns is greater than 40%, a comment should be placed in LIMS.
	Retention time window calculated for each analyte (see section 9 for how to calculate RTWs).	System set-up, with each new column or major instrument maintenance. Update the mid-RTW at the start of the run or as needed.	Each analyte of the LCS, MS/MSD and CCV must be within the calculated RTW.	Correct the problem and re-process or re-analyze samples. If questions, see the supervisor or technical director.
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Department Manager.

3 - This is a summary of the acceptance criteria, refer to the method SOP for specific or more information.
4 - All abnormalities must be noted on the data, the benchsheet, and in LIMS.
6 - Report all target compounds identified in the method blank above the MDL.
7 - If unable to re-extract the samples because of insufficient sample volume or holding time has expired, then place a comment on the benchsheet and in LIMS.

Appendix 4: Summary of Calibration and QC Procedures for GC/MS Organics

Method	QC Check	Frequency	Acceptance Criteria[2]	Corrective Action[3]
SW8260 SW8270	Check of mass spectral ion intensities[1], i.e., Tune	Prior to initial calibration or Continuing calibration verification, every 12 hours	Refer to criteria listed in the method SOP for Tune criteria, including DDT, Benzidine and Pentachlorophenol requirements for 8270.	Retune the instrument and verify (instrument maintenance may be needed).
SW8260	Minimum five-point initial calibration for all target analytes	Initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	SPCCs average RF ≥ 0.30 or 0.1 depending on the compound and %RSD for RFs for CCCs ≤ 30% and all other target analytes %RSD for RF ≤ 15%.	Correct problem then repeat initial calibration
SW8270			SPCCs average RF ≥ 0.050 and %RSD for RFs for CCCs ≤ 30% and all other target analytes %RSD for RF ≤ 15%.	Correct problem then repeat initial calibration
			option (if %RSD is > 15%)–linear regression $r^2 \geq 0.990$, r • 0.990.	If the calibration is not considered linear by either %RSD or linear regression, then correct the problem and re-calibrate.
SW8260 SW8270	Initial calibration verification (ICV) must be from a 2nd source.	Immediately following five-point initial calibration	All analytes within 20% of expected value	Correct problem then repeat initial calibration
	Relative Retention time window	Each sample	Relative retention time (RRT) of the analyte within 0.06 RRT units of the RRT of the internal standard	Correct problem then reprocess or re-analyze all samples analyzed since the last retention time check
SW8260	Continuing calibration verification (CCV)	Daily, before sample analysis and every 12 hours of analysis time	SPCCs average RF ≥ 0.30 or 0.1 depending on the compound; and	Correct problem then repeat initial calibration and re-analyze all samples since last successful CCV.
SW8270			SPCCs average RF ≥ 0.050; and	
SW8260 SW8270	Continuing calibration check		CCCs: ≤20% difference (when using RFs) or drift (when using least squares regression). **All other target compounds ≤20%, up to 5 non-CCC target compounds, may fail this requirement provided the % difference is • 40%.**	
SW8260 SW8270	Method blank	One per analytical prep batch	No analytes detected ≥ ½ RL, with the exception of the common lab contaminates. (reference SOPs)	Correct problem then re-prep[5] and analyze method blank and all samples processed with the contaminated blank

Method	QC Check	Frequency	Acceptance Criteria[2]	Corrective Action[3]
SW8260 SW8270	Internal Standards	Every sample/standard and blank	Retention time ±30 seconds from retention time of the mid-point std. in the CCV/ICAL (sample/standard). EICP area within -50% to +100% of ICAL mid-point std for the CCV and –50% to +100% of the prior CCV for the samples.	Inspect mass spectrometer and GC for malfunctions; mandatory re-analysis of samples analyzed while system was malfunctioning (dilution of the sample may be required, see the supervisor or the technical director for advice).
	LCS for all analytes must be from a 2nd source.	One per prep batch, not to exceed the 20 samples in a batch.	See LIMS Control Limits	Correct problem then re-prep[5] and analyze the LCS and all samples in the affected analytical batch
	MS/MSD must be from a 2nd source.	One per batch per matrix	See LIMS Control Limits	None (the LCS is used to evaluate to determine if the batch is acceptable).
	Surrogate(s)	Every sample, spike, standard, and blank	See LIMS Control Limits	Check system, re-analyze, re-prep[5]
SW8260	pH check	All 8260 water samples.	pH • 2.	If the pH is > 2, then comment the data, and generate NCM in LIMS.
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Department Manager.

1 – SW8260B requires BFB; SW8270C requires DFTPP
2 - This is a summary of the acceptance criteria, refer to the method SOP for specific or more information.
3 - All abnormalities must be noted on the data, the benchsheet, and in LIMS.
4 - Report all target compounds identified in the method blank above the MDL.
5 - If unable to re-prep samples because of insufficient sample volume or the holding time has expired, then place a comment on the benchsheet, and in LIMS.

Appendix 4: Summary of Calibration and QC Procedures for GC/MS Organics

Method	QC Check	Frequency	Acceptance Criteria[2]	Corrective Action[3]
EPA624 EPA625	Check of mass spectral ion intensities[1] (i.e. Tune)	Prior to initial calibration or Continuing calibration verification every 12 hours.	Refer to criteria listed in the method SOP for Tune requirements including DDT, Benzidine and Pentachlorophenol criteria for 625.	Retune instrument and verify instrument maintenance may be needed.
	Five- point initial calibration for all target analytes	Initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	%RSD < 35%, if %RSD is > 35% then linear regression is used (for linear regression $r^2 \geq 0.990$), r • 0.990.	If the calibration is not considered linear by either %RSD or linear regression, then correct problem then repeat initial calibration
	Initial calibration verification (ICV), 20 ug/L, must be from a 2nd source. May be the same as the LCS.	Immediately following initial calibration	See LIMS Control Limits	Correct problem then repeat initial calibration
	Relative Retention time window	Each sample	Retention time (RT) of the analyte within 30 seconds of the RT (± 0.25 min. RTW is used) of the target.	Correct problem then reprocess or re-analyze all samples analyzed since the last retention time check
EPA625	Continuing calibration verification (CCV)	Daily, before sample analysis and every 12 hours of analysis time.	All calibration analytes within 20% of expected value	Correct problem then repeat initial calibration and re-analyze all samples since last successful CCV.
EPA624 EPA625	Method blank	One per prep batch (not to exceed 20 samples per batch).	No analytes detected ≥ ½ RL or MDL, whichever is greater[4]	Correct problem then re-prep[5] and analyze method blank and all samples processed with the contaminated blank
	LCS for all analytes, 20 ug/L, must be from a 2nd source. May be the same as the ICV.	One per prep batch (not to exceed 20 samples per batch) or daily.	See LIMS Control Limits	Correct problem then re-prep[5] and analyze the LCS and all samples in the affected analytical batch
	MS must be from a 2nd source.	One per batch of 20 per matrix, if insufficient sample for MS, then a duplicate LCS will be analyzed.	See LIMS Control Limits	All target compounds should be reported, and any compound that is outside criteria must be within criteria in the LCS.
	Surrogate(s)	Every sample, spiked sample, standard, and method blank	See LIMS Control Limits	Correct problem then re-prep[5] and analyze sample
EPA624 EPA625	Internal Standards	Every sample/standard	Retention time ±30 seconds from retention time of the mid-point std. in the CCV/ICAL (sample/standard). EICP area within -50% to +100% of ICAL mid-point std for the CCV and –50% to +100% of the prior CCV for the samples.	Inspect mass spectrometer and GC for malfunctions; mandatory re-analysis of samples analyzed while system was malfunctioning (dilution of the sample may be required, see the supervisor or the technical director for advice).
EPA624	pH check	All 624 samples after analysis	pH should be • 2.	If the pH is > 2, then comment the data, in the PIPE database, and LIMS.

Method	QC Check	Frequency	Acceptance Criteria[2]	Corrective Action[3]
EPA624	Residual chlorine check (North Carolina samples only)	All samples after analysis	Residual chlorine should be negative.	If the residual chlorine is positive, then comment the data, in the PIPE database, and LIMS.
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 – 624 requires BFB; 625 requires DFTPP
2 - This is summary of the acceptance criteria, refer to the method SOP for specific or more information.
3 - All abnormalities must be noted on the data, the benchsheet and in LIMS.
4 - Report all target compounds identified in the method blank above the MDL.
5 - If unable to re-prep samples because of insufficient sample volume or holding time has expired, then place a comment on the benchsheet and in LIMS.

Appendix 4: Summary of Calibration and QC Procedures for Method SW8015B

Method	QC Check	Frequency	Acceptance Criteria[1]	Corrective Action[2]
CT ETPH SW8015[5]	Five-point initial calibration for all target analytes	Initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	RSD of CF • 20% Linear – least squares regression r^2 ≥ 0.990, r • 0.990	Correct problem then repeat initial calibration
	Initial calibration verification (ICV), must be from a 2nd source.	Immediately following five-point initial calibration	All analytes within 15% of expected value	Correct problem then repeat initial calibration
	LCS for all analytes must be from a 2nd source.	One per prep batch, not to exceed 20 samples in a batch.	See Control Limits Manual	Re-prep[4] and analyze the LCS and all samples in the affected analytical batch
	Continuing calibration verification (CCV)	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 15% of expected value and within the RTW.	Correct problem then repeat initial CCV (re-calibrate if necessary) and re-analyze all samples since last successful CCV.
	Method blank	One per analytical prep batch, not to exceed 20 samples in a batch.	No analytes detected ≥ RL	Correct problem then re-prep[4] and analyze method blank and all samples processed with the contaminated blank
	Surrogate	Every sample, spiked sample, standard, and method blank	See Control Limits Manual	Check system, re-analyze, re-prep[4]
	MS/MSD must be from a 2nd source.	One per batch per matrix	See Control Limits Manual	None (LCS is used to determine if data is acceptable).
	GC/MS confirmation.	At the clients request or analyst judgment.		
	Retention time window calculated for each analyte (see section 9 for how to calculate RTWs).	System set-up, with each new column or major instrument maintenance. Update the mid-RTW as the start of the run or daily.	Each analyte of the LCS, MS/MSD and CCV must be within the calculated RTW.	Correct the problem and re-process or re-analyze samples. For questions, see the supervisor or technical director.
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - This is a summary of the acceptance criteria, refer to the method SOP for specific or more information.
2 - All abnormalities must be noted on the data, the benchsheet and in LIMS.
3 - Report all target compounds identified in the method blank above the MDL.
4 - If unable to re-prep the samples because of insufficient sample volume or holding time has expired, then place a comment on the benchsheet and in LIMS.
5 - For DRO, see state specific SOP/Method for acceptance criteria. If there is not a specific method for that state, then follow the acceptance criteria in this table.

Appendix 4: Summary of Calibration and QC Procedures for Method SW6010

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW6010	Initial calibration (minimum 1 standard and a blank)	Daily initial calibration prior to sample analysis.	N/A	N/A
	Second-source calibration verification (ICV)	Daily after initial calibration	All analytes within 10% of expected value	Correct problem then repeat initial calibration
	Calibration blank (CB)	After every continuing calibration verification	Must be <3 times the MDL	Correct problem then analyze calibration blank and previous 10 samples
	Continuing calibration verification (CCV)	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 10% of expected value and RSD of replicate integrations <5%	Repeat calibration and re-analyze all samples since last successful calibration
	Method blank	One per prep batch	No analytes detected >½ RL	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank
	Interference check solution (ICS)	At the beginning of an analytical run	Within 20% of expected value	Terminate analysis; correct problem; re-analyze ICS; re-analyze all affected samples
	LCS	One per prep batch	Within 20% of expected value	Correct problem then re-prep and analyze the LCS and all samples in the affected analytical batch
	MS	One per batch per matrix	Recovery within 25% of expected results	None
	Duplicate	One per batch per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Flag Sample data
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.
	Dilution test	Each new sample matrix	1:5 dilution must agree within 10% of the original determination	Perform post digestion spike addition
	Post digestion spike addition	When dilution test fails	Recovery within 25% of expected results	Correct problem then re-analyze post digestion spike addition

1 – Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Method SW7196

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW7196	Initial calibration (minimum three standards and a blank)	Initial calibration prior to sample analysis.	r ≥ 0.995 for linear regression	Correct problem then repeat initial calibration
	ICV	Immediately following initial calibration	90-110%	Correct problem then repeat initial calibration
	Continuing calibration verification (CCV)	Beginning and after every 10 samples and at the end of the analysis sequence	90-110%	Correct problem then repeat initial calibration and re-analyze all samples since last successful calibration
	Method blank	One per prep batch	No anlaytes detected > RL	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank
	Duplicate	One per 10 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MS	One per 20 samples per matrix	75-125% or no criteria if sample result >4x's spike added	Dilute the sample tenfold and spike to verify matrix interference
	LCS	Second source-one per batch	85-115%	Re-prep; reanalyze all affected samples.
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Method SW7470/SW7471

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW7470 SW7471	Initial calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	r ≥0.995 for linear regression	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.
	Second-source calibration verification (ICV)	Immediately following initial daily calibration	Analytes within 10% of expected value	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.
	Calibration blank	Once per initial daily calibration	No analytes detected > MDL	Correct problem then re-digest and re-analyze calibration and entire digestion batch
	Continuing calibration verification (CCV)	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	Analytes within 20% of expected value	Correct problem then repeat all QC and samples since last successful calibration. If the CCV fails again upon reanalysis, reprep the entire digestion batch.
	Method blank	One per prep batch	No analytes detected >½ RL	Correct problem then re-prep and analyze method blank, all samples, and QC processed with the contaminated blank
	LCS	One per prep batch	Aqueous ± 20%. Soil -See LIMS Limits Manual	Correct problem then re-prep and analyze the LCS, all samples, and QC in the affected analytical batch
	Matrix Spike	One per batch of 20 samples	All analytes within 25% of expected value	Flag Sample data
	Duplicate	One per batch per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Flag Sample data
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Method SW9010/SW9012/ EPA-335.4

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW9012 EPA-335.4 SM 4500-CN G	Initial calibration (six standards and a calibration blank)	Initial daily calibration prior to sample analysis.	$r \geq 0.995$ for linear regression	Correct problem then repeat initial calibration
	Distilled standards (one high and one low)	Once per calibration	Analytes within 10% of true value	Correct problem then repeat distilled standards
	Second-source calibration verification (ICV)	Immediately following initial daily calibration	Analytes within 15% of expected value	Correct problem then repeat initial calibration
	Continuing calibration verification (CCV)	Beginning and after every 10 samples and at the end of the analysis sequence	Analytes within 15% of expected value	Correct problem then repeat initial Continuing calibration verification and re-analyze all samples since last successful Continuing calibration verification
	Method blank	One per prep batch	No analytes detected > RL	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank
	LCS (soils)	One per batch per matrix	Manufacturer's recommended acceptable range	Re-prep, re-run affected samples
	Duplicate	One per 10 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MS	One per batch per matrix	75-125% or no criteria if sample result >4x's spike added	Analyze Post Digest Spike
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Mercury

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
EPA245.1	Initial calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	r ≥ 0.995 for linear regression	Correct problem then repeat initial calibration
	Second-source calibration verification (ICV)	Immediately following five-point initial calibration	Analyte within 5% of expected value	Correct problem then repeat initial calibration
	Calibration blank	Once per initial daily calibration	No analytes detected ≥ MDL	Correct problem then re-analyze calibration blank and all samples associated with blank
	Continuing calibration verification (CCV)	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	Analyte within 10% of true value	Correct problem then repeat calibration and re-analyze all samples and QC since last successful calibration
	LCS	One per prep batch	All analytes within 15% of expected value	Correct problem then re-prep and analyze the LCS, all samples, and QC in the affected analytical batch
	Matrix Spike	One per batch or 10 samples	All analytes within 30% of expected value	Flag Sample data
	Duplicate	One per batch per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Flag Sample data
	Method Blank	One per batch	No analytes > RL	Reprep
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for ICP Metals

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
EPA200.7	Initial calibration (minimum 1 standard and a blank)	Daily initial calibration prior to sample analysis.	N/A	N/A
	Second-source calibration verification (ICV)	Each calibration	Value of all analytes within 5% of expected value	Correct problem then repeat initial calibration
	Linear Dynamic Range	Once annually	All analytes within 10% of expected value	Calibration range lowered to meet LDR results
	Calibration blank	After every Continuing calibration verification	Must be <3 times the MDL	Correct problem then analyze calibration blank and previous 10 samples
	Continuing calibration verification (CCV)	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 10%	Repeat calibration and re-analyze all samples since last successful calibration
	Method blank	One per prep batch	No analytes detected > RL	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank
	Interference check solution (ICS)	At the beginning of an analytical run, daily	Within 20% of expected value	Terminate analysis; correct problem; re-analyze ICS; re-analyze all affected samples
	LCS	One per prep batch	All analytes within 15% of expected value	Correct problem then re-prep and analyze the LCS and all samples in the affected analytical batch
	Dilution test	Each new sample matrix	1:5 dilution must agree within 10% of the original determination	Perform post digestion spike addition
	Post digestion spike addition	When dilution test fails	Recovery within 25% of expected results	Correct problem then re-analyze post digestion spike addition
	Matrix Spike	One per batch of 20 samples	All analytes within 25% of expected value	Flag Sample data
	Duplicate	One per batch per matrix	RPD: $\leq$20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be $\leq$the RL	Flag Sample data
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Gravimetric Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SM2540 C (TDS) SM 2540 D (TSS) SM 2540 B (TS) EPA160.4 (TVS) SM2520B (salinity)	Verification standard– single standard (if available)	Each batch	Manufacturer's recommended acceptable range	Repeat
	Method blank	Each batch	No analytes detected > RL	Repeat, rerun
	Duplicate	One per 10 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Titrimetric Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Alkalinity. SM2320: HCO_3-, CO_3^{2-}. SM4500-S^{2-}	LCS (if available)	Each batch	85-115%	Repeat, check
	Method blank	Each batch	<RL	Repeat batch
	Duplicate	One per 10 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MS (if applicable)	One per batch per matrix	75-125% or no criteria if sample result >4x's spike added	reanalyze
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Spectrophotometric Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
EPA350.1: NH_3. EPA410.4: COD. SM4500-Cl^- G -Cl_2 Res. SM5310 C: TOC. EPA9060: TOC. EPA351.2:TKN EPA365.3, SM4500-P E: Phosphorus EPA420.2: Phenols	Calibration curve – minimum 5 point	Initial. Perform re-calibration once per year minimum.	r • 0.995	Recalibrate
	ICV	Immediately following initial calibration.	90-110% 85-115% for TKN and TOC	Recalibrate
	Continuing calibration verification (CCV)	Beginning, every 10 samples, and at end of sequence	90-110% 85-115% for TKN and TOC	Correct, recalibrate
	Method blank	Each use	No analyte detected > RL	Reprep, rerun
	Duplicate	One per 10 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MS (if applicable)	One per batch per matrix	75-125% or no criteria if sample result >4x's spike added	Reanalyze or perform Post Digest Spike per method guidance
	LCS (if applicable)	Each batch	85-115%	Rerun
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Electrometric Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Sm 5210 B: BOD, CBOD[1]. EPA120.1: SM2510B Cond. [1] SM4500-O G: DO[1]. SM4500-H+B: pH. [1] SW9040, 9045:pH[1]. EPA180.1: Turbidity.	Calibration Curve – minimum of 5 standards (if applicable)	Initial Calibration. Perform calibration daily.	r • 0.995.	Recalibrate
	Initial calibration verification (ICV) (if applicable)	Immediately after calibration	90-110%	Recalibrate
	Continuing calibration verification (CCV) (if applicable)	Beginning, every 10 samples, and end of batch	90-110%	Rerun
	Method blank	Each batch	No analyte detected > RL	Reprep (if applicable)
	LCS (if applicable)	Each batch	85-115%	Rerun batch
	MS (if applicable)	Each batch	75-125%	None
	Duplicate	One per 10 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MDL verification (if applicable)	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

[1]Calibration curve does not apply.
2 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Ion Chromatographic Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
EPA300 & SW9056: Bromide Chloride Fluoride Nitrate Nitrite Sulfate.	Calibration Curve – Minimum 5-point calibration	Initial calibration. Perform instrument re-calibration once per year minimum.	RSD ± 10%, r • 0.995.	Recalibrate
	Calibration verification (ICV), second source	Immediately following initial calibration	±10%	Recalibrate
	Continuing calibration verification (CCV)	Each use, beginning, every 10 samples, end of batch	± 10%	Rerun affected samples
	Method blank	Each batch	No analyte detected >RL	Rerun batch
	LCS	Each batch	85-115%	Rerun batch
	MS	Each batch	80-120%	Rerun
	Duplicate	One per 20 samples per matrix	RPD: ≤20% for samples >5x's RL; for samples <5x's the RL, the difference between the two results must be ≤the RL	Reanalyze the sample and duplicate
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1-Report all targets identified in the method blank above the MDL

Appendix 4: Summary of Calibration and QC Procedures for Oil & Grease Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
1664 Oil & Grease	Method blank	Each batch	No analyte detected > RL	Repeat batch (if applicable)
	LCS	Each batch	See Control Limits Manual	Repeat batch
	MS	Each batch	75-125%	Repeat (if applicable)
	MDL verification	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

1 - Report all targets identified in the method blank above the MDL.

Appendix 4: Summary of Calibration and QC Procedures for Physical Analyses

Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW1020: Flash Point. SM2120B: Color (Pt/Co). SW1030: Ignt. EPA140.1: Odor. SW9095: Paint Filter. SM2540F: Settleable Solids. SM 2710D: SVI.	Method blank (if applicable)	Each batch	No analyte detected > RL	Repeat, rerun
	Standard-(if applicable)	Each batch	Refer to individual methods	Refer to individual methods
	Duplicate-(if applicable)	Each batch	Refer to individual methods	Refer to individual methods
	MDL verification -(if applicable)	Minimum yearly	Detectible	Re-evaluate MDL standard used and MDL; see Technical Director.

[1]Report all targets identified in the method blank above the MDL.

Appendix 5. 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. (NELAC)

Accrediting Authority:
The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (NELAC) [1.5.2.3]

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. (NELAC)

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 NELAC). (NELAC)

Assessment Criteria:
The measures established by NELAC and applied in establishing the extent to which an applicant is in conformance with NELAC requirements. (NELAC)

Assessment Team:
The group of people authorized to perform the on-site inspection and proficiency testing data evaluation required to establish whether an applicant meets the criteria for NELAP accreditation. (NELAC)

Assessor:
One who performs on-site assessments of accrediting authorities and laboratories’ capability and capacity for meeting NELAC requirements by examining the records and other physical evidence for each one of the tests for which accreditation has been requested. (NELAC)
Audit:

A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA-QAD)

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. (NELAC Quality Systems Committee)

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)

Blind Sample:
A sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibration:
To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve:
The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method:
A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM):
A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30–2.2)

Chain of Custody:
An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. (NELAC) [5.12.4]

Clean Air Act:
The enabling legislation in 42 U>S>C> 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and enforce them. (NELAC)

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/SUPERFUND):
The enabling legislation in 42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601 et seq., to eliminate the health and environmental threats posed by hazardous waste sites. (NELAC)

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. (NELAC)

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
Derivatization
Mass spectral interpretation
Alternative detectors or
Additional Cleanup procedures

(NELAC)

Conformance:
An affirmative indication or judgement 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). (NELAC)

Data Reduction:
The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Detection Limit:
The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

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)

Environmental Detection Limit (EDL):
The smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (NELAC Radioanalysis Subcommittee)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA):
The enabling legislation under 7 U.S.C. 135 et seq., as amended, that empowers the EPA to register insecticides, fungicides, and rodenticides. (NELAC)

Federal Water Pollution Control Act (Clean Water Act, CWA):
The enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

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 Testing:
NELAC's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required to submit to only that portion of the accreditation process not previously addressed (see NELAC, section 1.9ff). (NELAC)

Finding:
An assessment conclusion that identifies a condition having a significant effect on an item or activity. As assessment finding is normally a deficiency and is normally accompanied by specific examples of the observed condition. (NELAC)

Holding Times (Maximum Allowable Holding Times):
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Inspection:
An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. (ANSI/ASQC E4-1994)

Internal Standard:
A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

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 Response:
Instrument response is normally expressed as either peak area or peak height however it may also reflect a numerical representation of some type of count on a detector (e.g. Photomultiplier tube, or Diode array detector) and is used in this document to represent all types.

Laboratory:
A defined facility performing environmental analyses in a controlled and scientific manner. (NELAC)

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. 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), there is no LCS. 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.

Note: NELAC standards allow a matrix spike to be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. (NELAC)

Laboratory Duplicate:
Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

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 of Detection (LOD):
An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Manager (however named):
The individual designed as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

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: 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):

Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate 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 spikes shall be performed at a frequency of one in 20 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 selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Matrix spike duplicates or laboratory duplicates shall be analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory shall document their procedure to select the use of an appropriate type of duplicate. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the duplicate. (QAMS)

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. (NELAC)

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)

National Environmental Laboratory Accreditation Conference (NELAC):
A voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP):
The overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC Standards:
The plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference. (NELAC)

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. (NELAC)

Performance Based Measurement System (PBMS):
A set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

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. (NELAC)

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. (NELAC)

Preservation:
Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (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. (NELAC) [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. (NELAC)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Quality Assurance:
An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

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 which purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample:
An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. 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. (EPA-QAD)

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 (ANSI/ASQC-E-41994)

Quantitation Limits:
The maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. (NELAC)

Range:
The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Reagent Blank (method reagent blank):
A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Reference Material:
A 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. (ISO Guide 30-2.1)

Reference Method:
A method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard:
A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.0-8)

Replicate Analyses:
The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Requirement:
Denotes a mandatory specification; often designated by the term “shall”. (NELAC)

Resource Conservation and Recovery Act (RCRA):
The enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the “cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal. (NELAC)

Safe Drinking Water Act (SDWA):
The enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample Duplicate:
Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis. (EPA-QAD)

Second Order Polynomial Curve (Quadratic): The 2^{nd} 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 2^{nd} 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:
(Analytical chemistry) the capability of a test method or instrument to respond to a target substance of constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

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.

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. 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, a representative number (at a minimum 10%) of the listed components may 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.. (NELAC)

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of NELAC and meets the approval requirements of NELAC procedures and policies. (ASQC)

Standard Operating Procedures (SOPs):
A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM):
A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Supervisor (however named):
The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties, and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

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 Director:
Individuals(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test:
A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process, or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method:
An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Toxic Substances Control Act (TSCA):
The enabling legislation in 15 USC 2601 et seq., (1976) that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture. (NELAC)

Traceability:
The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

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.

United States Environmental Protection Agency (EPA):
The Federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation:
The process of substantiating specified performance criteria. (EPA-QAD)

Verification:
Confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Work Cell:
A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented. (NELAC)

Acronyms:

BS – Blank Spike
BSD – Blank Spike Duplicate
CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
CRS – Change Request Form
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DU – Duplicate
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
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
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAC - National Environmental Laboratory Accreditation Conference
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
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 6.

Laboratory Certifications, Accreditations, Validations

TestAmerica Connecticut 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	Responsible Agency	Certification	Lab Number
Connecticut	Department of Health Services	Drinking Water, Wastewater	PH-0497
Maine	Department of Health and Environmental Services	Drinking Water, Wastewater/Solid, Hazardous Waste	CT023
Massachusetts	Department of Environmental Protection	Potable/Non-Potable Water	CT023
New Hampshire	Department of Environmental Services	Drinking Water, Wastewater NELAC	2528
New Jersey	Department of Environmental Protection	Drinking Water, Wastewater **NELAC***	CT410
New York	Department of Health	CLP, Drinking Water, Wastewater, Solid/ Hazardous Waste NELAC	10602
Rhode Island	Department of Health	Chemistry...Non- Potable Water and Wastewater	A43
Utah	Department of Health	RCRA- NELAC	2032614458

* Primary Accrediting Authority

The certificates and parameter lists (which may differ) for each organization may be found on the corporate web site, the laboratory's public server, the final report review table, and in the following offices: QA, marketing, and project management.

Claims of Accreditation Status

TestAmerica Connecticut has agreed to make only valid claims as to its accreditation/certification status by any authority by ensuring that the expiration dates are not exceeded and the method-specific scope or parameter lists are supportable, as required by each. Any false claims would be reported to that authority. The agreement covers the use of the authority's name, such as "Authority-Accredited," logo, or certificate number. The only valid proof of accreditation/certification is the current certificate and scope of the authority. It is the responsibility of the laboratory to make these documents available to all staff, and it is the staff's duty to reference only the current documents.

A report with scope and non-scope analytes may only be presented on the same report if the non-accredited results are clearly and unambiguously identified. No report with non-scope analytes may be associated with the logo, "Authority accredited" phrase, or the certificate number. Only the analytes specified by a unique method are valid within the scope. There shall be no intentional misleading of the users of the laboratory's services in this regard.

No opinions and/or interpretations based on results outside the laboratory's scope may be presented on a document referenced by "Authority-accredited, the logo, or the certificate number. If these are made, they must be written in a separate letter which is not endorsed by the authority.

The "Authority-accredited" logo may only be affixed to equipment calibrated by a laboratory that is accredited by the authority. If calibration labels contain the logo, they must also show the calibration laboratory's name or its certificate number, the instrument's unique identification, the date of the last calibration, and a cross-reference to the last calibration certificate.

Should the company decide to use the "Authority-accredited" logo in marketing activities, no misrepresentation may occur. Only reference to the accredited scope at a specific laboratory site is allowed. If any "Authority-accredited" language is used in proposals or quotations, any non-scope analytes must be clearly denoted as not accredited by that authority. The same is true for any use of laboratory letterhead with the "Authority-accredited" wording or logo. The logo may not be affixed to any material, item, product, part, or packaging, thereby implying accreditation status to that piece. In literature, any use of the logo must be positioned adjacent to the accredited laboratory's name and clearly state that the presence of the logo does not imply certification/approval of the products tested. At no time may the logo appear to suggest that a person is accredited. Misrepresentation of accreditation status is never allowed and must be reported if it occurs. If in doubt, the idea of the logo's use may be presented to the authority for approval.

If accreditation is terminated or suspended, the laboratory will immediately cease to use the "Authority-accredited" wording, the logo, or the certificate number reference in any way and inform clients impacted by the change.

Appendix 7. Data Qualifiers

Flagging Suite	Flag	Flag Description	Condition Applied
Organics			
OLM04.2 plus	*	RPD of the LCS and LCSD exceeds the control limits	LCSD Percent RPD
OLM04.2 plus	*	MS or MSD exceeds the control limits	MSD Recovery
OLM04.2 plus	*	MS or MSD exceeds the control limits	MSD Rec Low
OLM04.2 plus	*	LCS or LCSD exceeds the control limits	LCS Rec Hi
OLM04.2 plus	*	Duplicate RPD exceeds control limits	MSD RPD
OLM04.2 plus	*	MS or MSD exceeds the control limits	MS Recovery
OLM04.2 plus	*	LCS or LCSD exceeds the control limits	LCSD High
OLM04.2 plus	*	Surrogate exceeds the control limit	SUR Rec Low
OLM04.2 plus	*	MS or MSD exceeds the control limits	MS Rec Low
OLM04.2 plus	*	LCS or LCSD exceeds the control limits	LCSD Low
OLM04.2 plus	*	MS or MSD exceeds the control limits	MS Rec Hi
OLM04.2 plus	*	LCS or LCSD exceeds the control limits	LCS Recovery
OLM04.2 plus	*	ISTD response or retention time outside acceptable limits	ISTD RT Fail
OLM04.2 plus	*	MS or MSD exceeds the control limits	MSD Rec HI
OLM04.2 plus	*	Surrogate exceeds the control limit	SUR Rec Hi
OLM04.2 plus	*	ISTD response or retention time outside acceptable limits	ISTD Area High
OLM04.2 plus	*	Duplicate RPD exceeds control limits	Duplicate RPD
OLM04.2 plus	*	LCS or LCSD exceeds the control limits	LCS Rec Low
OLM04.2 plus	*	LCS or LCSD exceeds the control limits	LCSD Recovery
OLM04.2 plus	*	ISTD response or retention time outside acceptable limits	ISTD Area Low
OLM04.2 plus	A	The tentatively identified compound is a suspected aldol-condensation product.	Aldol Condensation
OLM04.2 plus	B	The analyte was found in an associated blank, as well as in the sample.	PB Result Detected
OLM04.2 plus	B	Analyte was found in the associated method blank as well as in the sample.	CCB Result Detected
OLM04.2 plus	C	Identification has been confirmed by GC/MS.	Confirmed GCMS
OLM04.2 plus	D	The reported value is from a dilution.	From a Dilution

Inorganics			
ILM05.3 plus	*	Duplicate analysis not within control limits.	Duplicate RPD
ILM05.3 plus	+	MSA correlation coefficient is less than 0.995.	MSA CC < 0.995
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CRI Fail
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CRI Recovery Low
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CRI Recovery High
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ISCA Recovery
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CRA recovery high
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICV Rec Hi
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	MRL Fail Low
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICV Rec LOW
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CCV Rec Low
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CRA recovery low
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICSB Recovery
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICSA Recovery Low
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CRA Fail
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICV Recovery
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICSA Recovery High

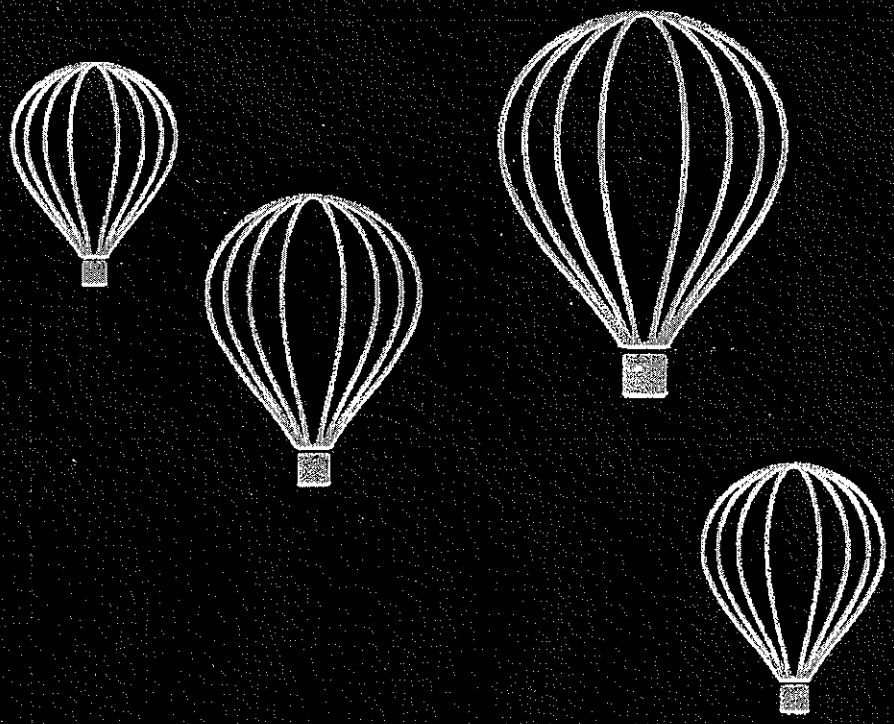
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICSAB Recovery High
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CCV Rec Hi
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICSAB Recovery Low
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	ICB Result Detected
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CCV Recovery
ILM05.3 plus	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA or MRL standard: Instrument related QC exceeds the control limits.	CCB Result Detected
ILM05.3 plus	4	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.	Analyte 4X MS
ILM05.3 plus	B	Sample result is greater than the IDL but below the CRDL	Below Reporting Limit (B
ILM05.3 plus	D	The reported value is from a dilution.	From a Dilution
ILM05.3 plus	E	The reported value is estimated because of the presence of interference based on serial dilution analysis.	Not Reported - Interference
ILM05.3 plus	H	Sample was prepped or analyzed beyond the specified holding time	Sample Prepped out of HT
ILM05.3 plus	H	Sample was prepped or analyzed beyond the specified holding time	Sample Analyzed out of HT
ILM05.3 plus	HF	Field parameter with a holding time of 15 minutes	Sample HT is Immediate and is flagged.
ILM05.3 plus	J	Sample result is greater than the MDL but below the CRDL	Estimated Result
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MSD Recovery
ILM05.3 plus	N	PDS exceeds control limits	Post Spike Hi
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MSD RPD
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MS Recovery
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MSD Rec Low
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	LCS Rec Hi
ILM05.3 plus	N	PDS exceeds control limits	Post Spike Low

ILM05.3 plus	N	Spiked sample recovery is not within control limits.	LCSD High
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MS Rec Low
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MS Rec Hi
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	LCS Recovery
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	MSD Rec HI
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	LCSD Low
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	LCS Rec Low
ILM05.3 plus	N	Spiked sample recovery is not within control limits.	LCSD Recovery
ILM05.3 plus	R	The percent relative abundance for the ICPMS internal standard is outside the specified acceptance ranges	ISTD RI Low
ILM05.3 plus	R	The percent relative abundance for the ICPMS internal standard is outside the specified acceptance ranges	ISTD RI High
ILM05.3 plus	U	Indicates analyzed for but not detected.	Below Lower Limit

ARCADIS

Attachment B-5

Air Toxics Limited Quality Manual



AIR TOXICS LIMITED
QUALITY MANUAL

"Quality....the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs."

"Quality Assurance....all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality."

Excerpts from ISO 8402

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This Quality Manual was designed to meet 2003 NELAP (National Environmental Laboratory Accreditation Program) standards and supports assessment programs and/or certifications with the following agencies:

Certifying Agency	ATL Certificate #	Basis of Certification/Approval	Location of Certificate and Parameter List
California DOH (Primary NELAP)	02110CA	Onsite assessment (biennial) and WP PTs	Laboratory internal network: O:\QA\Certifications
Florida DOH (Primary NELAP)	E87680	Onsite assessment (biennial) and SOP Review	Laboratory internal network: O:\QA\Certifications
New Jersey DEP (Primary NELAP)	CA004	Onsite assessment (biennial), LQAP and SOP Review	Laboratory internal network: O:\QA\Certifications
Louisiana DEQ	02089	SOP Review, WP PTs, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
New York State DOH	11291	LQAP, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
State of Utah DOH	9166389892	LQAP, PT, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
U.S. Navy NFESC/IR/QA	NA	DOD Quality System Manual for Environmental Laboratories v.3/ Recognition of NELAP Accreditation	Laboratory internal network: O:\QA\Certifications
Arkansas DEQ	03-084-0	LQAP, PT, MDL Review, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
Pennsylvania State Dept. Health	68-690		Laboratory internal network: O:\QA\Certifications
Arizona DHS	In progress	Onsite assessment, LQAP and PT	In progress

MANAGEMENT QUALITY POLICY STATEMENT

At ATL, we strive to be the **BEST** in everything that we do. Our very existence is based on our continued ability to provide innovative, dependable, and cost effective environmental services to our clients. We **CARE** about our clients as well as our co-workers and manage our daily activities to build relationships based on mutual **TRUST, HONESTY,** and **RESPECT**. We are **LEADERS** in our field and accept the risks associated with building new frontiers in our professional lives. Our strength comes from our **TEAMS** for through them we can achieve our goals. This Quality Assurance Manual defines and documents the core systems surrounding good professional as well as laboratory best practices for all staff. The management signatures below represent our commitment to continually define, assess, and improve the quality systems, which provide the basic infrastructure in support of these goals.

Linda L. Freeman _____ 10/11/07
CEO, Laboratory Director (Technical Director I) Date

Heidi C. Hayes _____ 10/12/07
VP, Director of Business Development (Technical Director II) Date

Melanie A. Levesque _____ 10/12/07
Quality Assurance Manager Date

The Air Toxics Limited Quality Assurance Manual is effective as of the date of the signature of the Laboratory Director.

AIR TOXICS LIMITED
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1.0 INTRODUCTION

The Air Toxics Limited (ATL) Quality Manual describes the Quality Assurance (QA) program and Quality Control (QC) procedures used to ensure that data of known and documented quality are produced. It is designed to be used as a manual that outlines the process by which we ensure that the customer expectations are met, and hence, the quality goal is met. *ISO/IEC Guide 17025-General Requirements for Competence of Calibration and Testing Laboratories* are incorporated wherever possible, however the primary guidance document is *Chapter 5: Quality Systems* as published in the June 5, 2003 NELAP Standard.

The Quality Manual contains a discussion of the following topics:

Introduction: The quality objective is discussed along with management and information systems in support of the objective.

Organization: Staff qualifications and responsibilities, management organization, laboratory facilities, and equipment are detailed in this section.

Quality Assurance Program: This section deals with project management, standard operating procedures, staff members' training, evaluation and documentation of adherence to quality assurance and quality control requirements, corrective action system, and health and safety.

Quality Objectives: This section explains the quality control parameters and procedures, procedures to establish limits of detection and quantitation and perform calibrations, traceability, and preparation of standards.

Sample Handling: Sampling containers, preservation and Chain-of-Custody requirements, sample receiving and tracking procedures, internal custody, storage and disposal are discussed.

Analytical Methods and Procedures: In this section, a brief method description is given for all analytical procedures carried out at ATL. The limit of quantitation concentrations, quality control acceptance criteria and method modifications are provided as well.

Data Review and Reporting: This section explains the procedures involved in data collection/reduction, data review, and final report production. Hardcopy and electronic data production, data flagging, and data storage are also discussed in this section.

Establishing Acceptance Criteria: The control chart program is outlined in this section along with generating and evaluating in-house statistical limits.

Preventative Maintenance: Routine maintenance, service contracts, and control of miscellaneous monitoring equipment are explained briefly.

Assessments and PT Samples: A brief explanation of internal and external assessments programs and NELAP PT samples program is provided.

Computer and Software Systems: This section of the quality manual deals with the management of computer and software systems. Data storage, back-up routines, and internal software validation efforts are included.

Control of Purchased Items: Control of purchased items and external services as well as the purchase requisition system are outlined in this section.

Project Management System: This part of the quality manual gives a brief description of steps to ensure that the customer expectations are met once the project is undertaken.

1.1 QUALITY OBJECTIVE

Air Toxics Limited is committed to producing data that meet or exceed the client's measurement needs. Customer satisfaction is the motivating force behind most of the ATL processes. An underlying network of systems designed to define, document, and process each individual customer's need supports this primary objective. This systems network includes Marketing/Sales, Project Management, IT, Laboratory Production, Support Services, Technical Services, Quality Assurance, and Finance. Each of these operational areas is organized around an empowered work team accountable for delivering an automated, on time and defensible result.

We believe the ultimate responsibility for quality resides at the team level. Every team member has the responsibility and authority to suspend a process if it appears that the quality objectives are not being met. Analytical team members are informed of the quality objectives via documented Standard Operation Procedures (SOPs) and project related information systems (ATL's Project Profiles and Project Requirement tables). Team members work closely with the Project Management and QA Departments to ensure that the quality objectives are met.

1.2 QUALITY MANAGEMENT SYSTEM

The role of the ATL management team is to help ensure that the quality objective is met through a continuous and reiterative program of process improvements. The management team consists of Business Directors, Department Managers and Team/Task Leaders.

The primary role of the management team is to establish performance goals at the corporate and team levels as well as to develop tools capable of producing quantifiable measures of performance against these goals (e.g., customer satisfaction index, sales quotas, report turn around time, net profit, days to complete corrective actions, etc.). A secondary role of management is to help ensure that the work environment and facilities promote continued development of empowered work teams through facilities management and programs for recruiting, training, and retaining qualified staff.

Quality Assurance Management: The role of the ATL Quality Assurance team is to help ensure that the systems described above are designed, documented, and operating in accordance with the quality objectives. This is accomplished via coordination and dissemination of internal and external assessment information, review of SOPs to document variances taken to published methods, monitoring of the Quality Manual to assure consistency with actual practices, maintenance of an ongoing Corrective Action Program with monthly reports to management, and a leadership role in employee training programs. A secondary function of the QA team deals with data review and other quality control related programs.

The QA team is free from any commercial, financial, or production pressures when making assessments or decisions regarding the quality of work produced or effectiveness of the quality systems. The Quality Assurance Manager reports directly to the President in order to maintain independence from business operating units and facilitate communications regarding quality related issues.

Communication between the QA team and other management teams occurs on a regular basis via weekly status meetings. Information regarding outstanding corrective action items, upcoming assessments, assessment results or general observations are brought up and documented via a database of agenda notes. The corrective action database along with the ATLAS database compiles a 'Monthly Quality Assurance Status Report', which is distributed to the entire management team for review.

Sales and Project Management: The role of the ATL Sales and Client Services teams is to effectively document and communicate the needs of the customer. These teams represent the

customer in all matters and serve as a liaison between the customer and the Technical Services, Laboratory, Support Services, Finance, and Quality Assurance areas. The ATL Marketing and Client Services teams ensure that client needs are matched by laboratory resources. Strong communication linkages exist between the lab Department Managers, Team Leaders and the ATL Marketing and Client Services teams. Information regarding customer needs flows into all ATL systems via these two teams. Interactions may be as complex as Quality Assurance Project Plan (QAPP), contract or Scope of Work (SOW) review or as simple as processing shipments of canisters and other sampling media. Project specifics are documented and stored via an interactive database that assigns a unique identifier for every reference.

Sample Receiving: The goal of the department is to enable every sample to be received and processed into a unique laboratory Work Order within 24 hours of sample receipt. Sample non-conformities are communicated to the clients in the same time frame. Custody information relating to sample receipt, a copy of the sample receipt summary, and an example report format is emailed or faxed to the client for review and comments.

Laboratory Management: Laboratory management is divided into work teams equipped with necessary resources to complete the sample analysis, review, data reporting and creation of all electronic data packages, which include email, EDD and eCVP on CD-ROM. The laboratory work teams are responsible for verifying the quality of electronic deliverables by reviewing a percentage of the product. In this way, team members are easily able to accept the control and accountability for quality. The Support Services team is responsible for cleaning, assembling, coordinating media certification and shipping all sampling media. The primary responsibility of the Team or Task Leaders is to monitor customer needs versus resource availability. Staff and equipment management are carefully balanced with customer needs. The goal for each team is to deliver defensible data within the time frame promised to the client. The Team or Task Leaders review daily sample receipt work lists to determine that the laboratory has adequate resources to perform the work. In those cases where either the technical or sample capacity demands cannot be met, the Team or Task Leader works with the Client Services Representative and the client to provide a solution via inside resource re-allocation or outside subcontracting. The ATLAS laboratory automation system creates and tracks special analytical lists, deliverables, or Turn Around Time (TAT) requests which are automated via customized linkages (work tools) into the centralized Structured Query Language (SQL) database. Performance measurements against the goal are routinely monitored using the same SQL database. Performance and quality related information is shared with team members during team meetings. Project or client related information resides both in the project management module and in sample tracking modules, reducing the need for relying on verbal communication of project specifics to the team. The Team and Task Leaders report to a Department Manager who reports to the President.

The remaining team positions are divided into four levels:

1) **Senior Scientist** (Lab Personnel) or **Senior Associate** (non-Lab Personnel):

This is the highest level professional position reporting to a Director, Manager, or Team Leader. The Senior Scientist or Senior Associate works independently at a company wide level. In addition to all of the responsibilities of the Scientist described below, the Senior Scientist or Senior Associate is recognized within the company as an expert in his/her field. He or she is often asked to work outside of the team whenever the need arises, and is able to demonstrate above average leadership skills. Senior Scientists or Senior Associates are

responsible for method development activities and take a lead role in proprietary software and hardware design and testing. High profile projects or client relations, including more intricate analyses and data interpretations, are assigned to a Senior Scientist to oversee. The Senior Scientist or Senior Associate maintains knowledge at the level of Masters Degree or equivalent with a minimum of 5 years of analytical environmental experience.

Scientist (Lab Personnel) or
Associate (Non-Lab Personnel):

The Scientist or Associate works independently at the team level. A Scientist or Associate demonstrates a high level of skill, judgement, problem solving ability, and is able to independently perform troubleshooting. The responsibilities of a Scientist/Associate include: scheduling of work, providing routine as well as non-routine bench level activities in a highly efficient manner, writing SOPs, reviewing data, performing non-routine instrument maintenance and troubleshooting, and representing the team during internal/external assessments. Individuals in this position play a lead role in monitoring health and safety on the team, and acting as a resource or trainer. A Scientist or Associate must have a Bachelor's Degree and a minimum of three years of analytical environmental experience.

Analyst (Lab Personnel
and Non-Lab Personnel):

The Analyst works under the direct supervision of a Scientist, Senior Scientist, Team Leader and/or Manager at all times. He/she follows a specific formal training program to learn the necessary skills required of the position and demonstrates the ability to recognize problems and to seek assistance. The primary responsibility of an Analyst is to follow written laboratory SOPs in an efficient and well-informed manner. The Analyst performs routine maintenance on the equipment, prepares standards, and performs all relevant bench level activities. The minimum qualification for a laboratory analyst is a Bachelor's Degree.

Each team has a mix of Scientists and Analysts. Each Team Leader coordinates the activities of the respective team, serves as a resource to the Analysts and Scientists, communicates the corporate objectives to the team, and monitors team progress against the quality objective, which is customer satisfaction. A Scientist may be assigned as 'team lead' in a subset of team activities. As 'team lead' the Scientist is responsible for all the technical activities of the assigned area, oversees both the quality and quantity of work produced, and serves as resource for the Analysts. The Analyst performs all of the routine activities and quality checks (i.e., makes sure the customer expectations are met).

Every team member is empowered to make sure that the customer expectations are met, is trained in the elements of the quality process, and has the responsibility and authority to stop or suspend a process when the quality objective is in jeopardy.

Technician (Lab Personnel
and Non-Lab Personnel):

The Technician works directly under the supervision of a more experienced team member, Team Leader and/or Manager at all times. He/she is responsible for meeting the team's production and quality goals. The Technician performs a variety of tasks in whatever area of the laboratory they are assigned. For example, the Technician's responsibilities may include washing and solvent rinsing glassware, cleaning and preparing media to ship to clients, pressurizing and screening samples, logging samples, assist in preparing standards and other duties as assigned. He/she is also expected to communicate issues to a team Scientist and/or Team Leader. The minimum qualification for a Technician is a High School Diploma.

Information Technology:

The Information Technology (IT) team is responsible for the design and maintenance of the SQL server based data system. Its primary goal is to ensure that customer satisfaction is achieved by the way information is transferred, processed, or queried. This includes systems relating to telephone service, e-mail service, Internet access, project management, data acquisition, assessment trails, data security, and automated data reporting linkages. The group consists of the IT Manager, and one full time programmer. Around-the-clock, system support is achieved via a combination of in-house and contract support. Additional programmers are hired on a project specific basis. All of the ATL information systems are designed, coded, and tested in house and as such, are proprietary in nature. The IT Manager reports to the President.

Financial Management: The quality systems rely on bottom line profitability to provide strength to the framework that produces quality results. The ATL Finance team is responsible for monitoring the profitability of all operations. Customer satisfaction goals are built into budgeting, purchasing, invoicing, employee compensation and benefits programs, collections, contracts, insurance, and banking. The primary goal of the team is help ensure bottom line profitability while achieving the quality objective, which is customer satisfaction. The group consists of a Controller, a Finance Associate, a Credit & Collection Associate and an Accounts Payable/Purchasing Associate. The Finance Manager reports to the President.

Data Integrity Procedures: Since a commitment to data integrity is a vital component for credibility of our core product, Air Toxics Limited cannot function as a business entity without a clear definition of ethical expectations for all employees. Integrity is defined as the ability to discern right from wrong, and the commitment to do what is right, good and proper. Data integrity procedures relating to generation of analytical reports are built into the systems via the operational SOPs, which describe appropriate practices. Additional systems and training programs that safeguard strict adherence to the SOPs ultimately ensure that data integrity procedures are employed. Intentional fraud will be grounds for severe reprimand and/or termination of complicit employees. In addition, employees who witness or are otherwise aware of data integrity violations, even if they are not a party to such acts, are expected to immediately report these lapses to their Team/Task Leader, their Department Manager or to a member of the Board of Directors.

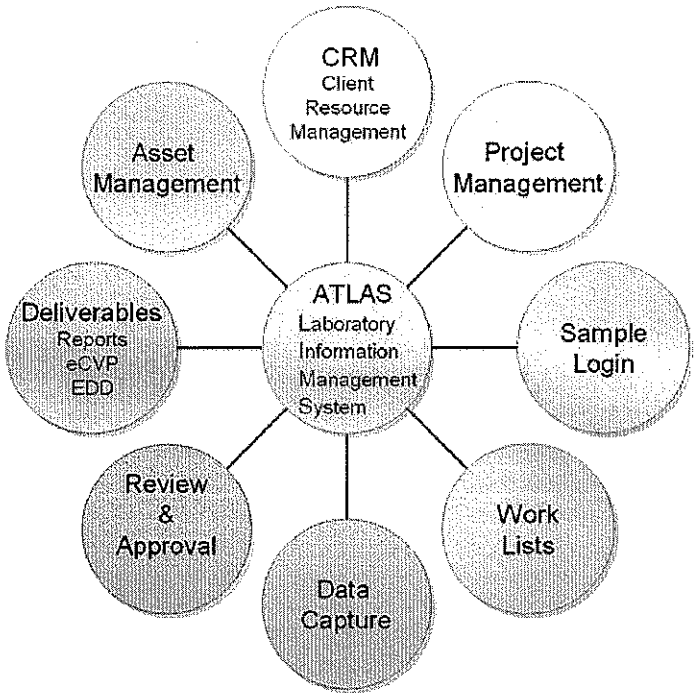
Data integrity training is conducted within a variety of frameworks and is mandatory for all Air Toxics Limited employees. New employees read both the LQAP and the Employee Handbook to properly orient ethical expectations. In addition, within one month of date of hire there is basic training provided by the Quality Assurance Department to familiarize new employees with principles of documentation to pre-empt practices that would call into question the data integrity procedures of the laboratory. The Chief Executive Officer of Air Toxics conducts a Standards of Conduct presentation that defines data integrity expectations, potential penalties and consequences for lapses of integrity for new employees as they join the company. In addition, the CEO conducts a yearly ongoing Ethics Training II for the remainder of the employees. The Inappropriate Lab Practices Class (also done on a yearly basis) defines allowable parameters for the lab to assure defensibility and to define illegal practices. The purpose of all training is to provide specific examples of data integrity expectations that are relevant to actual job functions. Employees document the training in their training records (see Section 3.2.1).

1.3 INFORMATION MANAGEMENT SYSTEM

Information is stored in the Air Toxics Laboratory Automation System (ATLAS) databases using ATL designed hardware and proprietary software. This in-house Laboratory Information Management System (LIMS) is an

evolving development project designed to find more efficient means to meet the customer needs. Each client contact (telephone call, quote, shipping request, or inquiry) is stored in a database, which can be queried for sample log-in, project backlogs, project TAT or revenue statistics.

Some modules are designed to track non-traditional information such as the sample history of individual canisters, number of reports completed per analyst per shift, and overdue work by reason code. These types of information directly affect the ability of the management team to provide quality process improvements. Some non-traditional calculations such as the boiling point distribution of a hydrocarbon background, EPA rounding, and percent difference calculations have been made available at the bench. This type of information directly affects the ability of the individual employee to meet the quality objectives.



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2.0 ORGANIZATION

2.1 STAFF QUALIFICATIONS AND RESPONSIBILITIES

ATL's management organization includes the Board of Directors comprising four core areas: Operations, Finance, IT, and Sales. In addition there are Department Managers, Area Managers and Team/Task Leaders. Each operating area is either lead by a Department Manager or a Team/Task Leader. Due to the size and complexity of the main laboratory, Department Managers and Team or Task Leaders are required. Most Managers and Team/Task Leaders report to a member of the Board of Directors. One of the Directors is designated as the Vice President. If the President is absent, the Vice President may fulfill the responsibilities as President. In addition, if the primary Technical Director is absent the second Technical Director will fulfill the responsibilities. If the QA Manager is absent, the Technical Directors may fulfill QA responsibilities. In the absence of a Manager or Team/Task Leader, one of the Directors will name an interim successor.

LINDA L. FREEMAN
CHIEF EXECUTIVE OFFICER AND LABORATORY (TECHNICAL) DIRECTOR (1)

Ms. Linda L. Freeman is the Technical Director and the Chief Executive Officer of ATL providing leadership that ensures the founding mission and core values of the company are put into practice. Ms. Freeman leads programs relating to the development of long range strategy, quality systems, and financial infrastructure. As Technical Director (1), her responsibilities include: the administrative review of laboratory operations and qualifications for the technical positions, ensuring and documenting initial and ongoing proficiency, and oversight of the Quality systems. She holds a Bachelor's Degree from Boston College and a Master's Degree in Chemistry from the University of Wisconsin-Madison. Ms. Freeman has over 20 years of combined environmental experience and 18 years of laboratory business management experience.

BRAD MOSAKOWSKI
PRESIDENT

Mr. Mosakowski is the President of ATL and represents the partnership in all matters. Mr. Mosakowski provides day-to-day leadership and management of programs for overseeing the processes and resources necessary for establishing long-range service objectives, plans and policies, in cooperation with the CEO and Board of Managers. He is responsible for the measurement and effectiveness of both internal and external processes by providing accurate and timely feedback on the operating condition of the company. In addition, Mr. Mosakowski also directs the definition and operation of the laboratory production by fostering a success-oriented and accountable environment within the company. A critical component of which is his ability to motivate and lead a high performance management team capable of meeting both customer service and bottom line financial objectives. Mr. Mosakowski has over 15 years of combined environmental laboratory experience.

HEIDI C. HAYES
VICE PRESIDENT, DIRECTOR OF BUSINESS DEVELOPMENT AND TECHNICAL DIRECTOR (2)

Ms. Heidi C. Hayes is the Vice President, the Director of Business Development and Technical Director (2) of ATL. Ms. Hayes is responsible for developing sustainable customer relations by providing customized solutions through technical leadership in marketing, sales and service. She is the key technical interface between laboratory services and major clients. Ms. Hayes plans, develops, and establishes policies and objectives for developing a more technical marketing, sales and service organization by performing the

following duties personally or through subordinate managers; provides the technical leadership, management and vision necessary to ensure the company has the proper operational controls, administrative procedures and human resource management in place to meet customer need and quality objectives. Ms. Hayes holds a Bachelor's Degree in Chemistry and Mathematics from Luther College and a Master's Degree in Chemistry from the Colorado School of Mines.

MELANIE LEVESQUE
QUALITY ASSURANCE MANAGER

Ms. Melanie Levesque develops and supervises programs intended to ensure that the laboratory is producing data of known and acceptable quality. Ms. Levesque oversees QC activities including various independent checks of laboratory systems, SOP generation, and corrective action procedures, as well as monitoring laboratory certification programs. Ms. Levesque has documented training in the approved methods and can verify that the laboratory is following SOPs. Ms. Levesque maintains independence from the operations by not engaging in production activities and reports directly to the President. The QA Department conducts a yearly independent audit of the quality systems and methods criteria, and notifies laboratory directors of deficiencies via a written report. Ms. Levesque holds a Bachelor's degree in Chemistry and a Master of Science degree in Analytical Chemistry both from Rochester Institute of Technology, followed by eight years of environmental laboratory experience. Ms. Levesque has worked in a variety of positions including HPLC chemist, GC/MS chemist, and laboratory supervisor.

NATHAN SHAFER
LABORATORY DEPARTMENT HEAD

Mr. Nathan Shafer is the Department Manager for the Volatile Organic Compound (VOC) GC/MS analysis group. This department is responsible for all analyses via methods TO-14A/15, VOST methods 0030 and 0031, TO-17, and all VOC pptv work in the area of vapor intrusion. Mr. Shafer is responsible for managing and overseeing all processes and resources involved in the daily operations of the VOC department. In addition, he provides technical support to client services, sales, and the department; he is also responsible for coaching and training team members, data review, scheduling, and conferencing. Mr. Shafer has been employed by Air Toxics since 1997 and has 10 years of environmental laboratory experience. His experience comes from roles such as GC/MS chemist, laboratory supervisor, and project development chemist. Mr. Shafer holds a dual degree from Claremont McKenna College in the fields of chemistry and psychology.

SEPIDEH SAEED
LABORATORY DEPARTMENT HEAD

Ms. Sepideh Saeed is the Department Manager for the GC, HPLC and GC/MS semi volatiles analysis, which includes EPA Method TO-3/TO-12, ASTM D-1945/1946, 25C/3C, TO-14A Direct Inject, Extractions, Headspace, Sulfur ASTM D-5504, TO-13A, TO-5/CARB430, TO-11, Method 0011, PM10, TSP, NIOSH, Siloxanes, Pesticide and PCB Analytical Group. She is responsible for managing and overseeing all processes resources involved in the daily operations of SVOC department. In addition, she serves as Team Leader for the Reporting Team. She provides technical support to client services, sales, and the department and is also responsible for supporting both the Senior Scientist and the Task Leader in managing staff, production and technical matters. Ms. Saeed has been employed at Air Toxics since 1998 and has over 15 years of environmental laboratory experience. Her experience comes from roles such as a GC, HPLC, GC/MS and extraction chemist and laboratory supervisor. Ms. Saeed has a B.S. Degree in Biochemistry from University of California, Davis.

MINDY WILKE-DOUGLAS
SALES & MARKETING MANAGER

Ms Mindy Wilke-Douglas is the Sales & Marketing Manager of Air Toxics, Ltd. She is responsible for establishing and leading the sales and marketing efforts through the development and implementation of strategies to generate profitable sales and growth of the company. She also provides the leadership, management and vision necessary to the project management team to exceed client expectations. Ms Wilke-Douglas has 10 years of laboratory research experience as well as over 13 years of experience in scientific sales and marketing. She also spent 4 years as an Adjunct Professor teaching Environmental Biology within the Los Rios Community College District. Ms Wilke-Douglas holds a Bachelor's Degree in Microbiology and a Master's Degree in Molecular Biology (Bacteriology) both from the University of California, Davis.

KEN ZELENY
INFORMATION TECHNOLOGY MANAGER

Mr. Zeleny is the Information Technology Manager for the IT Group. His responsibilities include database management, software development and network management. Mr. Zeleny has over 18 years experience with computer and technology functions in both large and small organizations. His experience also includes 5 years as a Sr. Systems Architect and then as a Manager of the Development Team. Prior to this, Mr. Zeleny has worked as a Sr. NT Systems Engineer, IT Supervisor, Network Administrator and Sr. Technical Support Analyst. Mr. Zeleny has been employed at Air Toxics Limited since August, 2005.

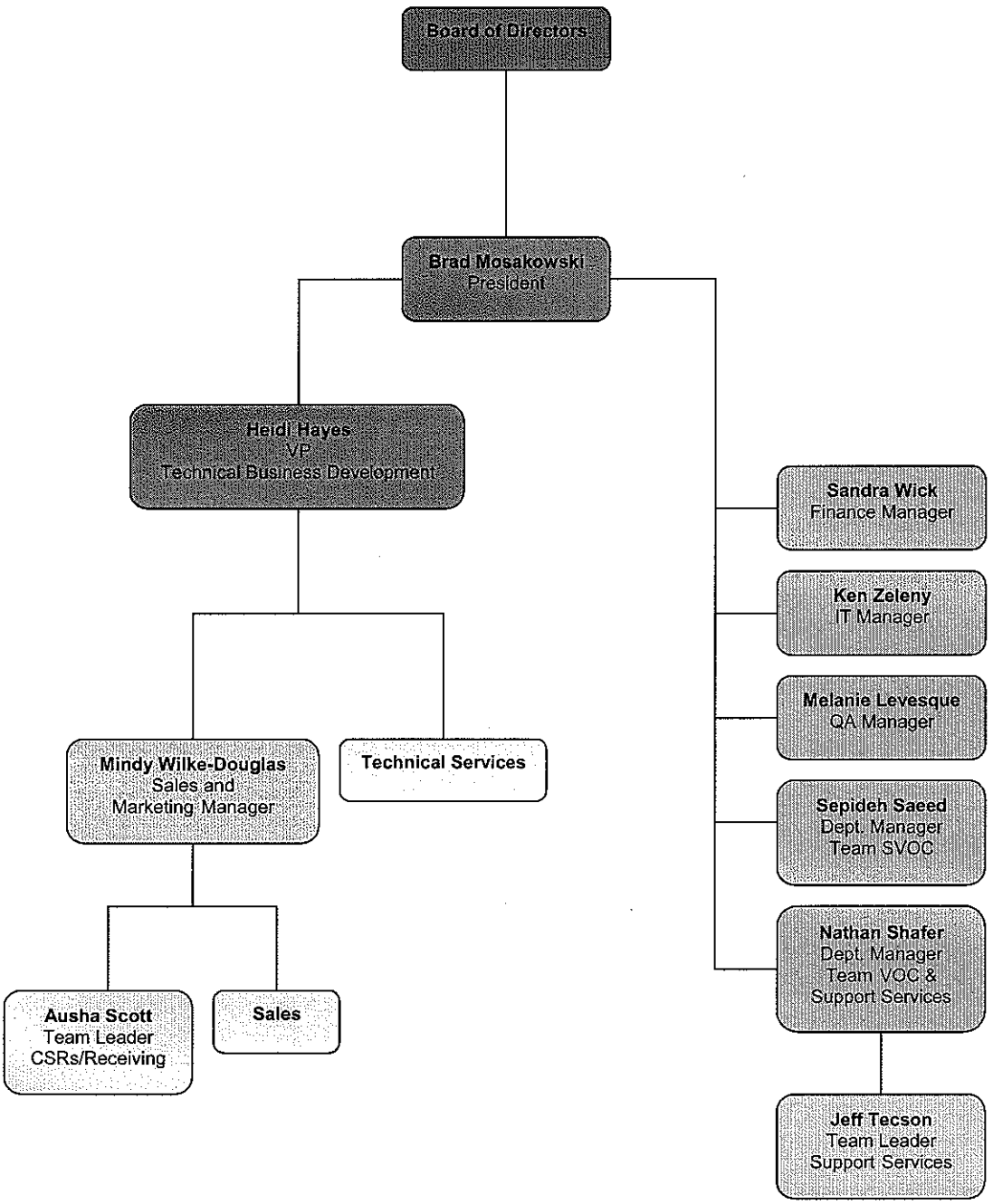
JEFFREY TECSON
SUPPORT SERVICES TEAM LEADER

Mr. Jeffrey Tecson is the Team Leader for the Support Services Team. This team is responsible for cleaning and coordinating the certification of Summa, Silco and Silonite Canisters. Other responsibilities include preparation of flow controllers, TO-17 tubes, VOST/SMVOC tubes for Methods 0030 and 0031. Mr. Tecson has 5 years experience in doing bench work for Support Services; currently Mr. Tecson is spending 25% of his time on the bench. Mr. Tecson has an A.S. Degree in Computer Technology Heald College in Rancho Cordova, CA; he also has 11 years management experience.

AUSHA SCOTT
CLIENT SERVICES/RECEIVING
TEAM LEADER

Ms. Ausha Scott is the Team Leader for the Client Services and Login/Receiving Departments. She is responsible for overseeing the project management functions, including client relations and technical support. In addition, she directs the daily activities of the Login/Receiving team. Ms. Scott has 6 years of environmental laboratory experience in a variety of positions including GC/MS chemist and client service representative. Ms. Scott holds a Bachelor's degree in Marine Biology from University of California, Santa Cruz.

Exhibit 2.1. ATL Management Organization



2.2 FACILITIES

The ATL laboratory occupies 30,000 square feet of space in Folsom, California with approximately 6,000 square feet of office space. The single story building is custom designed to suit the specifications of an air laboratory. Design criteria included floor plans to accommodate segregation of conflicting tests and provide an environment that is conducive for cross-functional work teams. The main instrumentation laboratory is based on an "open" concept in which walls are removed to promote a sense of community and teamwork. Wide hallways with alcoves are designed to encourage congregation and discussion. The number of private offices is minimized so that barriers between management and staff are removed. Elements of the quality system are evident throughout the facility design.

Sample receiving occupies approximately 950 square feet. There is sufficient floor space to receive, unpack, and tag up to 150 Summa™ canisters per day. The main laboratory is centrally located and houses twenty GC/MS systems, eight GCs, and a network of computers.

A caged canister storage area was constructed on one side of the laboratory to securely hold all canister and Tedlar bag samples. An isolated negative pressure room was designed for solvent handling and extraction activities. Approximately 1000 square feet of air-conditioned space is designated for research and development activities, and a work shop/tooling area. Sorbent tube preparation and canister cleaning operations are located in segregated areas. Long-term file storage occurs off site. A local document storage and retrieval service picks up files for storage. Files are kept in bar coded boxes making retrieval easier. Typically a file can be retrieved within one working day from the original request.

Security is maintained through a controlled access system. Representatives of State, Federal or private entities have access to the laboratory facility and records during laboratory normal business hours. Guests must enter/exit through a central reception area. The receptionist keeps a date/time log. After work hours, the building is secured and linked to a commercial security agency. The security system is equipped with perimeter alarms, motion sensors, and speakers that monitor background sounds. Heat activated fire alarms are monitored by an outside agency. A fire alarm also activates the security system. ATL SOP #30 describes the security and controlled access protocols.

2.3 EQUIPMENT AND INSTRUMENTATION

The laboratory is equipped with over $2,000,000 of instrumentation, dedicated exclusively to the analysis of air samples. Much of the commercially available equipment is modified in-house in order to enhance performance in the areas of:

- *overcoming challenging sampling problems;*
- *analyzing difficult matrices;*
- *achieving greater sensitivity.*

A staff of design engineers and a 1,000 square feet fabrication shop is maintained by ATL in order to build, test, and service the custom equipment. A facilities map and equipment list can be found in Exhibit 2.2 and Tables 2.1 and 2.2.

Exhibit 2.2. Facilities Map

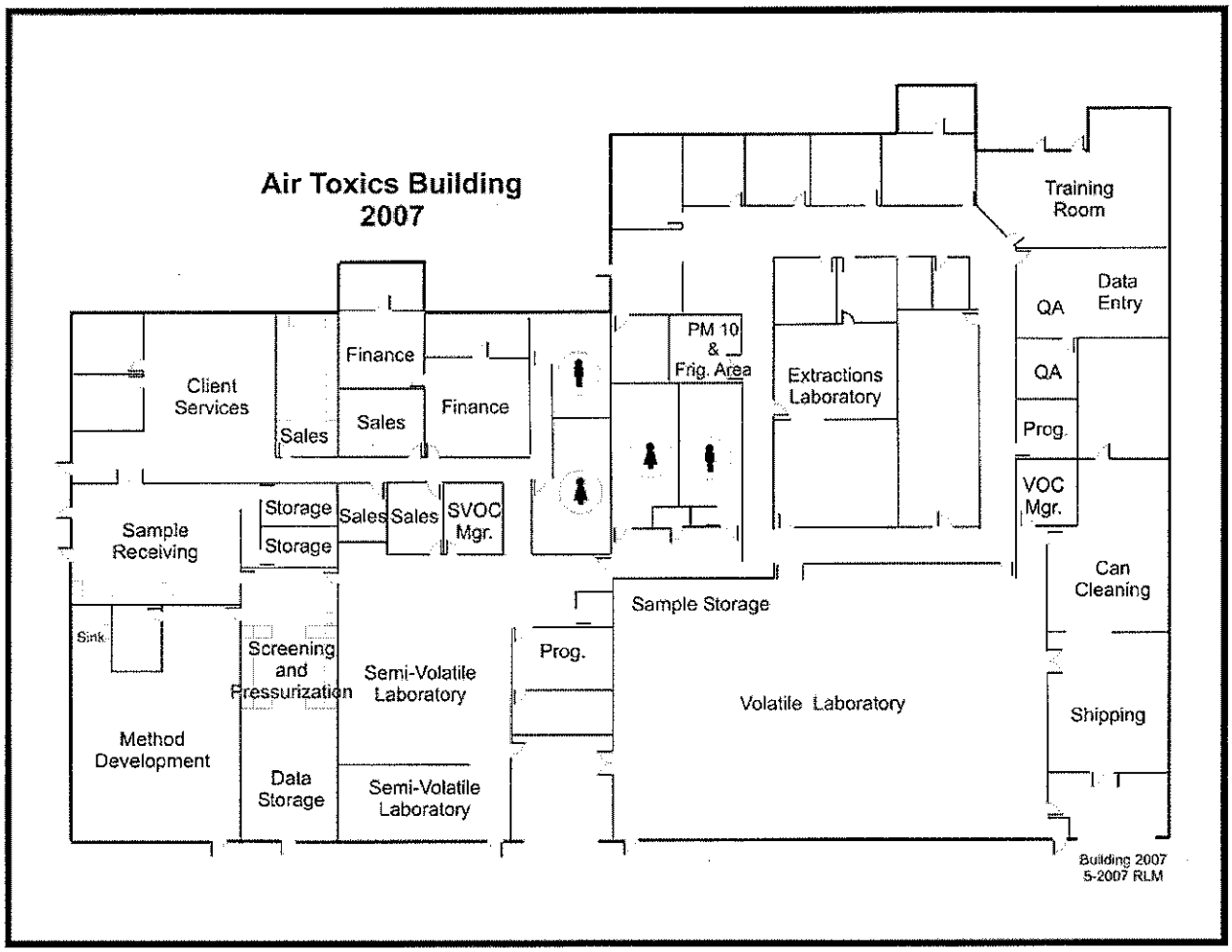


Table 2.1. Laboratory Instrumentation and Equipment

#	Description
9	Agilent 5973 GC/MSD
9	Agilent 5975 GC/MSD
1	Leco Time of Flight MS
1	Markes Autosampler
1	Hewlett-Packard 5980 GC/ECD/ECD
2	Hewlett-Packard 5980 GC/SCD
2	Hewlett-Packard 5890 GC/FID
1	Hewlett-Packard 5890 GC/TCD/FID
2	Hewlett-Packard 6890 GC/PID/FID
1	Hewlett-Packard 5890 GC/TCD/ECD
1	Sequoia-Turner Spectrophotometer
1	SIS Shortpath Thermal Desorber
1	Hewlett-Packard 1200 Gradient HPLC
2	Air Toxics Canister Autosampler
2	Air Toxics Custom Sorbent Tube Desorption Unit
1	Air Toxics Permeation calibration system
3	Canister pressurization stations
40	Soxhlets Extractors
1	Automated Canister CART Cleaning Station
2	Automatic Solvent Extraction System
8	Custom Convectron Pressure/Vacuum Canister Cleaning Manifold

Table 2.2. Sampling Media

Description	Quantity
Air sampling canisters	
6-Liter Summa canister	2120
1-Liter Summa canister	1300
PAC250 Summa Canister	240
High Pressure Sample Cylinder	30
Flow Controllers for air sampling canisters	800
24-hour flow controllers for canisters	700
Vacuum gauges	200
Tedlar bags: 1, 3, 10 liter	In inventory
MM5 air sampling traps	20
Midget impingers	30
VOST tubes kept in inventory	50 pair
TO-13 PUF/XAD and TO-4/TO-10 air sampling cartridges	200
TO-17 CarboTrap 300 air sampling tubes	150

3.0 QUALITY PROGRAM PLAN

Air Toxics Limited maintains comprehensive Quality Assurance programs to ensure that analyses are being conducted according to prescribed analytical methodology, and are within project specific QAPP requirements. The program is an integrated system of activities involving planning, quality assessment, quality control, reporting, and quality improvement. The basic elements of this program include:

- ***DOCUMENTING*** *procedures, method requirements, and project requirements*
- *Organizing, monitoring, and leading* ***TRAINING*** *programs on quality related issues*
- ***ASSESSING*** *adherence to requirements, including maintenance of a system which documents, tracks, and provides closure when corrective actions are necessary*
- *Formally* ***COMMUNICATING*** *results of those assessments to laboratory management*

These critical elements of the Quality Plan are described in detail in the following sections.

3.1 DOCUMENTING

3.1.1 The Quality Assurance Manual

The Quality Assurance Manual describes the major programs or systems by which the laboratory provides data of known and predictable quality. The QA Manager and the President are responsible for the content, accuracy and completeness of the Manual. The Manual must comply with all State and Federal requirements for those programs in which the laboratory maintains accreditation. The Quality Assurance Manual is a required reading for all laboratory staff and everyone must comply with the procedures documented as a condition of continued employment. Each staff person documents in his/her training record that the latest revision Manual has been read and understood. The Department Manager and/or the Team Leader assess the accuracy and completeness of the documentation annually at the time of the employee's performance review. Missing or incomplete documentation is noted in the performance review.

The Quality Assurance Manual is reviewed and updated annually. All personnel are required to document reading the latest version in their training record.

3.1.2 Standard Operating Procedures/Methods Manual

The laboratory procedures used at ATL are documented in method-specific standard operating procedures (SOPs). These procedures are based on standard EPA or ASTM methodology whenever possible. The SOPs contain all necessary QC parameters, acceptance criteria, and directions for corrective action measures. The SOPs govern the laboratory response to results that are outside acceptance limits and address anticipated problems with associated recommended corrective action to eliminate the problem or further occurrences of the problem. SOPs also specify the type of written records (typically Corrective Action Requests known as CARs) necessary to fully document anticipated as well as unanticipated problems. The SOPs are maintained in numerical order in binders, which also serve as the laboratories Methods Manual. The SOPs address the following (where applicable):

- Identification of the test method
- Applicable matrix or matrices
- Limit of Detection (MDL)
- Method reporting limits
- Scope and application (includes target analytes)
- Summary of the method

- Table of significant variances from the method
- Definitions and interferences
- Safety
- Equipment and supplies
- Reagents and calibration standards
- Sample preservation and storage requirements
- Quality control
- Calibration, validation, and standardization
- Procedures
- Data analysis and calculations
- Method performance objectives
- Pollution prevention (if applicable)
- Data review and acceptance QC criteria
- Corrective Action for out of control data
- Waste management (if applicable)
- Method identifier and references
- Any relevant tables, flow charts or diagrams

The SOPs are written by the Department Manager, the Team/Task Leader or an experienced Scientist and are reviewed annually for technical accuracy and adherence to general QA/QC protocols. The SOP is signed and dated by the author, then is submitted for technical review, QA review, and final review by the laboratory director. Each method SOP contains a detailed table of all modifications taken against the actual reference method. Modifications and/or additions to the SOP are similarly reviewed and signed. Each hard copy SOP carries a unique revision number, control copy number, and date of generation. The SOPs are treated as confidential and proprietary and are maintained under the authority of the QA department. The original is kept in the QA department and extra copies in various laboratory sections as needed. Electronic versions of the SOPs are stored on a secured network drive, which only the QA Department can access. SOP summaries that include analyte lists, reporting limits, QC criteria and current variances to published methods are available to clients in .pdf form as the ATL Methods Manual Summary. Copies of SOPs are made available to State and Federal accreditation and regulatory entities.

Current SOPs are stored electronically in a secured read-only database to allow review online by laboratory personnel. Whenever an SOP is updated and implemented, it appears in the electronic database. The QA personnel inform the Department Managers and the Team Leaders of the availability of the revised SOP. The Department Managers or the Team Leaders inform team members who then access the SOP from the laboratory network in order to read the SOP. Once the Scientist/Analyst reads the SOP, he/she logs the date in the SOP tracking software, or signs and dates a copy of the title page from the hard copy stored in the laboratory. This documentation is then filed in his/her training record. The Department Manager and/or the Team Leader assess the accuracy and completeness of the documentation annually at the time of the employee's performance review. Missing or incomplete documentation is noted in the employee's performance review.

A comprehensive list of ATL's SOPs can be found in Appendix B.

3.1.3 Revisions to SOPs

The revision number of the referenced method is noted in the method-specific SOPs. The protocols and deviations are specific to that revision number. Air Toxics does not operate under more than one version of a referenced method at any time. The specific protocol used for analysis can be tracked using the effective date noted on the front page of the SOP.

Each SOP update is identified by a unique revision number. As with referenced method revisions, only one revision of an SOP is used in the laboratory at any one time. A complete description of ATL's system for writing and

updating SOPs can be found in ATL's SOP #46.

3.1.4 Documenting Method Specific Deviations

Most air methods were not written as definitive and all have a strong performance based component to them. It is not unusual for the lab to have to design and create sampling interfaces or moisture control devices or to add additional quality assurance requirements to the methods in order to meet more stringent project or program requirements. Any variances to referenced methods are summarized in tabular form in the laboratory SOP. Signatures of the Laboratory Director and QA Manager on the front page of each SOP indicate review and approval of these variances. A copy of the method modifications table from the SOP appears in the Laboratory Narrative section of the comprehensive validation package or standard final report (Table 3.1). The QA team maintains and updates the templates used to create the Laboratory Narrative section of each work order. Each template has a revision date to ensure that only the most recent SOP table appears in the Laboratory Narrative.

On occasion, the need arises to change some aspect of an established SOP to accommodate enhancements to either the equipment or the method. The bench chemist documents the request for the change and the reasons behind it in the 'Request for Technical Change' form (Exhibit 3.1). The form is routed through the Department Manager and Team Leader with approval for the change noted by signature of the Laboratory Director and Technical Director. The form also identifies any established SOP's which should be revised/amended to incorporate the changes made. The forms are serialized in order to track progress and implementation. SOP Amendment forms are also used to reflect changes that are made to SOPs prior to a new revision.

Table 3.1. Example Method Modification Table

Requirement	EPA Method TO-3	ATL Modifications
Preparation of Standards	Levels achieved through dilution of gas mixture	Levels achieved through loading various volumes of the gas mixture
Initial Calibration Calculation	4-point calibration using a linear regression model	5-point calibration using average Response Factor
Initial Calibration Frequency	Weekly	When daily calibration standard recovery is outside 75 – 125 %, or upon significant changes to procedure or instrumentation
Daily Calibration Standard Frequency	Prior to sample analysis and every 4 - 6 hrs	Prior to sample analysis
Minimum Detection Limit (MDL)	Calculated using the equation DL = A+3.3S, where A is intercept of calibration line and S is the standard deviation of at least 3 reps of low level standard	40 CFR Pt. 136 App. B
Moisture Control	Nafion system	Sorbent system

Exhibit 3.1. Example Technical Change Request Form

Request for Technical Change Form **No.** VOC -001

This form is to be used to propose any technical changes from ATL's Standard Operating Procedures.

Initiated By: _____ Date: _____

I. Description of Proposed Change:

II. Reasons for Proposed Change:

III. Method/Instruments Affected:

(continued)

Exhibit 3.1. Example Technical Change Request Form (*Continued*)

IV. Approvals:

Laboratory Director Approval: _____ _____
Linda L. Freeman Date

Technical Director Approval: _____ _____
Signature Date

V. Changes in ATLAS Database

Valid Values Table(s)/Analyte Lists changed by: _____ _____
Signature Date

VI. Affected SOPs:

SOP/Rev #: _____ Date Revised/Amended: _____ Revised/Amended by: _____
Initials

SOP/Rev #: _____ Date Revised/Amended: _____ Revised/Amended by: _____
Initials

SOP/Rev #: _____ Date Revised/Amended: _____ Revised/Amended by: _____
Initials

VII. Additional Comments:

_____

_____

Initials: _____ Date: ____

VIII. Notifications:

QA Manager: _____ _____
Signature Date

Department Manager: _____ _____
Signature Date

CSR Team Leader (as required): _____ _____
Signature Date

Team Leader (as required): _____ _____
Signature Date

Team Leader (as required): _____ _____
Signature Date

Team Leader (as required): _____ _____
Signature Date

Date Implemented:

This change to ATL's Standard Operating Procedures has been implemented by:

_____ _____
QA Signature Date

3.1.5 Documenting Project Specific Deviations

Project specific QAPPs are reviewed by the Project Chemist (or designee) or a Technical Director. Project Managers, Team Leaders and key Scientists may review these documents as well. The laboratory may also take variances against method criteria established in project specific SOWs or QAPPs. The Project Chemist (or designee) reviews the project specific criteria during project proposal and notes any variances from standard laboratory SOP in a table. A variance table (Table 3.2) is then incorporated into the bid proposal for review and acceptance by the prospective client. The client notes acceptance by signature or initial and date in the designated field of the table. The project specific variance table is stored on a secured network drive following approval. A Project Profile (Exhibit 3.2) is initiated at the same time. A summary of the analytical requirements which differ from ATL's relevant SOP is documented in a Project Requirement Table and included in each Work Order folder. The Project Profile may also be accessed through the ATLAS database. The Client Service Representative is responsible for noting the location of the Project Requirement Table in the Project Profile. Finally, the variance table is included in the Comprehensive Validation Package (CVP). The project specific QAPPs are maintained in electronic form on a network drive.

Table 3.2. Example Project Specific Variance Table

SOW	ATL SOP	VARIANCE APPROVAL*
Method 2720C Fixed Gases	ASTM D-1945 Fixed Gases	
RDLs determined upon receipt of lab MDLs	Standard lab RDLs of 10 ppmv	
Field blank can one per batch	Not provided	
Canister released 90 days past reporting	Canisters released 30 days past day of sampling	
72 hour retention time study	±0.06 minutes standard SW-846	
Calibration verification daily with all analytes ±25% expected value	All compounds within 15%; Spike concentration is 25 ppbv	
Accuracy/precision study per analyst with project limits	Per analyst once every 12 months using ATL standard limits only	
LCS once per 5 point, ±25% difference for all compounds	All compounds within ±15%; Spike concentration is 25 ppbv	

*NOTE: Each variance needs to be approved by the client's initial and date. An initialed copy of this variance table will appear in the Comprehensive Validation Package.

3.2 TRAINING

3.2.1 Team Training

ATL laboratory staff members have sufficient education, training, and technical knowledge to perform their assigned duties. Each team has both experienced and in-training staff members. Those in training work under the supervision of a more experienced peer who is typically the lead Scientist assigned to that area.

Training of laboratory staff in analysis consists of three developmental stages:

- *STAGE I. Introduction*

Initial instruction by the analytical team leader or an experienced staff member concerning basic elements of the method and brief overview of instrumentation. Applicable SOPs and methods are read. During this time, the trainee is an observer.

- *STAGE II. Training*

Periods of close contact and direct supervision by an experienced staff member. During this time, which may last for several weeks, the analyst performs tasks independently. All aspects of his/her work are reviewed by the supervisor or experienced staff member.

- *STAGE III. Advanced Operation*

Independent work with data review by the analytical team leader or a designated peer.

The final step in the training process allows the bench Analyst to document competency by analyzing four consecutive Laboratory Control Samples which is documented by a Demonstration of Capability Form (see Exhibit 3.5). A Continuing Demonstration of Capability must be made on an annual basis and documented by a Continued Method Proficiency Form (see Exhibit 3.6). Personnel who perform on odd shifts and do not commonly spec out instrumentation may substitute a duplicate analysis with acceptable precision (%RPD) for the four Laboratory Control Sample analyses when fulfilling the Continuing Demonstration of Capability.

The QA team ensures that training of each member of the technical staff is complete, documented, and up to date. Exhibit 3.4 is an example of a Training Record form. It is the responsibility of the employee to keep his/her record current. An Analyst's/Scientist's training is considered current if the training record contains evidence that the employee has:

Training Record Checklist

- read the current version of the QA Manual
- completed laboratory training record
- completed necessary internal or external training classes
- completed the training class on ethical responsibilities
- read and understood the current version of relevant SOPs
- demonstrated initial proficiency in the methods by acceptable performance on four Laboratory Control Samples; proficiency is measured by accuracy and precision
- demonstrated continued proficiency in the methods by acceptable performance on four Laboratory Control Samples or duplicate analysis with RPD $\leq$ 25% between two analysts; proficiency is measured by accuracy and precision

The Department Manager and/or Team Leader review the training record on a yearly basis during an employee's annual performance review. Deficiencies in the training record are documented and returned for correction (see Exhibit 3.7). Consistent failure to maintain updated training records is noted in the performance review and effects the employees overall job rating.

A series of classes taught by in-house experts are offered throughout the year. Topics range from in depth technical aspects of the instrumentation to an overview of selected methods. Exhibit 3.8 contains a sample of internal courses that have been offered. The list of courses is subject to change on a yearly basis as a function of availability of instructors. Course attendance is mandatory for topics specifically related to an employee's job function. The QA department and management teams determine which courses are mandatory. Course attendees may be tested to ensure that they have achieved an acceptable understanding of the material presented. Completion of courses is documented in the employee's training record.

3.2.2 External Training

External training courses offered by software experts, instrument manufacturers, or other recognized experts in analytical instrumentation and/or analysis are attended by ATL employees. The course description, dates offered and record of attendance are kept in the employee's training records. The company maintains a budget for external training classes and higher education.

3.2.3 Quality Training

All new Air Toxics Limited employees are required to attend the Quality Assurance Orientation course. Completion of the course is documented in the employee's training record. The course outline includes:

- Introduction to QA and Laboratory Nomenclature
- How to Use CARs
- Definitions of SOPs and LQAP
- Training Documentation
- Ethics I (Overview)
- Ethics II (Annual)

3.2.4 Health and Safety Training

Laboratory staff may, on occasion, be exposed to the handling of flammable solvents, compressed gases or toxic calibration standards. There are four to six staff members comprising the Safety Committee. Some members are 40 hour OSHA trained and respirator fitted. Education in the safe handling and disposal of these materials is accomplished as follows:

- Each new employee is given a safety tour of the facility within the first two weeks of employment. Documentation of this orientation appears in the employee's training record.

- The safety committee meets quarterly (or more frequently if needed) to discuss safety concerns and ways of improving safety in the work place.

- The safety committee schedules on going safety training throughout the year.

- If special precautions must be taken to perform a method, a safety section is included in the method SOP which discusses protocols and other measures for risk reduction through exposure prevention.

- ATL maintains Material Safety Data Sheets (MSDS) for each chemical used on-site. The MSDS are accessible to all personnel in the library area.

- ATL has access to MSDSs on the Internet through its vendors.

The safety committee staff members are assigned to duties including hazardous waste disposal, incident or spill management, staff training, Chemical Hygiene Plan review, and leading the safety committee.

3.3 ASSESSING ADHERENCE AND COMMUNICATING FINDINGS

The QA team plays a key role in establishing quality policy and protocols. The QA Department ensures that the established guidelines are followed through various quality control programs, which are designed to detect non-compliance or departure from protocol. Each quality control program includes documentation of the assessment process and timely feedback to the management and staff involved.

3.3.1 Data Review

The QA team reviews Work Orders which the client has requested 100% QA review. Deficiencies noted during review are documented and communicated to the staff involved.

QA REVIEW CHECKLIST

- **Assessing accuracy and completeness of the laboratory narrative**
- **Assessing Analysis/Reporting vs. Project Profile/SOP requirements**
- **Documentation of any corrective actions**
- **Documentation of unusual circumstances**
- **Verification of the QC meeting criteria**
- **Verification of sample dilution factors**
- **Appropriate peak integration and documentation for manual integration**
- **Verification of appropriate data flags**
- **Verification of sample id's vs. COC**
- **Verification of reporting list, units and report header information**
- **Verification of sample holding time**
- **Verification of adherence to analytical sequence clock times**
- **Verification of the appropriate Initial Calibration**
- **Verification of sample reporting limits**
- **Manual verification of one sample result from raw area counts**
- **Assessing accuracy and completeness of the Client Lumen report (if applicable)**

The QA reviewer will look both for appropriate as well as inappropriate laboratory practices. Inappropriate practices are those which fall outside established laboratory SOPs. If inappropriate practices are suspected, the QA reviewer will verify the result with the QA Manager and the Department Manager and/or Team Leader, initiate a Corrective Action Request, and if necessary, form a committee consisting of but not limited to the Department Manager and/or Team Leader, Technical Director, and Laboratory Director. Most Corrective Action Requests may be traced to human error. Oversights of this nature are simply documented and feedback is given to the Analyst or Scientist involved.

On occasion, the committee may determine that the Corrective Action Request was not attributable to simple human error. The reasons for the non-conformance and appropriate action to be taken are discussed and implemented by this committee. Typical actions include retraining of the individual involved along with a remedial period of close monitoring by the Department Manager and/or Team Leader. The QA team or an approved peer reviews all data reported by the Analyst during the remedial period. The laboratory uses a three-strike rule with respect to non-compliance issues. New Analysts are rigorously trained to follow SOPs. This training lasts several months. Re-training is done if there is cause to suspect non-compliance. Secondary training typically lasts 30 days. Any further evidence of non-compliance may result in termination.

Client Services Representatives create Project Profiles that specify 100% QA review. When samples are received the Sample Receiving Team will automatically add a QA review to a workorder if 100% frequency has been requested as per the profile.

After QA review is complete the reviewer enters the review date in the sample tracking database. If a QA reviewer discovers an error, necessary corrections are made and the work order is reissued.

Another tool used for data review involves the use of proprietary in-house data validation software to review every data point generated

and to alert the reviewer when manual integrations occur. The software is also programmed to report when more than three attempts for a daily CCV or tune check standard to pass have been attempted. (Validation software currently reviews all method TO-14A/TO-15 results. Further software development is scheduled in 2007 to bring more methods on line).

3.3.2 Corrective Action Program

The QA team manages the Corrective Action Program and maintains the Corrective Action tracking database. A Corrective Action Request (CAR) is initiated any time sample results are adversely affected by system non-compliance with established SOPs or program requirements, any time an internal or external assessment results in a finding, any time there is a failed proficiency evaluation sample, any time there is a failure quality system such that data quality is affected, and lastly, any time there is a customer inquiry into the laboratory's data quality and laboratory error is found (see Exhibit 3.2). This request is documented using one of ATL's eCAR forms - see Exhibit 3.9. A database is used to track the date of resolution, the necessity for a follow-up, and the date the follow-up action is completed.

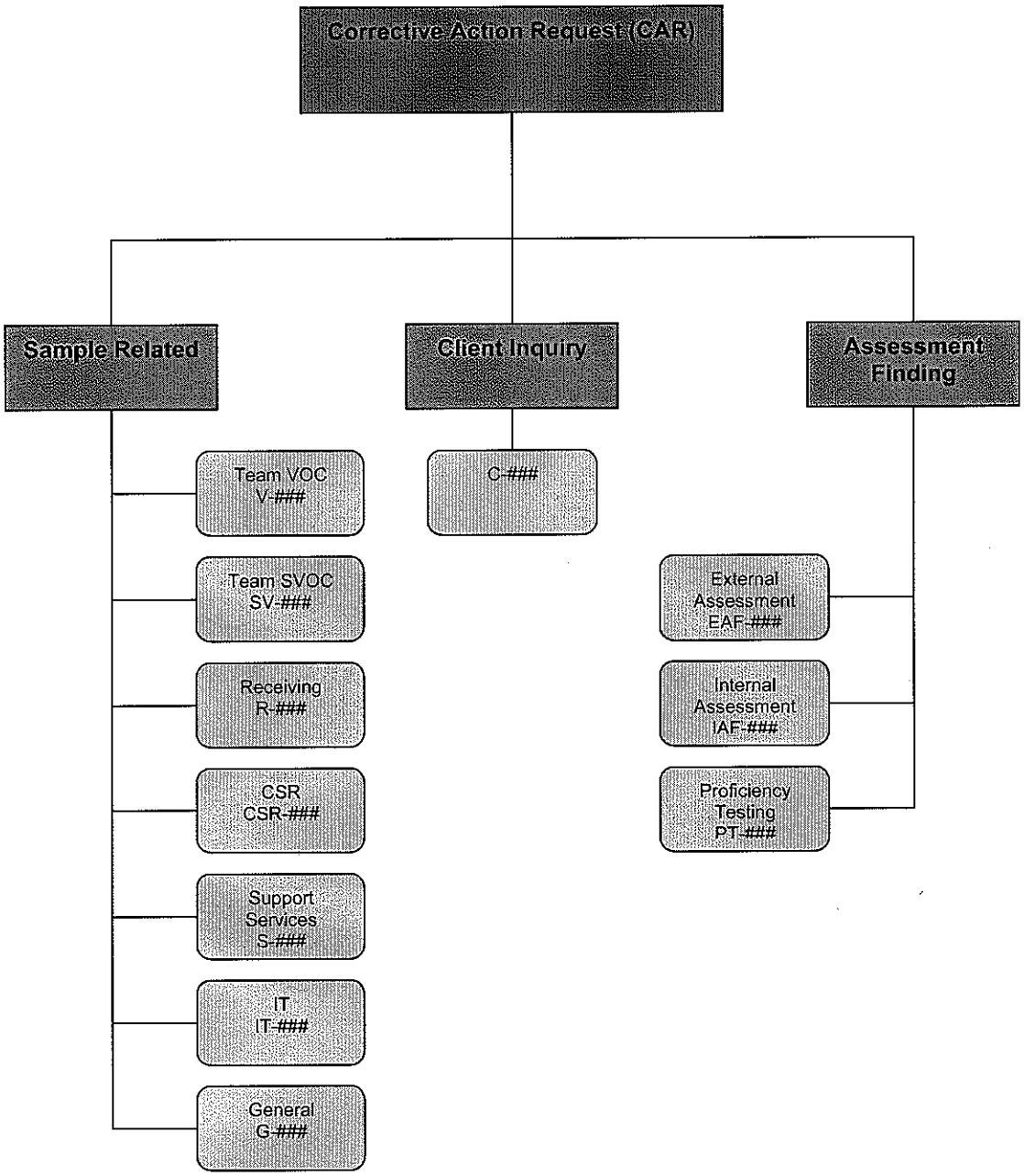
Corrective Action Requests which require immediate resolution must be completed and finalized within 2 business days. All other CARs must be resolved within 30 business days. The status of corrective actions that have not yet been completely resolved (including follow-up actions), are discussed during the weekly QA Meetings. Whenever a customer raises an issue relating to data quality, the inquiry is documented in the Atlas Contacts database. A representative of the QA team or a Technical Director reviews the data in question and investigates any systematic problem that may be evident. If results of the review and investigation merit corrective action a CAR will be initiated along with any necessary follow-up action.

Examples of when the client inquiry CAR may be initiated include:

- Blind field duplicates that do not agree
- Field blanks that had contamination present.
- Blind proficiency sample that did not meet accuracy objectives
- Sample splits that do not meet precision objectives
- Outlet sample results that were higher than inlet sample results
- Sample results that cannot be manually verified
- Sample results that do not meet program requirements

A portion of the CAR database is associated with sample receiving and analysis. Should a malfunction occur with a pending sample, the client is contacted prior to analysis to confirm if the analysis should continue. The CAR form documents the contact and resolution of the issue. Should the decision be made to proceed with analysis then any malfunction affecting data quality is detailed in the laboratory narrative. Instructions to proceed with analysis and narration of the affected results are documented in the CAR form. The Department Manager and/or Team/Task leader must review the CAR and determine if the error is isolated or systematic. After QA review, the CAR form is then filed with the Work Order as a permanent record of the nature of the problem and the resolution. A complete description of ATL's CAR system can be found in ATL's SOP #61.

Exhibit 3.2. Types of Corrective Action Request Forms



3.3.3 QA Management Meetings

Each week the QA Manager leads a meeting with the Department Managers, the analytical Team Leaders, the Client Services Team Leader, and the Support Services Team Leader. All other Managers and Directors are welcome to attend. These meetings are called to discuss the effectiveness of the quality systems, specific quality issues that may have surfaced during the week, and to monitor progress with respect to open Corrective Action items. Agenda items are added and removed at the discretion of the QA Manager or QA staff.

The meeting is used as an interactive forum in which non-compliance issues are discussed with respect to the overall suitability of the quality system involved. Non-compliances are screened to see if the quality system itself is in need of a review or modification. If it is determined that a particular quality system needs to be designed or revised then the committee takes responsibility for restructuring that system. The issue cannot be removed from the weekly agenda until the new system is in place. Minutes of each meeting are kept in a QA electronic form on the QA network drive.

3.3.4 Conducting Internal Assessments

The QA team conducts internal assessments of all major production areas of the lab on a yearly basis. The production areas are separated into assessment modules by referenced methodology. Whenever possible audits are scheduled to occur after the yearly update and revision of the relevant SOP. Audits are composed of three events:

- Laboratory assessment based on the current SOP by the QA Team.
- Circulation of the assessment report and issuing of any necessary corrective action forms.
- Satisfactory response to audit findings.

An assessment checklist is developed for each area by the QA Manager or designated staff. The checklist contains general, method specific, and SOP specific practices (Exhibit 3.10). The assessment process addresses whether or not quality systems (e.g., adherence to the current revision of the SOP, proper and complete documentation practices etc.) are in place and understood. Health and safety issues are also covered.

Results of the assessment are summarized in the checklist that serves as the basis of the report. Findings that are determined to be in need of Corrective Action are processed through the standard CAR program. If findings imply that there has been a significant impact on the data, the report will be corrected and reissued to the client. Copies of the internal assessment report are circulated to the Department Managers and Team Leaders and other members of ATL management team.

3.4 COMMUNICATING WITH MANAGEMENT

Results of the QA assessments are documented in a **Monthly QA Status Report** that summarizes the numbers and types of CARs produced, the status of any outstanding CARs, a summary of customer inquiries received, and the number and types of reissued sample reports. This report is distributed to all Directors, Managers, and Team Leaders.

Exhibit 3.3. Example ATL Project Profile

Project Profile

Project Name	Project Number	P.O.#
Big Landfill		

Project Description

Project Requirement Table: O:\Variances\2003\0303-001QC

	Report to Address	Bill to Address
Name:	Mr. John Jones	Mr. John Jones
Company:	Average Engineering Firm	Average Engineering Firm
Address:	1234 Anystreet Avenue	1234 Anystreet Avenue
City:	Your Town	Your Town IA 50841
State/Zip:	IA 50841	
Phone/Fax:	641-987-6543 (Phone) 641-234-5678 (Fax)	
Email:	jj@aef.com	

Done:	Y	QAPP on File?	Y
CS Rep:	DD	Penalties?	N
ProjectID:	5273	24 Hour Clock?	Y
Variance:	Yes	Charge For Shipping?	N

Analysis(es):	Reporting List:	Units	TAT	Price	Surcharge
Modified TO-15	Modified TO-15	ppbv	10 Day	.00	None

QA/QC:

Reporting List	Dups	CCV	LCS
Modified TO-15	10%	10%	1/ANB

Media:	Media Price:
6 Liter Summa Canister	.00

Deliverables:	Done:	Price:	Price Is:	Due:	Send VIA:
Standard ATL Report	☐	.00	Per WO	10 Working Days	
Client Specific Disk Format	☐	.00	Per WO		Mail

Notes to Receiving:

Notes to Lab:

Notes to Reporting:

Miscellaneous Items:	Price:

Exhibit 3.4. Example Laboratory Training Record

@ Air Toxics Ltd.

LABORATORY TRAINING RECORD

EMPLOYEE:_____ PROCEDURE:_____

The normal training program consists of three developmental stages, as explained below. Indicate the necessary dates completed for each stage. You should always progress from one stage to the next in sequential order. Training is complete when this form, along with associated precision data, is submitted to the Quality Assurance Department. Upon return this form should be retained in the employee training record.

STAGE I. Introduction

Initial instruction covers the basic elements of the method as well as a brief overview of the instrumentation and is provided by the Team Leader or an individual who has been previously qualified for training on the procedure. Activities include reading applicable SOP(s), reading the reference method, and loading samples. During this time, the trainee is an observer.

Date Initiated: _____ Trainer:_____

Date Completed:_____ Trainers Qualification Date:_____

STAGE II. Training

This is a period of close contact with and one-on-one training by the Team Leader or a qualified peer. Activities include performing Initial and Continuing Calibrations, routine maintenance, and data reporting. During this time the trainee performs tasks independently as assigned but with all aspects of his/her work reviewed by the Team Leader or qualified peer.

Date Initiated: _____ Trainer:_____

Date Completed:_____ Trainers Qualification Date:_____

Stage III. Advanced Operation

During this period the trainee operates completely independently with his/her work passed into the normal review cycle. Completion of this stage is accomplished when four LCS standards are analyzed and meet the method accuracy and precision objectives (attach quant sheet(s) and/or summary and copy of run logbook/extraction logbook page(s)).

Date Initiated: _____

Date Completed:_____

Employee Signature:_____

Training Approval

The three stages of training have been completed and the employee considered to be qualified to perform the procedure.

TEAM LEADER: _____ Date:_____

QUALITY ASSURANCE: _____ Date:_____

Revised 8/8/2007

Exhibit 3.5. Demonstration of Capability Form

@ Air Toxics Ltd.

Demonstration of Capability

Initial Method Proficiency Certification Statement

Date Certified: _____

Laboratory Name: Air Toxics Limited
Address: 180 Blue Ravine Road, # B
Folsom, CA 95630

Matrix: Air
Method Name: _____
SOP: _____
File Numbers: _____

We, the undersigned, CERTIFY that:

Analyst/Scientist	Signature	Date

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 identified on this certificate.

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 of Capability are true, accurate, complete and self-explanatory (1).

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well-organized and available for review by authorized assessors.

Heidi C. Hayes		
VP/Technical Director	Signature	Date

Melanie A. Levesque		
Quality Assurance Manager	Signature	Date

This certification form must be completed each time a capability study is completed.

(1) True: consistent with supporting data
Accurate: based on good laboratory practices consistent with sound scientific principles and practices.
Complete: includes the results of all supporting performance testing
Self-explanatory: data properly labeled and stored so that the results are clear and require no additional explanation

Revised 8/1/2007

Exhibit 3.6. Continued Method Proficiency Form

@ Air Toxics Ltd.

Demonstration of Capability

Continued Method Proficiency Certification Statement

Date Certified: _____

Laboratory Name: Air Toxics Limited
Address: 180 Blue Ravine Road, # B
Folsom, CA 95630

Matrix: Air
Method Name: _____
SOP: _____
File Numbers: _____

We, the undersigned, CERTIFY that:

Analyst/Scientist	Signature	Date

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 Continued Demonstration of Capability.

2. The test method(s) was performed by the analyst identified on this certificate.

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 Continued Demonstration of Capability are true, accurate, complete and self-explanatory (1).

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well-organized and available for review by authorized assessors.

Heidi C. Hayes		
VP/Technical Director	Signature	Date
Melanie A. Levesque		
Quality Assurance Manager	Signature	Date

This certification form must be completed each time a capability study is completed.

(1) True: consistent with supporting data
Accurate: based on good laboratory practices consistent with sound scientific principles and practices.
Complete: includes the results of all supporting performance testing
Self-explanatory: data properly labeled and stored so that the results are clear and require no additional explanation

Revised 8/1/2007

Exhibit 3.7. Example Training Record Review Check Sheet

@ Air Toxics Ltd.

TRAINING RECORD CONTENT SHEET

Employee: _____ Review Date: _____

Department: _____ Position: _____

Required Documentation

- ☐ Resume
- ☐ QA Orientation Training
- ☐ Safety Orientation checklist
- ☐ Documentation of Reading current version of the LQAP
- ☐ Current Ethics Training
- ☐ Documentation of reading current version of applicable SOP(s)/Amendments

Documentation of Classes / Continuing Education Courses (completed since previous review)

- ☐ Quality Assurance Class Date: _____
- ☐ Manual Integration Protocol Date: _____
- ☐ Hazard Communication Training Date: _____
- ☐ Inappropriate Lab Practices Date: _____
- ☐ Other: _____ Date: _____
- ☐ Other: _____ Date: _____
- ☐ Other: _____ Date: _____
- ☐ Other: _____ Date: _____

Other Documentation / Comments

(notation of additional or missing items, incorrectly completed forms, organization, etc.)

☐ **Documentation of Training attached for Methods/Procedures** (please list)

_____

_____

_____

Review

Employee Signature: _____ **Date:** _____

Reviewed By: _____ **Date:** _____

Revised: 8/8/2007

Exhibit 3.7. Example Training Record Review Check Sheet *(Continued)*

@ Air Toxics Ltd.

ADDITIONAL TRAINING RECORD CONTENT

Employee: _____ Date: _____

Department: _____

Documentation of Training (Continued)

Procedure: _____

Laboratory, Data Write-up, or General Training Record

Completion Date: _____

- ☐ "Date Completed" and "Trainer" filled out for each stage
- ☐ Employee Signature
- ☐ Team Leader Signature
- ☐ Quality Assurance Signature

Initial Proficiency Data

Completion Date: _____

- ☐ NELAP *"Demonstration of Capability"* form completed
- ☐ Four replicate LCSs (analyzed on the same day or on separate days)
- ☐ Meets method criteria for Accuracy and Precision
- ☐ Date and initials of reviewer on Proficiency Data

Current Continued Proficiency Data

Completion Date: _____

- ☐ Current NELAP *"Demonstration of Capability"* form
- ☐ Four replicate LCSs (analyzed on the same day or on separate days), or Duplicate Analysis (%RPD ≤ 25% between two Analysts)
- ☐ Meets method criteria for Accuracy and Precision
- ☐ Date and initials of reviewer on Proficiency Data
- ☐ Performed within a year of review date

Procedure: _____

Laboratory, Data Write-up, or General Training Record

Completion Date: _____

- ☐ "Date Completed" and "Trainer" filled out for each stage
- ☐ Employee Signature
- ☐ Team Leader Signature
- ☐ Quality Assurance Signature

Initial Proficiency Data

Completion Date: _____

- ☐ NELAP *"Demonstration of Capability"* form completed
- ☐ Four replicate LCSs (analyzed on the same day or on separate days)
- ☐ Meets method criteria for Accuracy and Precision
- ☐ Date and initials of reviewer on Proficiency Data

Current Continued Proficiency Data

Completion Date: _____

- ☐ Current NELAP *"Demonstration of Capability"* form
- ☐ Four replicate LCSs (analyzed on the same day or on separate days), or Duplicate Analysis (%RPD ≤ 25% between two Analysts)
- ☐ Meets method criteria for Accuracy and Precision
- ☐ Date and initials of reviewer on Proficiency Data
- ☐ Performed within a year of review date

Exhibit 3.8. Examples of Internal Training Courses (Subject to Change)

Gas Chromatography
Column Selection, Care & Maintenance
Detectors – Overview of Team VOC & SVOC
The mass spec detector - specific training
GC Parameters
Injection Techniques
Proper Use of Fittings and Gas Traps
Quality Assurance
Introduction to QA and Lab Nomenclature (2 sessions)
Calibration and Analysis
Standards Preparation and Documentation
Syringe & Dilution Techniques
Proper Log Book Protocol
Canister Pressurization
Correct Operation of Manual Interface
NOAH – Overview
The ATL Way
Bidding through Invoicing, the Process
Training Records - How to set up & maintain
Health & Safety Training
Integrity Training – Ethical Laboratory Practices
Computer Systems and Security
On the Job Team Specific courses
Detectors – Specific Training (PID/FID, ECD)
Hydrocarbon Profiling and NMOC
NIOSH Overview – 2456 & 5515
EDD Production
Understanding Analysis of Atmospheric Gases
Understanding Analysis by TO-3
Understanding Analysis by TO-13/8270
Overview of Sulfur Analysis & the SCD
Overview of Headspace (RSK-175) analysis
Understanding Analysis by TO-14A/15
Understanding VOST Analysis
Power Point
Ethical and Defensible Manual Integration

Exhibit 3.9. Example eCAR Form

Corrective Action Report

No._____

Initiated By:	**Date:**
Team Leader:	**Date:**
CSR:	**Date:**
QA Dept:	**Date Closed:**

Team(s) affected:

Method(s) affected:

Work order(s) affected:

Project Profile ID(s):

Sample(s) affected:

CSR:

Describe the nonconformity and its cause:

Describe the Corrective Actions:

Client Notification:

Person Notified:	**By:**	**Date:**

Client Instructions:

Exhibit 3.9. Example eCAR Form *(Continued)*

Team Leader Notification:

Person Notified:	By:	Date:

Additional Corrective Actions:

Date Implemented:

Follow-up Action Necessary?

Describe Follow-up Action:

Date Follow-up Action Completed:

Completed By:

Exhibit 3.10. Example Internal Audit Checklist

Modified TO-17
Technical & Quality Audit Checklist

Date Audit Performed:_____
Auditor(s):_____
Participant(s): _____

Category	OK	Observ.	Finding (CAR #)	Comments
General				
Has it been documented in the analyst's Training Record that the current SOP for this procedure has been read and understood? (#5 Rev.7)				
Has the analyst demonstrated Proficiency for these methods within the last 12 months?				
Has it been documented that the analyst has read the current Laboratory QA Plan? (Rev. 19)				
Safety Procedures				
Does the analyst have documented Safety Training?				
What is the proper procedure to follow when working with solvents or standards?				
Sample Preservation, Handling, and Storage				
What are the holding times for TO-17 samples? At what temperature are the samples stored? How are these temperatures verified?				
How are tubes stored in order to prevent contamination?				
How is potential contamination monitored?				
How are samples logged into and out of the sample custody cage?				

Exhibit 3.10. Example Internal Audit Checklist *(Continued)*

Modified TO-17
Technical & Quality Audit Checklist

Category	OK	Observ.	Finding (CAR #)	Comments
Standard Preparation				
How are these standards stored? What are the expiration dates of these standards?				
Provide documentation of standard preparation for TO-17 samples. Perform a manual re-calculation of a standard concentration. Trace a standard back to its certificate of analysis.				
Calibration and Quality Control Procedures				
How often must a BFB tune be analyzed? What if it fails acceptance criteria?				
At what level is the CCV analyzed? Is this level ever varied?				
When is an LCS analyzed and what are the acceptance criteria? Does the LCS contain all target analytes?				
What is the acceptance criterion for the Lab Blank? When is a Lab Blank analyzed?				
Sample Analysis				
How does the analyst verify Project QC requirements prior to analysis?				

Exhibit 3.10. Example Internal Audit Checklist *(Continued)*

Modified TO-17
Technical & Quality Audit Checklist

Category	OK	Observ.	Finding (CAR #)	Comments
Verify the instrument operating parameters for TO-17 Methods. How are deviations from these parameters documented? Who is authorized to make these changes?				
What is the definition of an analytical batch?				
Review instrument Run Logbook. Has the logbook been reviewed on a monthly basis? Is documentation correct and complete?				
How are temperatures and flows used during analysis verified to be accurate?				
How are compounds qualitatively identified?				
How are compounds quantitatively identified? Re-calculate a sample result.				
What must be done when there is interference with the primary quantitation ion? What is the criterion for this to occur?				
Is it ever necessary to perform manual integrations? When is it acceptable or unacceptable to perform manual integrations? How must manual integrations be documented?				

4.0 QUALITY OBJECTIVES

The primary objective of the QA Program is to ensure that the laboratory is producing data that meet the laboratory's standard acceptance criteria for each method. Acceptance criteria from project-specific QAPPs are also used when required.

The laboratory's standard acceptance criteria and the sources of those criteria are specified in Sections 6.0-6.18 of this Quality Manual. Definitions of parameters used to assess the quality of the data are defined below.

4.1 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

4.1.1 Precision

Precision measures the reproducibility of measurements. Analytical precision is the agreement among duplicate (two) or replicate (more than two) analyses of the same sample. The acceptance for precision is determined using the relative percent difference (RPD) between the duplicate sample results. The %RSD (relative standard deviation) is used to document precision of linearity for the initial calibrations. The formula for the RPD and RSD calculations are provided in Exhibit 4.1.

Field duplicate samples represent *total* precision, the reproducibility associated with the entire sampling, and analysis process. However, the identification of field duplicate samples are typically not known to the laboratory, and therefore not specifically evaluated by the laboratory's QA department.

4.1.2 Accuracy

Accuracy measures correctness and includes components of random error (variability due to imprecision) and systemic error. Analytical accuracy is measured by comparing the percent recovery of analytes spiked (as compared to the expected value) to pre-established accuracy limits (i.e., acceptance criteria). Any type of spiked sample measures accuracy. The formula for calculation of accuracy is included in Exhibit 4.1 as percent recovery (%R) from pure and sample matrices.

4.1.3 Representativeness

Representativeness is achieved through use of the standard analytical procedures described in this Quality Manual.

4.1.4 Completeness

Completeness is the percentage of data, which meets the established acceptance criteria referenced in Sections 6.0-6.18. ATL's goal is to achieve at least 95% completeness for both normal turn-around-time (TAT) and rush TAT data. Meeting the method specification outlined in each SOP prior to analyzing project samples is our means of achieving this goal.

4.1.5 Comparability

Comparability is the confidence with which one data set may be compared to another. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. Comparability is achieved by using standard analytical methods, reporting data in standard units, and using standard and comprehensive reporting formats.

4.2 LIMIT OF DETECTION, LIMIT OF QUANTITATION, AND INSTRUMENT CALIBRATION REQUIREMENTS

4.2.1 Limit of Detection

The Limit of Detection (LOD) is a statistically determined value (by Method Detection Limit per 40CFR Part 136 Appendix B). The LOD

must be less than the Limit of Quantitation (LOQ). If the true concentration is below this value, the analyte may not be detected. Each LOD study is repeated at least once per twelve-month period, when a new instrument is installed, when there is a major change in the analytical configuration such as column, detector, sample concentrator, sample loop size, etc. or when there is a major change in the extraction method such as solvent, extraction apparatus, clean-up procedure, etc.

All analytical constituents noted by methods in Section 6.0 are to be reported with a valid and current LOD, but in the case of special request compounds LODs are performed only when a client specifies it to be a project requirement. Special request compounds are reviewed by the Department Managers to determine the cost to the laboratory for additional LOD analyses. The additional value added is then factored into the bid that is submitted to the prospective client.

4.2.2 Limit of Quantitation

ATL reports down to the Limit of Quantitation (formerly called the Practical Quantitation Limit or Reporting Limit) which is the lowest concentration contained in a linear calibration).

The LOQ represents a uniform value that can be accurately detected for any particular analyte on each instrument thereby providing consistency for samples analyzed on different instruments. The Reporting Limit is verified by the statistical and analytical LOD studies.

The acceptance criterion for the LOD study is a value of less than the LOQ. Corrective action including raising the LOQ may be performed if the statistically and analytically determined LOD does not meet the stated criterion.

4.2.3 Instrument Calibration

Analytical instruments are calibrated in accordance with the referenced analytical methods and internal SOPs. The acceptance criteria are summarized in Section 6.0. All specific target analytes are included in the initial and continuing calibrations.

If multi-point calibrations do not meet acceptance criteria stated in the relevant SOPs, an option to narrow the range of the curve either by eliminating the low point or the high point of the curve may be considered providing all project criteria are still met. Otherwise, the entire calibration curve is repeated. Reanalysis of any level of the multi-point calibration in order to meet QC acceptance criteria is not allowed unless there is evidence of an anomaly such as instrument malfunction or an improper load volume. Documentation of the anomaly must accompany the raw data for the Initial Calibration. Elimination of any of the inner levels of the multi-point calibration in order to meet QC acceptance criteria is not allowed.

Records of instrument calibration and records that unambiguously trace the preparation of standards and their use in instrument calibration are maintained for 5 years. Calibration standards are traceable to standard materials.

A second source (or different lot) standard that contains all target compounds, as noted in the Section 6.0 tables, is analyzed after each initial calibration curve to verify that the standards are correct and the calibration is accurate. The acceptance criteria for the independent source recoveries are presented in Section 6.0.

In the case of special request compounds, a second source analysis is performed only when a client specifies it to be a project requirement. Special request compounds are reviewed by the Department Managers to determine the cost to the laboratory for additional second source analyses. The

additional value added is then factored into the bid that is submitted to the prospective client.

Analyte concentrations are determined primarily using the average RF from the initial multi-point calibration.

4.2.4 Retention Time Windows

The techniques used to establish retention time windows for GC and HPLC analyses vary by method, based on the class of compounds targeted, as well as the instrument specifications (e.g., column type, etc.). Protocol for establishing retention time windows can be found in the method-specific SOPs.

4.3 ELEMENTS OF QUALITY CONTROL

The various types of QC samples are described below. The method specific laboratory QC sample frequency and acceptance criteria may be found in Section 6.0.

4.3.1 Analytical Batch Definition

For non-extractable methods, samples analyzed during a single 24-hour period along with associated matrix specific laboratory QC samples make up an analytical batch. At a minimum, any analytical batch will include a Laboratory Blank, CCV, LCS and an end check for non-GC/MS methods. Reporting of the batch QC samples varies according to project requirements. The number of field samples included in any one analytical batch is limited to 20.

In the case of samples that require extraction prior to analysis, the sample preparation process defines the batch. At a minimum, the sample preparation batch will include a Laboratory Blank and a Laboratory Control Sample (LCS). The maximum number of samples included within one preparation batch may not exceed 20 in one given day.

4.3.2 Continuing Calibration Verification (CCV)

A Continuing Calibration Verification (CCV) containing all analytes of concern is performed at the start of each day and, if required, at the start of every 12 or 24 hour clock for GC/MS analyses. GC and HPLC sample analyses are generally bracketed by opening and end check CCVs (TO-4A, TO-10A and PAMS methods excluded). Mid-batch CCVs are also analyzed as per individual SOP.

The concentration of the CCV is usually near the mid-level of the calibration. The CCV is analyzed at other concentrations within the working range at least once a quarter, or more frequently if specified in an SOP. If the CCV fails to meet the performance criteria then the test is repeated with the same standard (or optionally with a different preparation of the same calibration mix). If the second analysis fails criteria, maintenance should be performed and the test repeated a third time. If the system still fails the calibration verification, a new multi-point calibration curve is performed.

4.3.3 Laboratory Control Spike (LCS)

Each analytical or extraction batch contains at least one mid-level spike using a second source (or different lot) standard containing all (or in the case of extractable a subset of) the target analytes. In the case of non-extracted batches, the LCS is generally analyzed daily prior to sample analysis, but may also serve as an End Check standard. If the stated criteria are not met, the system is checked and the standard reanalyzed. In the event that the criteria cannot be met, the instrument is recalibrated. In the case of extracted LCS, out-of-control recoveries result in data flags since samples cannot be re-extracted.

4.3.4 Internal Standard (IS)

For all GC/MS methods an IS blend is introduced into each standard and blank to monitor the stability of the analytical system. The internal standard acceptance criteria vary by method, but for all applicable analyses at ATL, if the internal standards for the blank do not pass the acceptance criteria, the system is inspected and the blank reanalyzed. Analyses are discontinued until the blank meets the internal standard criteria.

4.3.5 Surrogates

For GC/MS methods and some GC methods, the recovery of the surrogate standard is used to monitor for unusual matrix effects, gross sample processing errors, and to provide a measure of recovery for every sample matrix. The surrogate recovery acceptance criteria vary by method, but for all applicable analyses at ATL, if the surrogate recoveries for the Laboratory Blank do not pass the acceptance criteria, the system is inspected and the blank is reanalyzed. Analyses are discontinued until the blank meets the surrogate recovery criteria.

In some extractable methods, surrogates are added prior to extraction to monitor the efficiency of the extraction process. If the surrogate recoveries are outside acceptance limits, reanalysis occurs. Re-extraction of samples is not possible.

If the surrogate recoveries for a sample are outside the limits, the sample is reanalyzed unless obvious matrix interference is documented. If the surrogate recoveries are within limits in the reanalysis, the second analysis will be reported. If the surrogate recoveries are out of limits a second time, the initial analysis is reported with a narrative indicating that the acceptance criteria for surrogate recoveries are exceeded. Upon request, the data from the matrix effect confirmation analysis is provided to the client.

4.3.6 Laboratory Blank

A Laboratory Blank is analyzed after any applicable standards and prior to the analysis of project samples. A blank is also analyzed in the event saturation-level concentrations are incurred to demonstrate that contamination does not exist. For methods that involve an extraction, a Laboratory Blank is prepared with each set of no more than 20 samples per method per matrix.

The acceptance criterion for the Laboratory Blank is a result less than the Limit of Quantitation (Reporting Limit). The Laboratory Blank is analyzed immediately after the LCS (non-extractable analysis) or the CCV (extractable analysis) to ensure that both the instrument and extraction process are free from contamination. When samples that are extracted together are analyzed on different analytical clocks, a solvent (instrument) blank is analyzed to demonstrate that the instrument is free from contamination.
For work that falls under the scope of the DoD, the acceptance criteria for the Method Blank is as follows:
No analytes detected at $\geq$ ½ the RL. For common laboratory contaminants, no analytes detected $\geq$ the RL. If an analyte in the laboratory blank fails these criteria the associated samples must be reprocessed in another analytical batch unless the analyte resulted in a non-detect. In no sample volume remains for re-analysis, the results will be reported with the appropriate data qualifying code (B flag).

4.3.7 Laboratory Duplicate

Project samples are analyzed in duplicate on a minimum of 10% of the samples received. For some projects the required frequency is one duplicate analysis per analytical batch. The acceptance criteria for analytical reproducibility generally apply to analytes present at $\geq$ 5 times the Reporting Limit. If the noted criterion is exceeded, the sample is re-

analyzed a third time. If acceptable reproducibility is still not obtained, the cause is investigated and the system is brought back to working order. If no problem is found on the system, the data is narrated to note the non-conforming event.

4.3.8 Matrix Spike

Matrix spiking permanently alters the native concentrations of whole air samples. Therefore, matrix spiking is performed only on samples, such as condensates, submitted as part of a sampling train or on waters submitted for Headspace analysis (RSK-175). When applicable, matrix and matrix duplicate spiking is performed using a subset of target analytes. Recoveries and demonstrated reproducibility values, which do not meet the acceptance criteria, are flagged and explained in the laboratory narrative.

4.3.9 Field QC Samples

Field blanks, field spikes, and field duplicates are generally treated as normal project samples by the laboratory. The exceptions include methods in which the laboratory at the direction of the client specifically prepares the sample media. To assure consistency it is recommended that certified summa canisters connected to a sampling tee be used for the collection of Field Duplicate samples.

4.4 QUALITY CONTROL PROCEDURES

4.4.1 Holding Times

All sample preparation and analysis are to be completed within the method-required holding times. The analytical holding time for a non-extractable method begins the day of sample collection. For extractable methods, the holding time is calculated from the day of sample collection for the extraction process and from the day the extraction process begins for the analytical process.

If holding times are exceeded, a CAR form (Section 3.3.2) is generated, the client is notified, and situation is narrated on the final report.

4.4.2 Confirmation

GC and HPLC methods do generally not perform quantitative confirmation for air sample analysis. The exception is for analysis of pesticides by SW-846 methodology, in which case, second column confirmation is completed within the method-required holding times.

4.4.3 Standard Materials

All purchased supplies, reagents, solvents and standards are verified as acceptable and meeting criteria for analysis prior to use. All neat and liquid standards used are traceable to the National Institute of Standards and Technology (NIST) and NIST traceable weights are used to verify balance calibration. Documentation from the manufacturers is maintained to verify each standard. Gaseous standards (which are by nature unable to be quantified on a balance) are verified by accuracy documentation supplied by the manufacturer.

A second source (or different lot) standard is used to confirm the accuracy of primary source calibration standards. Ideally the second source is obtained from a vendor other than that of the primary standard. In the case of TO-14A/TO-15 a reliable second source vendor may be difficult to find and therefore a different lot standard may be used for this purpose. These standards are used for the laboratory control samples as well. Non-standard and polar TO-14A/TO-15 compounds may be prepared from neat standards. Second source standards for these compounds are either derived from a different vendor or from a different lot if only one vendor exists.

4.4.3.1 Liquid Standards

Liquid Standards are prepared by dilution from commercial sources. Stock solutions are purchased and stored in a separate refrigerator/freezer. Dilutions to working ranges are prepared using high purity solvents. Solvents are logged into the receiving logbook and the date of arrival is documented. Open solvent containers are stored in a vented, flammables cabinet.

4.4.3.2 Gas Standards

Gas standards are purchased from a commercial supplier and stored in vendor recommended cylinders using high purity regulators. Standards that are not available in certified blends from commercial suppliers are purchased in neat form. Neat materials are purchased with a purity of at least 96% whenever possible.
Certified gas blends are purchased at parts per million volume (ppmv) levels and diluted into the working range by transfer into 1.0 L or 6.0 L certified evacuated summa canister. The canister is then pressurized to 5.0 psi or 15.0 psi depending on the volume. Alternatively, a high purity flow controller is used to fill a conditioned Tedlar bag with a controlled volume of N_2 or zero air. Neat liquid standards are transferred into the Tedlar bag by injection to achieve the desired concentration. The standard is given sufficient time for equilibration and then is transferred into a conditioned summa canister and pressurized appropriately to achieve the desired final concentration.

Concentration of the blend is determined using density based calculation:

$$\text{ppbv} = \frac{\text{ng/MW}}{\text{vol(L)/24.45*}}$$

* *24.45 is the molar volume of any gas at normalized pressure (1 atmosphere) and temperature (25°C), derived form the ideal gas law (PV = nRT), where R = the universal gas constant.*

Once blended, the standard is transferred into a Summa™ canister for long-term storage and stability.

The preparation of working standards, in gaseous or liquid states, is documented in bound standard preparation logbooks. Each standard is given a unique identification number. Additional information including the solvent or standard lot number and stock standard concentration is noted. Each page is signed and dated by the analyst.

4.4.3.3 Reagent Water

The laboratory uses water to prepare moist Laboratory Blank canister samples, VOST condensate water blanks and water impinger blanks. The volume of water required for these purposes is insignificant. As such, the laboratory relies on high purity HPLC grade bottle reagent water, which is subjected to a constant purge flow of Ultra High Purity Nitrogen. The water is purchase certified and then supported by certifying Laboratory Blank analyses.

4.4.4 Expiration Dates of Standards

4.4.4.1 Primary Standards

Primary standards expire according to the manufacturer's expiration date. If the manufacturer does not assign an expiration date, a period of one year from the date of opening is applied. Expiration dates are noted on standard labels. Expired standard materials are either revalidated by comparison with unexpired independently prepared standards, or are discarded. The acceptance criterion for standards revalidation is documented in ATL SOP #33. The newer of the two standards is always used as the primary source.

Expiration dates for laboratory-prepared stock and diluted standards are no later than the expiration date of the stock solution or material.
All efforts are made to obtain the highest purity possible when purchasing neat chemical standards. The vast majority of neat standards are ≥ 96% pure. The concentration of material purchased at less than 96% purity is corrected mathematically to assure that dilutions for working standards are accurate.

Neat liquid standards are used until analysis by GC/FID indicates a purity of less than 96% (or less than the stated purity for the exceptions). The date of the purity check is noted on the neat standard vial.

Purity analysis is performed once per year as needed.

4.4.4.2 Secondary Standards

Secondary Standards are assigned based on the expiration date of the primary source standard (i.e., no later than), the compounds present, and container type. Typical expiration dates are presented in Exhibit 4.2.

Exhibit 4.1. Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	$\overline{X}$	$\frac{\left(\sum_{i=1}^{n} X_i\right)}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\Sigma(X_i-\overline{X})^2}{(n-1)}\right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S/\overline{X}) \times 100$	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	%D	$\frac{X_1 - X_2}{X_1} \times 100$	Measure of the difference of 2 observations	Used to assess accuracy
Relative Percent Difference	RPD	$\left(\frac{(X_1 - X_2)}{(X_1 + X_2)/2}\right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery	%R	$\left(\frac{X_{meas}}{X_{true}}\right) \times 100$	Recovery of spiked compound in pure matrix	Used to assess accuracy
Percent Recovery	%R	$\frac{\left(\begin{array}{c}\text{value of}\\ \text{spiked}\\ \text{sample}\end{array} - \begin{array}{c}\text{value of}\\ \text{unspiked}\\ \text{sample}\end{array}\right)}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision
Correlation Coefficient	r	see SW8000B section 7.5.3		Evaluation of "goodness of fit" of a regression line

X = Observation (concentration)
n = Number of observations

Exhibit 4.2. Expiration Dates

Gas Standards Prepared from Certified Cylinders

Compounds	Tedlar Bag Standard	Summa™ Canister
TO-14A/15 List of 41 compounds	3 days	3 months
BTEX/TPH	3 days	3 months
Sulfur Compounds > 3000 ppbv	7 days	NA
Sulfur Compounds < 3000 ppbv*	1 day	NA

Gas Standards Prepared from Neat Materials

Compounds	Tedlar Bag Standard	Summa™ Canister
TO-14A/15 Extra Compounds	3 days	6 months
Other Compounds	3 days	6 months

Liquid Manufacturer's Certified Mix and Single Component Standards

The manufacturer's expiration date is used when indicated. If none is supplied, the following expiration dates are applied:

Compound	Expiration
Gases in Liquid	1 month after opening ampule
Other Volatile compounds	6 months after opening ampule
Semivolatile/Pesticides/PCBs	1 year after opening ampule

Liquid Stock Standards Prepared from Neat Materials

Compound	Expiration
Gases in Liquid	1 month
Other Volatile Compounds	6 months
Semivolatile/Pesticides/PCBs	1 year

* Used for Initial Calibration only

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5.0 SAMPLE HANDLING

5.1 SAMPLING MEDIA AND PRESERVATION REQUIREMENTS

General guidelines regarding sampling media, preservation, and holding time requirements are summarized in Exhibit 5.1. The laboratory first refers to project specific requirements. These requirements can be found in the individual Statement of Work (SOW) or Quality Assurance Program Plan (QAPP). If there are no project specific guidelines, the lab uses the criteria presented in Exhibit 5.1.

Disclaimer: *ATL assumes no real or implied responsibility or liability for client-related field sampling and shipping activities. It is the responsibility of the individual client to ensure that referenced methodologies are followed with respect to sample collection and shipment to the laboratory. Air sampling media and equipment should only be used by experienced field engineers. It is the ultimate responsibility of the client to be knowledgeable both in sample preservation requirements as well as relevant State, Federal, and International shipping requirements. Any time a chemical substance is collected using ATL media, the client bears sole responsibility to understand and abide by the laws involving shipment of potentially hazardous substances by common carrier.*

5.1.1 Sample Containers

Items provided by the laboratory include:

- Sampling media such as Tenax®, Anasorb®-747, charcoal traps, Carbon Molecular Sieve (CMS) tubes, Summa™ polished canisters, pack250s, Tedlar bags, PUF/XAD and DNPH impinger solution
- Chain-of-custody forms
- Sampling labels
- Chemical ice packs
- Shipping containers
- Custody Seals (per client request)
- Sample Acceptance Policy

Air sampling media prepared by the laboratory for field use must be certified for cleanliness. Tenax®, Anasorb®-747, charcoal traps, Carbon Molecular Sieve (CMS) tubes, PUF/XAD and DNPH impinger solutions are certified for each preparation batch. The canister cleaning process is certified on a 10% frequency basis. Individually certified canisters are also available per specific client request.

5.1.1.1 Summa™ Canisters

The Support Services Department has dedicated approximately 1400 ft^2 for canister cleaning and certification functions. Approximately 200 maximum canisters can be cleaned daily and up to 100 canisters individually certified daily. This area is also sufficient for storage of approximately 600 canisters and the entire in-house inventory of flow controllers (see Table 2.2).

Ten percent of all canisters that are cleaned per ATL SOP #7 are certified by GC/MS analysis for TO-14A/TO-15 target compounds. 6.0 L and 1.0 L canisters are certified to be clean to 0.2/0.5 ppbv for the standard product TO-14A/TO-15 target compound list (see Section 6.8 of this document).

If a canister fails certification, the cleaning process is repeated. The canister is not returned to the inventory until it has passed certification. More information on the preparation and certification of Summa™ canisters can be found in ATL SOP #7.

ATL recommends use of 100% certified canisters for projects that require Low Level or SIM TO-14A/TO-15 analysis and PAMS analysis. Project Managers document requests of this nature in the Project Profile to assure that all shipped media meet this requirement. Canisters and associated sampling train equipment intended for projects that are

defined as Low Level or SIM (see Section 6 Table 6.8.2) are certified at or below the Limit of Quantitation. Canisters used for PAMS analysis are certified below the Limit of Quantitation. An increase in the percent of canisters certified is also recommended for projects of a very sensitive nature.

Each ATL canister is barcoded, allowing the history of the canister to be maintained through a canister tracking system. The database keeps information, such as, date shipped, client name, date received, and the analytical work order number.

5.1.1.2 Sorbent Tubes

Each batch of sorbent tubes is certified using the prescribed analytical methodology which most commonly is either SW-846 5041A/8260B or Modified EPA TO-17. One set of tubes from each preparation batch are stored at 4°C ± 2°C and then certified by GC/MS analysis. Certification is performed before the media is shipped or used to collect samples. The background level of each target VOC must be less than the project reporting limits. The client may allow an exception to this criterion for common laboratory contaminents such as Methylene Chloride but must provide written documention to verify acceptance. The client will be notified in advance of sampling if the batch fails and a replacement shipment provided if necessary. Tube certification results are reported with the individual field sample reports. More information of the preparation and certification of sorbent tube media can be found in ATL SOP #4.

5.1.1.3 Polyurethane Foam (PUF/XAD) Cartridges

PUF and PUF/XAD cartridges are batch cleaned using a large soxhlet extraction apparatus per SOP #14. The weekly cleaning capacity is 400 PUF/XAD cartdriges and approximately 150 units are stored on-site and available for shipping at any point in time (see Table 2.2). For Method TO-13A, two PUFs from each batch are cleaned and extracted and analyzed by GC/MS. For Methods TO-4A and TO-10A, one PUF from each batch is extracted and analyzed by GC/ECD. For Method TO-13A XAD media, 20 mLs of the media is extracted and analyzed by GC/MS.

The background level of each target analyte must be less than the project reporting limits. Analysis of the extract is performed typically prior to shipping or at very least within 24 hours of shipping. The client is notified in advance of sampling if the batch fails and a replacement shipment is provided if necessary.

5.1.1.4 2,4-Dinitrophenylhydrazine (DNPH) Impinger Solution and Cartridges

The DNPH solution is prepared in bulk solution. An aliquot is removed, extracted and analyzed according to the particular method (CARB 430, Method 0011, Compendium Methods TO-5 and TO-11A). The DNPH reagent and the TO-11A media are certified as acceptable when the concentration of each analyte in the certification is below the reporting limit. In the case that contamination is present above the reporting limit; the source must be identified and eliminated prior to shipping of the reagent and the TO-11A media. If the contamination can not be eliminated, the presence of any aldehyde necessitates a call to the client. The data user, particularly in the case of source testing, may tolerate concentrations of target aldehydes near the reporting limit. Certification is completed before solution is shipped to the field. Results are shipped with the media, faxed to the site, or kept on file in the laboratory.
More information of the preparation and certification of DNPH media can be found in ATL SOP #62.

5.2 SAMPLE COLLECTION PROCEDURES – FIELD GUIDELINES

5.2.1 Information for Canister Sampling

Air Toxics Ltd. provides a technical "how to" guide on canister sampling. The guide includes the following information:

AIR TOXICS'

GUIDE TO AIR SAMPLING AND ANALYSIS

Canisters and Tedlar Bags

Sixth Edition

Tables

5.2.2 Information for Sorbent Tube Sampling

Contents of the guide include:

AIR TOXICS'

GUIDE TO AIR SAMPLING AND ANALYSIS

Sorbents and Solutions

Second Edition

The information provided in ATL's Sampling Guide is meant to serve only as general guidelines. In all cases, field sampling personnel are ultimately responsible for having expertise and knowledge in air sampling methodology sufficient to ensure that the defensibility of the data will not be compromised due to deficiencies in field sampling, handling or transportation.

5.3 SAMPLE RECEIVING PROCEDURES

Upon arrival at the laboratory, samples are received and inspected following Air Toxics' sample acceptance criteria as outlined in SOP #50. The SOP establishes specific guidelines for sample acceptance, which are generally accepted practices under EPA, AFCEE, USACE, Navy, and NELAP protocols. When samples do not meet the established guidelines, discrepancies are documented and the client is notified. Samples are noted in the individual work order and discrepancies noted in the Laboratory Narrative portion of the sample report.

5.3.1 Sample Acceptance Policy

Samples received by Air Toxics Ltd. must be relinquished following standard EPA approved guidelines. These include full and complete Chain of Custody (COC) documentation indicating:

- Unique sample name
- Location, date, and time of collection
- Canister Number
- Collector's name
- Preservation type (if applicable)
- Matrix
- Any special remarks

The COC form must be filled out in ink and indicate proper preservation and use of sample container specified by the method. Each sample should be labeled with unique, durable, and indelible identification and must be of adequate volume for the tests requested. Never affix a label directly on a Summa™ canister. A tag is attached to each canister for this purpose.

Proper, full, and complete inspection and documentation will be performed upon laboratory receipt in the following areas:

- evidence of container's physical damage
- status of the container's custody seal
- presence or absence of a COC form
- incomplete or incorrect COC form
- number of samples
- name of each sample
- sample collection date/time
- name of the Project Manager
- canister ID (if applicable)
- preservation type (if applicable)
- sample type (canister, XAD, DNPH etc.)
- sample tag information complete
- temperature (if applicable)
- pressure (canisters)
- presence of unlabeled samples
- presence of mis-labeled samples
- presence of unused media
- method required trip blanks, field blanks, equipment blanks, field duplicates, or field spikes

Any sample discrepancies against the above criteria are documented on the Sample Discrepancy Form (Exhibit 5.3), and communicated to the client via Electronic Sample Receipt Confirmation within 1 day of sample receipt. The client is contacted by the project manager for discrepancies of a more serious nature, e.g.,

- Chain of Custody Record was not received with sample(s).
- Analysis method(s) is(are) not specified.
- Sample(s) received out of holding time.
- Sample container (Tube/VOA vial) was received broken.
- Canister sample received at >15"Hg (not identified as a Trip/Field Blank).
- Tedlar Bag received leaking.

- Tedlar Bag received flat.
- Tedlar bag / canister received emitting a strong odor (sample cannot be analyzed).

Documentation of client notification is included on the form along with any instructions from the client on how to proceed. Project managers complete this section and return the form to the receiving group to complete the login process. The form is archived in the Work Order folder. Whenever there is any uncertainty of how the laboratory is to proceed or when the desired method is unclear, the receiving staff places the Login process ON HOLD and delivers the Work Order file to a project manager for follow-up. The project manager contacts the client to clarify the situation. Phone calls between the project manager and the client are documented in the Client Services Software. The phone contact and client instructions to resolve the issue are logged into the database and a hardcopy report is placed in the Work Order folder. The folder is then returned to the Receiving team to complete the Login process. Air bills, packing lists, Chain of Custody records, and any other documentation that may accompany the samples are placed in the work order folder.

Laboratory malfunctions occurring during/after sample receipt are documented via the laboratory Corrective Action system. Examples of receiving problems, which would necessitate a Corrective Action Request, include:

- Hold time expired due to laboratory error.
- Canister sample pressurized with wrong type of gas.
- Sample placed On Hold was released in error.
- Sample logged in for incorrect analysis method.
- DANGER tag was not affixed to an odiferous canister sample before sending to the lab.
- Canister was released and cleaned before second analysis method was run.
- Receiving did not affix the multiple analysis tag.
- Canister valve was left open following pressurization. Sample vented to ambient.

5.3.2 The Sample Receipt Confirmation

When a workorder is completed, Sample Receipt Confirmation (SRC) is sent to the client to confirm receipt of samples. A fax is sent if no email address is available. The Sample Receipt Confirmation has six sections:

Section 1 Introduction Page (not available if faxed)
Section 2 Cover page with discrepancies noted
Section 3 Sample Recipt Summary (sample names, etc.)
Section 4 Copy of Chain of Custody
Section 5 Reporting template showing referenced method, target compound list, and reporting limits
Section 6 Media outstanding (if relevant)

Discrepancies are noted on the cover page using a template of pre-approved statements. The QA Department is responsible for maintaining the approved template. Receiving staff electronically copy relevant statements from the template and onto the SRC cover page. Typical statements include:

- NELAC Chapter 5 specifies that a legal Chain of Custody must accompany samples when they arrive at the laboratory. In this case a chain of custody was not received with the samples. The discrepancy was noted in the Login email.

- The Chain of Custody (COC) form was not relinquished properly. A <signature OR date> was not provided.

- Samples were received past the recommended hold time of _____ days. Analysis proceeded.

- The sample collection date was incomplete on the Chain of Custody (COC) for samples(s) <insert names>. The client was contacted and a date of <enter date> was provided.

- The Tedlar bag for sample _____ was received flat. The client was notified that analysis was not possible.

- A Temperature Blank was included with the shipment. Temperature was measured and was not within 4±2 °C. Coolant in the form of ice/blue ice was present. Analysis proceeded.

5.3.3 The Work Order Folder

A folder is created during the Login process to hold all relevant documents. The folder is labeled with the unique Work Order number, client name and analysis. One folder for each desired analysis is created so that laboratory analyses can be efficiently handled as separate processes. The folder contains the following receiving documents:

- Original COC record, airbill, and any other packing documents

- Sample Receipt Summary with individual field sample names, dates of collection and project reference

- Specific method cited, and a copy of the reporting target compound template for review

- Sample Receiving Checklist

- Original copy of the Sample Discrepancy Report

- Copy of the Project Management Project Profile with associated special analysis and reporting requirements

- The Receiving Report (for ATL media only)

- ATL Shipment Report (if shipping charges apply)

- Copy of any approved Project Requirement tables generated after the bid has been won

The folder is passed to the analytical teams after Login, and follows the same process stream as the samples. All original documents generated during the processing of the samples are filed in this folder. The unique Work Order file makes archival and retrieval of evidentiary and custodial documents easier. The majority of analytical documentation is archived electronically. Documentation that remains in hard copy form includes:

- COC
- Data Review Checklist
- Sample Discrepancy Reports
- Corrective Action Requests
- Scan Packets (run logs, spectral defenses, manual integrations etc.)
- Phone contacts and emails
- Bid Ships/Canister Certifications
- Fed-Ex/UPS air bill/freight bill
- GC/FID screening results

Alternatively, the Work Order folder is placed in a bar coded storage box for long-term storage. Work Order inventory of each box is taken prior to offsite storage and maintained along with the bar code address. A private storage company archives the boxes by barcode and provides one-day retrieval service upon request. Alternatively, work order folders may be scanned onto CD-ROM Media and stored on-site.

5.4 SAMPLE TRACKING PROCEDURES

After samples have been inspected, they are given a unique tracking number and logged into an electronic sample receiving database. The tracking number consists of the year and

month plus a sequential Work Order number. As an example, the first set of samples received in July, 2004 would have the format:

0407001

If this set of samples consisted of eight individual samples, then each sample is identified by a consecutive postscript such as:

0407001-01A through 08A

If more than one analysis is requested for the samples, an alphabetic designation is given to each analysis sample set:

0407001A-01A TO-15
0407001B-01A TO-3

Laboratory assigned duplicates are designated using a double postscript such as:

0407001-01AA

A more detailed discussion of the sample receiving function is given in ATL SOP #50. The laboratory processes thousands of samples each month divided into hundreds of individual work orders. An efficient user-friendly database is critical in keeping track of each individual sample, monitoring hold times, monitoring due dates, and scheduling analyses. In addition, most air projects have specific target compound lists, reporting limit requirements, quality assurance requirements, analysis requirements, and data submission requirements. Relevant project information is immediately available as each processing step occurs. The ultimate goal of the ATL sample-processing system is to deliver what the customer wants the first time. Report re-issues and sample re-analyses are monitored and kept to a minimum. In order to meet the quality objective (customer satisfaction), every team member has access to information describing what the customer has requested.

The sample tracking database consists of a variable number of data fields sufficient to store project and sample batch information. The users can then query any field in the database. Each department creates work lists from the database and inputs relevant information (e.g., completion dates, etc.) throughout the day.

The database resides on a secured network server equipped with a daily-automated back up system. Multiple PCs are available to each team in their respective work areas. Access privileges are defined and maintained by the IT team. The database is designed such that work order status can be determined at any point in time. The 'status' field is updated each time the work progresses to a new stage in its processing. Status data include:

- Client Services
- Extractions
- Log-in
- Lab Bins
- Individual Instrument Assignment
- Data Review
- QA
- FAX
- EDD Generation
- Final Report
- Financial Hold
- Filed

Complete documentation of sample processing is maintained in the database. Each team completes relevant portions of the database as work is finished. Selected information includes:

SAMPLE TRACKING FIELDS

Work Order number
Client Services contact
Date received
Client name
Project name
Project ID number
#Samples
Date sampled
#Lab dups
#Sample holds
Container type
Expiration date
Method specific analysis code
Date promised
Rush turn
24 hour clock
Screen done
Date receiving done
Receiving analyst initials
Log-in date
Log-in analyst initials
Date analysis done
Date reported
Bench analyst initials
Date of final report
CVP due date
Date CVP completed
Date CVP shipped
CVP analyst initials
EDD due date
EDD completed date
Date EDD shipped
EDD analyst initials
Reissue due date
Reissue reason
Time Due

The electronic database is used to document and ensure that analytical hold times, reporting requirements, and project specific QC requirements are met. The database is used by the user to provide project specific activity reports and status of incomplete work. Users may query the database and easily produce a printed report. The sample database is the key to efficient information transfer and, as such, is a critical tool to meet the quality objective.

5.5 INTERNAL SAMPLE CUSTODY AND STORAGE PROCEDURES

The chain-of-custody for samples is documented from time of receipt until time of disposal. Internal sample chain-of-custody documentation consists of:

- Storage area logbooks
- Instrument run logs
- Raw analytical data for samples, calibrations and QC checks

The samples are stored in the custody cage, in a secure refrigerator, or in the event of late delivery in the receiving section until the next morning. The receiving staff or pressurization personnel logs the samples into the Internal Sample or Extractable Sample Tracking Logbook in the storage area.

Samples are tracked in/out of the limited access area by initials, date, and time. All staff members have access to the storage areas and all members are trained on proper custody documentation in the logs. Logbook protocol training is mandatory for all staff. The training and documentation of training is handled by the QA team. The QA team checks the Logbook Review Checksheet monthly to ensure that the analysts have reviewed their logbooks on a timely basis.

5.6 SAMPLE DISPOSAL

Samples are released for disposal upon satisfactory completion of analysis unless prior contractual arrangements have been made. The release of samples is documented in the Internal Sample Tracking Log via a "Released" stamp that includes the date and initials of the person who releases the sample for disposal. Samples are released by the Laboratory Director, Technical Director, Analytical Department Managers and Team

Leaders, Laboratory Scientists or qualified Analysts.

Sample disposal varies based on the sampling media. Whole air samples are vented through a charcoal scrubber, while liquid (i.e., solvent and water) samples are disposed of according to the procedures noted in ATL's Chemical Hygiene Plan.

5.7 SUBCONTRACTING

Air Toxics Limited subcontracts samples on an infrequent basis. Subcontracting is generally performed for contractual reasons in fields of testing which the laboratory does not perform. In the event that subcontracting is necessary, the client, working with the Sales or Project Manager, selects a suitable subcontract laboratory that meets the project specified certification criteria. Work that falls under the scope of NELAC accreditation shall be placed with a laboratory accredited under NELAP for the tests to be performed or with a laboratory that meets applicable statutory and regulatory requirements for performing the tests and submitting the results of tests performed. The laboratory performing the subcontracted work shall be indicated in the final report and non-NELAP accredited work shall be clearly identified. If the project has no criteria, then the project manager selects a subcontract laboratory based on state certification in the desired field of testing. The laboratory shall advise the client of the arrangement in writing and, when possible, gain the approval of the client, preferably in writing.

Work that falls under the scope of the DoD shall be placed with a laboratory that meets the DoD QSM requirements for the tests to be performed. In addition, the subcontracted laboratory must have successfully completed an assessment by the specified DoD component (i.e. Navy).

More information for subcontracting samples can be found in ATL SOP #90.

Exhibit 5.1.

Requirements for Containers, Preservation Techniques, and Holding Times

Method	Parameter	Type	Container	Preservation	Extraction Holding Time	Analytical Holding Time
VOST 5041A/8260B	VOCs	GC/MS	Sorbent Tube	4°C	NA	14 days
TO-3 & CARB 410A	BTEX/TPH	GC/FID/PID	Summa Canister Tedlar Bag	NA NA	NA NA	30 days 3 days
TO-4A & TO-10A	Pesticides PCBs	GC/ECD	PUF	4°C	7 days	40 days
TO-5 & CARB 430	Aldehydes & Ketones	HPLC/UV	DNPH Impinger	4°C	7 days	30 days
NIOSH 2546	Phenols	GC/FID	XAD-7 Tube	4°C	2 days	30 days
TO-11A	Aldehydes & Ketones	HPLC/UV	Sep-PAK	4°C	14 days	30 days
TO-12	NMOC	GC/FID	Summa Canister Tedlar Bag	NA NA	NA NA	30 days 3 days
TO-13A/ 8270	PAHs/ Semivolatiles	GC/MS	XAD/PUF	4°C	7 days	40 days
TO-14A/15	VOCs	GC/MS	Summa Canister Tedlar Bag	NA NA	NA NA	30 days 3 days
TO-17	VOCs	GC/MS	Sorbent Tube	4°C	NA	30 days
ASTM D1946	Fixed Gases CH_4, C_2^+	GC/TCD/FID	Summa Canister Tedlar Bag	NA NA	NA NA	30 days 3 days
ASTM D1945	Fixed & Natural Gases	GC/TCD/FID	Summa Canister Tedlar Bag	NA NA	NA NA	30 days 3 days
ASTM D5504	Sulfur Gases	GC/SCD	Tedlar Bag	NA	NA	24 hours
Method 0011	Aldehydes & Ketones	HPLC/UV	DNPH Impinger	4°C	7 days	30 days
Headspace Analysis	Dissolved Gases CO_2	GC/FID GC/TCD	40 ml VOA vials	4°C & 1:1 HCl, pH<2 4°C & No HCl	NA NA	14 days 7 days
PM10/TSP	Particulate Matter	Analytical Balance	Quartz Filter	59°F – 86°F RH< 45%	NA	14 days

Exhibit 5.2 Chain-of-Custody

@ AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action, of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922.

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX (916) 985-1020

Page ____ of ____

Contact Person _____

Company _____ Email _____

Address _____ City _____ State ____ Zip ____

Phone _____ Fax _____

Collected by: (Signature) _____

Project Info:

P.O. # _____

Project # _____

Project Name _____

Turn Around Time:

❑ Normal

❑ Rush

_____ *specify*

Lab Use Only
Pressurized by: _____
Date: _____
Pressurization Gas:
N_2 He

Lab I.D.	Field Sample I.D. (Location)	Can#	Date	Time	Analyses Requested	Canister Pressure/Vacuum			
						Initial	Final	Receipt	Final (psi)

Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	**Notes:**
Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	
Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	

Lab Use Only	Shipper Name	Air Bill #	Temp (°C)	Condition	Customer Seals Intact?	Work Order #
					Yes No None	

Form 1293 rev.10

Exhibit 5.3 Sample Discrepancy Form

Sample Discrepancy Report

Identification

Initiated By:_____ **Date:** _____ **Discrepancy Type:** (circle all that apply) **I. II. III.**

Workorder(s) affected: _____ **Sample(s) affected:**_____

I. Sample Receipt Discrepancies
Document on Cover Page of Sample Receipt Confirmation and in Receiving Notes of Lab Narrative

Narration not required:

- ☐ COC was not filled out in ink.
- ☐ Sample container (cartridge/tube/VOA vial) was received broken, however sample was intact.
- ☐ Flow controller used - canister samples received at ambient or under pressure.
- ☐ No brass cap on canister.
- ☐ VOA vial for RSK-175 analysis received with headspace bubble <5mm.
- ☐ Sample date error/missing on COC but noted on sample tag (circle one).

Narration Required:

- ☐ COC improperly relinquished / received.
- ☐ Sample tags / can numbers do not match the COC.
- ☐ Samples received at wrong temperature (up to 10°C); ice / blue ice (circle one) was present. A temp. blank was / was not present (circle one).
- ☐ Custody Seal on the outside of the container was broken / improperly placed (circle one).
- ☐ Other (describe below).

Describe the Discrepancy: _____

II. Sample Receipt/Screening Discrepancies requiring CSR notification
Document on Cover Page of Sample Receipt Confirmation and In Receiving Notes of Lab Narrative

If Section II. is filled out CSR must be notified within 24 hrs of initiation

- ☐ COC was not received with samples.
- ☐ Analysis method(s) is not specified / incorrectly specified (circle one) on the COC.
- ☐ Number of samples on the COC does not match the number of samples that were received.
- ☐ Samples were received expired.
- ☐ Sampling date / time (sulfur only) is not documented for *some* / *any* samples (circle one).
- ☐ Sample received with significant (pooling) volume of H_2O in the Tedlar Bag.
- ☐ Sample container (cartridge/tube/VOA vial/DNPH Bottle, etc.) was received broken / leaking (circle one); sample can / cannot be analyzed (circle one).
- ☐ VOA vial for RSK-175 analysis received with headspace bubble >5mm.
- ☐ Samples for RSK-175 CO_2 analysis received preserved with HCl.
- ☐ Tedlar Bag received leaking / flat (circle one). Sample can / cannot (circle one) be analyzed.
- ☐ Canister was at ambient pressure at time of pressurization and (check all that apply): ☐ canister failed leak check on two manifolds, ☐ canister valve was open, ☐ brass nut was loose. Sample can / cannot be analyzed (circle one).
- ☐ Tedlar bag / canister received emitting a strong odor; sample can / cannot (circle one) be analyzed.
- ☐ Canister sample received with a vacuum difference >7.0"Hg between the receipt vac. and the final vac. reported on the COC, indicating loss of vacuum.
- ☐ Canister sample received at >15"Hg (*not* identified as a Trip/Field Blank).
- ☐ Trip Blank received at low vacuum (< 25"Hg).
- ☐ Tedlar Bag for Sulfur analysis has metal fitting.
- ☐ Incorrect sampling media / container for analysis requested.
- ☐ Sample was received at ≥ 10°C.
- ☐ Other (describe below)

Initials: _____ **Date:** _____ ☐ **CSR Notified** (see section below)
(if not the original initiator)

Describe the Discrepancy: _____

Exhibit 5.3 Sample Discrepancy Form *(Continued)*

III. Lab Discrepancies requiring Team Leader/CSR notification
Document in Analytical Notes of Lab Narrative

If Section III. is filled out CSR must be notified within 24 hrs of initiation

- ☐ Tedlar Bag found to be leaking at the time of analysis; sample can / cannot (circle one) be analyzed.
- ☐ Tedlar Bag found to be flat at the time of analysis.
- ☐ Canister found to be leaking at the time of analysis.
- ☐ Tedlar Bag received at low volume; sample cannot be analyzed.
- ☐ Sulfur samples received with insufficient time to analyze prior to expiration.
- ☐ VOST tube saturated; bag dilution necessary.
- ☐ Sample loss due to instrument malfunction / broken glassware.
- ☐ Other (describe below).

Initials: _____ **Date:** _____ ☐ **CSR Notified**
(If not the original initiator) (see section below)

Team Lead Initials: _____ **Date:** _____

Describe the Discrepancy: _____

_____

Client Services Use Only

Client Services Notification

CSR notified: _____ Date: _____

Action:

☐ It is not necessary to notify the client. Narrate the discrepancy by documenting on cover page of Sample Receipt Confirmation and in Receiving Notes/Analytical Notes of Lab Narrative.

CSR Initials: _____ Date: _____

☐ Client notification required. See attached client contact / email, or comments below:

Client Notification:

Person notified: _____ Date: _____

Comments: _____

_____

☐ Lab notified Name: _____ Date: _____

Additional Notifications

CSR notified: _____ Date: _____

Action:

☐ It is not necessary to notify the client. Narrate the discrepancy by documenting on cover page of Sample Receipt Confirmation and in Receiving Notes/Analytical Notes of Lab Narrative.

CSR Initials: _____ Date: _____

☐ Client notification required. See attached client contact / email, or comments below:

Client Notification:

Person notified: _____ Date: _____

Comments: _____

_____

☐ Lab notified Name: _____ Date: _____

☐ **Additional notifications attached.**

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6.0 ANALYTICAL METHODS AND PROCEDURES

This section contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- Laboratory variances to Compendium and SW-846 methodologies
- A table of LOQs and QC acceptance criteria
- A table of calibration procedures and QC procedures

This Quality Manual references methods in a general manner. The specific revisions used by the laboratory can be found in the method-specific SOPs.

6.1 VOST SW-846 5041A/8260B

This method involves GC/MS full scan analysis of volatile organic compounds in air samples collected on Tenax/Charcoal (VOST) cartridges. Samples are collected using SW-846 Method 0030/0031 Volatile Organic Sampling Train (VOST) protocols. The VOST cartridges are thermally desorbed by heating and purging with Ultra High Purity Helium. The resulting gaseous effluent is then bubbled through 5 ml of organic free reagent grade water and trapped on the sorbent trap of the purge and trap system. The trap is then thermally desorbed for GC/MS analysis. For condensate analysis, a 5 ml aliquot of condensate sample is placed directly in the sparge vessel of the purge and trap (P&T) system and analyzed in a similar manner.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-1.1. Summary of Method Modifications

Requirement	EPA Method 5041A/8260B	Air Toxics Ltd. Modifications
Method Blank	Cartridges from the same media batches as the samples.	Media batch is certified prior to use in the field. Method Blank is from a different batch unless requested by the client.
Connection between thermal desorption apparatus & purge vessel.	PTFE 1/16" Teflon tubing.	Heated, 1/16" silica lined stainless steel tubing.
Calibration Criteria for non-CCCs.	RSD ≤ 15 % for all non-CCCs.	RSD ≤ 30 % for Acetone, Bromoform, Vinyl Acetate, Bromomethane, Chloromethane, 1,1,2,2-Tetracholoroethane, & 1,2,3-Trichloropropane.

Table 6-1.2. SW-846 Modified Method 5041A Standard Analyte List

Analytes	RL (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV
1,1,1-Trichloroethane	10	15	70 – 130	-
1,1,1,2-Tetrachloroethane	10	15	70 – 130	-
1,1,2,2-Tetrachloroethane – SPCC	10	30	70 – 130	RF > 0.30
1,1,2-Trichloroethane	10	15	70 – 130	-
1,1-Dichloroethane – SPCC	10	15	70 – 130	RF > 0.10
1,1-Dichloroethene – CCC	10	30	70 – 130	%D ≤ 25% VOST tubes; ≤20% condensates
1,1-Dichloropropene	10	15	70 – 130	-
1,2,3-Trichlorobenzene	50	15	70 – 130	-
1,2,3-Trichloropropane	10	30	70 – 130	-
1,2,4-Trichlorobenzene	50	15	70 – 130	-
1,2,4-Trimethylbenzene	10	15	70 – 130	-
1,2-Dibromo-3-chloropropane	50	15	70 – 130	-
1,2-Dichlorobenzene	10	15	70 – 130	-
1,2-Dichloroethane	10	15	70 – 130	-
1,2-Dichloropropane – CCC	10	30	70 – 130	%D ≤ 25% VOST tubes; ≤20% condensates
1,3,5-Trimethylbenzene	10	15	70 – 130	-
1,3-Butadiene[1]	50	30	50 – 150	-
1,3-Dichlorobenzene	10	15	70 – 130	-
1,3-Dichloropropane	10	15	70 – 130	-
1,4-Dichlorobenzene	10	15	70 – 130	-
2,2-Dichloropropane	10	15	70 – 130	-
2-Butanone[2]	50	30	50 – 150	-
2-Chloropropane	10	15	70 – 130	-
2-Chlorotoluene	10	15	70 – 130	-
2-Hexanone[2]	50	30	50 – 150	-
3-Chloropropene	10	15	70 – 130	-
4-Chlorotoluene	10	15	70 – 130	-
4-Methyl-2-pentanone[2]	50	30	50 – 150	-
Acetone[2]	50	30	50 – 150	-
Acrylonitrile	10	15	70 – 130	-
Benzene	10	15	70 – 130	-
Bromobenzene	10	15	70 – 130	-
Bromochloromethane	10	15	70 – 130	-
Bromodichloromethane	10	15	70 – 130	-
Bromoform – SPCC	10	30	70 – 130	RF > 0.10
Bromomethane[2]	10	30	50 – 150	-
Butylbenzene	10	15	70 – 130	-
Carbon Disulfide	10	15	70 – 130	-
Carbon Tetrachloride	10	15	70 – 130	-

Analytes	RL (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV
Chlorobenzene – SPCC	10	15	70 – 130	RF > 0.30
Chloroethane	10	15	50 – 150	-
Chloroform – CCC	10	30	70 – 130	%D ≤ 25% VOST tubes; ≤20% condensates
Chloromethane – SPCC	10	30	50 – 150	RF > 0.10
cis-1,2-Dichloroethene	10	15	70 – 130	-
cis-1,3-Dichloropropene	10	15	70 – 130	-
cis-1,4-Dichloro-2-butene	50	15	70 – 130	-
Cumene	10	15	70 – 130	-
Dibromochloromethane	10	15	70 – 130	-
Dibromomethane	10	15	70 – 130	-
Ethylbenzene – CCC	10	30	70 – 130	%D ≤ 25% VOST tubes; ≤20% condensates
Ethylene Dibromide	10	15	70 – 130	-
Freon 11	10	15	70 – 130	-
Freon 12	10	15	50 – 150	-
Freon 113	10	15	70 – 130	-
Hexachlorobutadiene	50	15	70 – 130	-
Hexane	10	15	70 – 130	-
Iodomethane	50	15	70 – 130	-
Methylene Chloride	10	15	70 – 130	-
Methyl t-butyl ether (MTBE)	10	30	70 – 130	-
Naphthalene	50	15	70 – 130	-
m,p-Xylene	10	15	70 – 130	-
o-Xylene	10	15	70 – 130	-
p-Cymene	10	15	70 – 130	-
Propylbenzene	10	15	70 – 130	-
sec-Butylbenzene	10	15	70 – 130	-
Styrene	10	15	70 – 130	-
tert-Butylbenzene	10	15	70 – 130	-
Tetrachloroethene	10	15	70 – 130	-
Toluene – CCC	10	30	70 – 130	%D ≤ 25% VOST tubes; ≤20% condensates
trans-1,2-Dichloroethene	10	15	70 – 130	-
trans-1,3-Dichloropropene	10	15	70 – 130	-
trans-1,4-Dichloro-2-butene	50	15	70 – 130	-
Trichloroethene	10	15	70 – 130	-
Vinyl Acetate[1,2]	50	30	50 – 150	-
Vinyl Bromide[1] (Bromoethene)	50	30	50 – 150	-
Vinyl Chloride – CCC	10	30	50 – 150	%D ≤ 25% VOST tubes; ≤20% condensates

[1] *Independent source verification check not available for these compounds.*

[2] *Due to nature of these compounds, recoveries outside of noted limits do not result in re-calibration.*

Table 6-1.3. Matrix Spike/Matrix Spike Duplicate

Analyte	%R
1,1-Dichloroethene .	60 – 140
Benzene	60 – 140
Trichloroethene	60 – 140
Toluene	60 – 140
Chlorobenzene	60 - 140

Table 6-1.4. Internal Standards

Analyte	CCV IS (%R)	Sample IS (%)R
1,4-Dichlorobenzene-d_4	50 – 200	60 – 140
Chlorobenzene-d_5	50 – 200	60 – 140
Fluorobenzene	50 – 200	60 – 140

Table 6-1.5. Surrogates

Analyte	%R
1,2-Dichloroethane-d_4	70 – 130
4-Bromofluorobenzene	70 – 130
Dibromofluoromethane	70 – 130
Toluene-d_8	70 – 130

Table 6-1.6. Summary of Calibration and QC Procedures for SW-846 Modified Method 5041A

Note: These criteria are used specifically for the standard list of analytes listed in Table 6-1.2.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at the start of every 12-hour clock.	Method 5041A tuning criteria.	Correct problem then repeat tune.
Initial 5-Point Calibration	Prior to sample analysis.	SPCC criteria in Table 6-1.2, CCC and non-CCC compound criteria in Table 6.1.2.	Correct problem then repeat initial calibration.
Laboratory Control Sample (LCS)	Once per initial calibration, and with each analytical batch (maximum of 20 samples).	See Table 6-1.2.	Investigate the problem and if warranted, analyze a new analytical curve for the out-of-limits compound. (except for compounds noted in Table 6-1.2.)
Continuing Calibration Verification (CCV)	At the start of every shift immediately after the BFB tune check.	**For SPCCs:** see "CCV criteria" column **For CCCs:** %D ≤ 25% for VOST tubes and ≤ 20% for condensates.	Investigate and correct the problem, up to and including recalibration if necessary.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Internal Standards (IS)	As each standard, blank, and sample is being loaded.	**For CCVs:** area counts 50% - 200%, RT w/in 30 sec of mid-point in ICAL. **For blanks, samples and non-CCV QC Checks:** area counts 60 – 140%, RT w/in 20 sec. of RT in CCV.	**CCV:** inspect and correct system prior to sample analysis. **For blanks:** inspect the system and re-analyze the blank. **For condensates:** re-analyze; if out again, flag data. **For VOST:** flag the data, evaluate system and correct problem before proceeding.
Surrogates	With all samples and QC.	See Table 6-1.5.	Same as for Internal Standards.
Laboratory Blanks	Immediately after the calibration standard or after samples with high concentrations (≥ 5000 ng).	Results less than laboratory reporting limit	Inspect the system and re-analyze the blank.
(MS/MSD)	Once/batch of condensate samples.	See Table 6-1.3.	Q-flag and narrate.

6.2 TO-3 - BTEX AND TPH

This method involves GC analysis of whole air samples collected in Summa™ canisters or Tedlar bags. Samples are analyzed for Benzene, Toluene, Ethylbenzene, Xylenes, and Total Petroleum Hydrocarbons (TPH) using EPA Method TO-3 protocols. Samples are analyzed using a Photo Ionization Detector (PID) and a Flame Ionization Detector (FID). Depending on the client's request, TPH is analyzed and referenced to either gasoline or jet fuel.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, RL, QC criteria, and QC summary can be found in the following tables.

Table 6-2.1. Summary of Method Modifications

Requirement	EPA Method TO-3	Air Toxics Ltd. Modifications
Preparation of Standards	Levels achieved through dilution of gas mixture.	Levels achieved through loading various volumes of the gas mixture.
Initial Calibration Calculation	4-point calibration using a linear regression model.	5-point calibration using average Response Factor.
Initial Calibration Frequency	Weekly.	When daily calibration standard recovery is outside 75-125%, or upon significant changes to the procedure or instrumentation.
Daily Calibration Standard Frequency	Prior to sample analysis and every 4-6 hrs.	Prior to sample analysis and after the analytical batch ≤ 20 samples.
Minimum Detection Limit (MDL)	Calculated using the equation DL = A+3.3S, where A is intercept of calibration line and S is the standard deviation of at least 3 reps of low level standard.	40 CFR Pt. 136 App. B.
Moisture Control	Nafion system.	Sorbent system.

Table 6-2.2. Method TO-3 Standard Analyte List

Analyte	RL (ppmv)	Acceptance Criteria		
		ICAL (%RSD)	LCS & CCV (%R)	Precision (%RPD)
Benzene	0.001	≤ 30	± 25	≤ 25
Toluene	0.001	≤ 30	± 25	≤ 25
Ethyl Benzene	0.001	≤ 30	± 25	≤ 25
Total Xylenes	0.001	≤ 30	± 25	≤ 25
TPH* (Gasoline Range)	0.025	≤ 30	± 25	≤ 25
TPH** (JP 4 Range)	0.025	≤ 30	± 25	≤ 25

* *TPH referenced to Gasoline (MW = 100)*

** *TPH referenced to JP 4 (MW = 156)*

Table 6-2.3. Surrogate

Surrogate	PID Accuracy (%R)	FID Accuracy (%R)
Fluorobenzene	75-125%	75-150%

Table 6-2.4. Summary of Calibration and QC Procedures for Method TO-3 (BTEX & TPH)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Calibration (ICAL)	Prior to sample Analysis.	%RSD ≤ 30.	Repeat the calibration.
Laboratory Control Sample (LCS)	With each initial calibration, and with each analytical batch.	±25% of the expected value.	Check the system and re-analyze the standard. Re-prepare the standard or re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis.	±25% of the expected value.	For initial CCV: Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Mid/End Check	At the end of the analytical batch, not to exceed 20 samples.	±25% of the expected value.	Check system and re-analyze the standard. If the 2nd analysis fails, identify and correct the problem, then re-analyze all samples since the last acceptable CCV.
Laboratory Blank	In between analysis of standards and project samples.	Results less than the laboratory Reporting Limit.	Repeat the Laboratory Blank. If the re-analysis of the Lab Blank contains compounds above but at less than 5 X the reporting limit, sample analysis may proceed and the associated sample results will be reported with a B flag.
Surrogate Spikes	As each standard, blank, and sample is being loaded.	75-125% recovery on the PID, 75-150% on the FID.	Low surrogate recovery results in re-analysis (at a higher dilution if high levels of moisture are present). If recovery is out and still low, report the analysis with the better recovery and flag. Because of TPH interference, high surrogate recoveries do not result in re-analysis. Data is flagged to note high recovery.
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for detections >5 X's RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found on the system, narrate the data.

6.3 TO-4A/TO-10A – PESTICIDES AND PCBS

This method involves GC analysis of Pesticides and Aroclor Polychlorinated Biphenyls (PCBs) in ambient air samples collected on polyurethane foam (PUF) cartridges.

Adsorbent PUF cartridges are cleaned using solvents and vacuum dried. Cartridges are sent to the field wrapped tightly in aluminum foil to prevent degradation by ultraviolet (UV) light. The PUF cartridges are batch certified for cleanliness prior to shipping. In addition, the laboratory analyzes one clean PUF cartridge for each extraction set to serve as a Laboratory Blank.

A high volume sampler is used for TO-4A and a low volume sampler is used for method TO-10A. A glass fiber filter may also be included in the sampling scheme in order to collect particulate bound matter.

The filters and cartridges are prepared for analysis by either Soxhlet or Pressurized Fluid Extraction (PFE) by EPA Method 3545A. The extract is concentrated, exchanged into Hexane and concentrated again to final volume. Analysis is performed using a GC/ECD (Electron Capture Detector).

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-3.1. Summary of Method Modifications for TO-4A/TO-10A

Requirement	**EPA Method TO-4A/TO-10A**	**Air Toxics Ltd. Modifications**
Extraction Solvent	10 % (5 % TO-10A) Diethyl Ether in Hexane.	DCM, exchanging to Hexane during the concentration step.
Reagent Blank	Set up extraction system without filter/PUF; reflux with solvent.	No Reagent Blank is extracted. Reagent lots are certified as acceptable prior to use.
Media certification (TO-10A only)	< 0.01 µg for single peak analytes, < 0.1 µg for PCBs.	< Reporting Limit for all analytes.
Frequency of Continuing Calibration Verification	Every 10 samples.	Every 20 samples with internal standard.
PCB Quantitation	Requires a minimum of 5 peaks.	Use 4 peaks for quantitation.

Table 6-3.2. Methods TO-4A/TO-10A Pesticides and PCBs Reporting and QC Limits

Analyte	RL (µg)	Acceptance Criteria				
		ICAL (%RSD)	ISCV (%R)	CCV (%D)	LCS② (%R)	Precision (%RPD)
4,4'-DDD	0.10	< 20	± 15	± 15		≤ 25%
4,4'-DDE	0.10	< 20	± 15	± 15		≤ 25%
4,4'-DDT	0.10	< 20	± 15	± 15	65-125	≤ 25%
4,4'-Methoxychlor	1.0	< 20	± 15	± 15		≤ 25%
Aldrin	0.10	< 20	± 15	± 15	65-125	≤ 25%
alpha-BHC	0.10	< 20	± 15	± 15		≤ 25%
alpha-Chlordane	0.10	< 20	± 15	± 15		≤ 25%
Aroclor 1016/1242	1.0	< 20	± 15	± 15	65-125	≤ 25%
Aroclor 1221①	1.0	< 20	± 15	± 15		≤ 25%
Aroclor 1232①	1.0	< 20	± 15	± 15		≤ 25%
Aroclor 1248①	1.0	< 20	± 15	± 15		≤ 25%
Aroclor 1254①	1.0	< 20	± 15	± 15		≤ 25%
Aroclor 1260	1.0	< 20	± 15	± 15	65-125	≤ 25%
beta-BHC	0.10	< 20	± 15	± 15		≤ 25%
delta-BHC	0.10	< 20	± 15	± 15		≤ 25%
Dieldrin	0.10	< 20	± 15	± 15	65-125	≤ 25%
Endosulfan I	0.10	< 20	± 15	± 15		≤ 25%
Endosulfan II	0.10	< 20	± 15	± 15		≤ 25%
Endosulfan Sulfate	0.10	< 20	± 15	± 15		≤ 25%
Endrin	0.10	< 20	± 15	± 15	65-125	≤ 25%
Endrin Aldehyde	0.10	< 20	± 15	± 15		≤ 25%
Endrin Ketone	0.10	< 20	± 15	± 15		≤ 25%
gamma-BHC (Lindane)	0.10	< 20	± 15	± 15	65-125	≤ 25%
gamma-Chlordane	0.10	< 20	± 15	± 15		≤ 25%
Heptachlor	0.10	< 20	± 15	± 15	65-125	≤ 25%
Heptachlor Epoxide	0.10	< 20	± 15	± 15		≤ 25%
Technical Chlordane①④	1.0	< 20	± 15	± 15		≤ 25%
Toxaphene①	1.0	< 20	± 15	± 15		≤ 25%

① The noted multi-component compounds use a one-point calibration.
② Recovery limits are derived from Compendium Method TO-10A January, 1999.
③ Recovery limits are for extracted samples only. Non-extracted samples use limits of 85 – 115 %R.
④ Not routinely reported, available at client request

Table 6-3.3. Surrogates③

Surrogate	%R
TCMX	60 – 120②
DCB	60 – 120②

Table 6-3.4. Summary of Calibration and QC Procedures for Methods TO-4A/TO-10A

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point ICAL*	Prior to sample analysis.	%RSD ≤ 20 for each compound or average %RSD ≤ 20.	Use linear regression per SW-846 or re-calibrate.
Independent Source Calibration Verification (ISCV)	After each Initial Calibration.	Recovery of an individual component or the average of all the target components for a list of 5 or more target components within 85 to 115 % recovery. Not to exceed 75-125% for any individual compounds.	Investigate the source of discrepancy, including re-preparation and re-analysis of standard. Re-calibrate if needed.
Breakdown Check	Daily, CCV Pesticides only.	Degradation ≤ 15%.	Perform maintenance. Repeat breakdown check.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, every 20 samples, and at the end of the analysis sequence.	Recovery of an individual component or the average of all the Pesticide target components for a list of 5 or more target components, within 15% of the expected values. Not to exceed 75-125% for any individual compounds.	Analyze new ICAL and/or prepare fresh standards. If the standard analyzed is high and associated samples are ND, "Q" flag the high recoveries. If the standard analyzed is low, re-analyze all samples.
Laboratory Control Spike (LCS)	Extracted with each set of up to 20 samples.	As mentioned in Table 6-3.2.	Analyze another aliquot. If it still fails, "Q" flag the compounds outside the control limits.
Surrogates	All samples, QC, and blanks prior to extraction.	As mentioned in Table 6-3.3	Analyze another aliquot, if it still fails, "Q" flag the compounds outside the control limits.
Internal Standard	With all analyses.	CCV 50-200% compared to midpoint of ICAL; Samples 50-200% compared to first CCV of the daily analytical batch.	Analyze another 100 µL aliquot. If a CCV fails, correct problem before proceeding. If a sample fails, analyze a second time. If it still fails, dilute the sample until IS meet the criteria. Narrate the matrix interference.
Laboratory Blanks	With each set of up to 20 samples extracted.	Results less than the Laboratory reporting limit.	Analyze another aliquot. If it still fails, "B" flag the compounds that do not meet the acceptance criteria.
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for detections > 5 X's RL.	Analyze sample a 3rd time. If criteria are still not met, narrate the data.
Second-Column Confirmation	100% for all positive results, for both Pesticide /PCB analyses.	Same as for initial or primary column analysis.	Same as for initial or primary column analysis.

* *A single point calibration is performed for Technical Chlordane, Toxaphene, and certain Aroclors.*

6.4 TO-5/CARB 430, METHOD 0011, AND TO-11A– ALDEHYDES AND KETONES

These methods involve High-Pressure Liquid Chromatography (HPLC) analysis of Aldehydes and Ketones in stationary and ambient air samples. The sampling media consist either of various-sized impingers containing 2,4-Dinitrophenylhydrazine (DNPH) reagent, or a Sep-PAK (silica) cartridge coated in-situ with a solution of DNPH. Aldehydes and Ketones are readily converted to a stable Hydrazone derivative. The impinger contents are extracted with a 70:30 Methylene Chloride/Hexane solution or Methylene Chloride only, concentrated, solvent exchanged and analyzed on the HPLC. The Sep-PAK cartridges are eluted with Acetonitrile using gravity feed technique. Analysis is performed by reverse phase HPLC with UV detection at 360nm.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-4.1. Summary of TO-5/CARB 430 Method Modifications

Requirement	TO-5/CARB 430	Air Toxics Ltd. Modifications
Initial Calibration (ICAL)	**TO-5:** Linear regression, $R \geq 0.999$.	Average Response Factor (RF), composite % RSD ≤ 10. Linear regression is performed when requested.
Sample Quantitation	Use daily RF.	Use ICAL RF.
Calibration Standard Precision	% RSD ±10%.	Recovery of all Continuing Cal. standards must be 90% - 110%.
Retention Time (RT) Precision	%RPD < 2% for daily calibration standards.	RT windows determined by bracketing standards.
Limit of Detection	**CARB 430:** The "limit of detection" is defined as the upper bound of the 95% confidence interval for the analysis of at least 4 reagent blanks.	Detection Limit is based on the current MDL study which is calculated from a minimum of 7 extracted spikes following 40 CFR Part 136 Appendix B.
Field Blank Subtraction	**CARB 430:** Subtract the average of the field blanks from the samples.	The samples and Field Blanks are not blank subtracted.
Laboratory Control Spike (LCS)	**CARB 430:** If the LCS is out it must be re-extracted until it is in or re-calibrate.	The LCS is only extracted once with out of control recoveries flagged.
UV Absorption Detector	**TO-5:** Operate at 370 nm.	Operate at 360 nm.
Mobile Phase	**TO-5:** Methanol/Water.	Acetonitrile/Water.

Table 6-4.2. Summary of Method TO-11A Modifications

Requirement	TO-11A	*Air Toxics Ltd. Modifications*
Initial Calibration Curve (ICAL)	Multi-point using linear regression performed every 6 months.	Multi-point using average Response Factor; re-calibration if daily cal. fails, major maintenance or column change. Linear regression is performed when requested.
ICAL Criteria	R2 for curve > 0.999	%RSD ≤ 10% unless Linear regression is requested.
Blank Subtraction	Average blank concentrations calculated. Blank value subtracted from sample result.	One Lab Blank is analyzed per batch; no blank subtraction performed on samples.

Table 6-4.3. Methods TO-5/CARB 430, TO-11A, and Method 0011 Standard Analyte List

Analyte	TO-5/ Method 0011/ CARB430 RL (µg)	TO-11A RL (µg)	Acceptance Criteria		
			ICAL (%RSD)	ISCV (%R)	CCV (%R)
Formaldehyde	0.5	0.05	≤ 10	± 15	± 10
Acetaldehyde	0.5	0.10	≤ 10	± 15	± 10
Acrolein [a]	0.5	0.25 [c]	≤ 10	± 15	± 10
Acetone*	NA	0.25	≤ 10	± 15	± 10
Propanal	0.5	0.25	≤ 10	± 15	± 10
Crotonaldehyde*	0.5	0.25	≤ 10	± 15	± 10
n- Butyraldehyde[b]	0.5	0.25	≤ 10	± 15	± 10
Isopentanal*	0.5	0.25	≤ 10	± 15	± 10
Pentanal	0.5	0.25	≤ 10	± 15	± 10
m,p-Tolualdehyde*	0.5	0.25	≤ 10	± 15	± 10
o-Tolualdehyde*	0.5	0.25	≤ 10	± 15	± 10
Hexanal	0.5	0.25	≤ 10	± 15	± 10
Dimethylbenzaldehye **	0.5	0.25	≤ 10	± 15	± 10

[a] *Because its derivative is not stable, when the target analyte list includes Acrolein, the sample will need to be extracted in field. A special order should be placed with the laboratory during the project set up stage.*

[b] *Methyl Ethyl Ketone, Iso-Butyraldehyde and the n-Butyraldehydes co-elute(report as n-Butyraldehyde)*

[c] *Not recommended for TO-11A*

* *Not included in the extracted LCS compound list for methods CARB 430/TO-5 and method 0011.*

** *Special request compound*

Table 6-4.4. Summary of Calibration and QC Procedures for Methods TO-5/CARB 430, TO-11A, and Method 0011

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Initial Calibration Curve (ICAL)	Analyzed in triplicate prior to sample analysis	%RSD ≤ 10.	Repeat calibration.
Instrument LCS	With each ICAL	%R = 85-115%.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, after a maximum of every 10 injections, and at the end of the analytical batch.	Within ± 10% of the expected value.	Check the system and re-analyze the standard. If the criteria cannot be met, re-calibrate the instrument. If the standard is biased low, re-analyze all samples since last acceptable CCV. If biased high and samples are "ND", re-analysis is not required. Q-flag high recoveries.
Instrument (Solvent) Blank Analysis	Following analysis of Standards.	Results less than the laboratory RL.	Inspect the system and Re-analyze the blank.
Laboratory Duplicates	10% of samples.	RPD ≤ 25% for detections >5 Xs RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.

6.5 NIOSH 2546 – CRESOLS AND PHENOLS

This method involves GC/FID (Flame Ionization Detector) analysis for Phenol and Methylphenols (Cresols) in ambient air samples. The sampling media consists of solid two section sorbent tubes containing 100mg/50mg XAD-7. A sample size of 5 to 24 Liters is collected. The sorbent media is sonicated and desorbed separately in 2.0 mL Methanol. A desorption efficiency study is necessary for each XAD-7 lot.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-5.1. Summary of Method Modifications

Requirement	NIOSH 2546	Air Toxics Ltd. Modifications
Desorption Study	Conducted once per year.	Conducted once per sorbent lot.
Sample Quantitation	Corrected for desorption efficiency.	Not corrected for desorption efficiency.
Calibration Standard	Calibrate daily with at least six working standards.	Initial calibration with at least six points (%RSD ≤ 20%). Continuing Calibration Verification at the start and at the end of each analytical batch (%D ≤ 25%).

Table 6-5.2. NIOSH 2546 Standard Analyte List

Analyte	RL (µg)	Low Point of the Curve (µg)	Acceptance Criteria			
			ICAL (% RSD)	LCS (% R)	CCV (% R)	Precision (% RPD)
2-Methylphenol (o-Cresol)	1.0	1.0	≤ 20	75 - 125	75 - 125	< 25%
m,p-Cresol	1.0	1.0	≤ 20	75 - 125	75 - 125	< 25%
Phenol	1.0	1.0	≤ 20	75 - 125	75 - 125	< 25%

Table 6-5.3. Summary of Calibration and QC Procedures for NIOSH 2546

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Six-point ICAL	Prior to sample analysis.	% RSD ≤ 20.	Correct problem then repeat Initial Calibration.
Independent Source Check Standard (LCS)	All analytes – once per Initial Calibration.	75 - 125 % of the expected value.	Investigate the problem and if warranted, analyze a new analytical curve for the out-of-limits compound.
Continuing Calibration Verification (CCV)	Daily, prior to sample analysis, every 20 samples, after last sample of the day, as an End Check.	75 - 125 % of the expected value.	Check the system and re-analyze the standard. If the criteria cannot be met, re-calibrate the instrument.
Laboratory Blanks	With each extraction batch.	Results less than laboratory RL.	Inspect the system and re-analyze the blank. If contamination still present, "B" flag associated sample detections.
Laboratory Control Spikes (LCS)	With each extraction batch.	% Recovery between 75-125 %.	"Q" flag the compounds outside the acceptance criteria.
Sample Duplicates	10 % of the samples.	RPD ≤ 25 % for detections > 5X the RL.	Re-analyze the sample a 3rd time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.
Desorption Study	For every sorbent tube lot.	Reported upon client request.	NA

6.6 TO-12 - NMOC

This method involves GC analysis of whole air samples collected in Summa™ canisters or Tedlar bags. Samples are analyzed for Non-Methane Organic Compounds (NMOC) using EPA Method TO-12 protocols. After concentration on a sorbent bed, samples are analyzed using a Flame Ionization Detector (FID). This method is used when speciation is not required.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Reporting Limits, QC criteria, and QC summary can be found in the following tables.

Table 6-6.1. Summary of Method Modifications

Requirement	EPA Method TO-12	Air Toxics Ltd. Modifications
Reporting Limit	0.02 ppmc.	0.010 ppmv.
Reported Units	Ppmc.	Ppmv, or if ref to CH_4, multiply by 7. Units in ppmvc.
Initial Calibration	Five levels – each level three runs with %RSD < 3%; Linearity criterion not specified.	Minimum of three single levels; %RSD ≤ 30%.
Sample Analysis Frequency	Duplicate analysis with RPD <5%, report average result .	Single analysis. Duplicate 10% of samples with RPD ≤ 25% for detections > 5 X's the RL.
Sample Hold Time	None specified.	Canister 30 days, Tedlar bags 3 days.
Column	GC column not used.	GC column used for analysis.

Table 6-6.2. Method TO – 12 Standard Analyte List

Analyte	RL (ppmv)	ICAL (%RSD)	CCV %D	LCS %R	Duplicates %RPD
TNMOC ref. to Heptane	0.010	≤ 30	± 25	75-125	≤ 25

Heptane MW = 100

Table 6-6.3. Summary of Calibration and QC Procedures for Method TO-12

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to sample analysis.	% RSD ≤ 30.	Repeat the calibration.
Laboratory Control Sample (LCS)	With each initial calibration and analytical batch.	75-125% of the expected value.	Check the system and re-analyze the Standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 samples or at the end of the analytical sequence.	% Difference ± 25.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met. Re-analyze all samples since the last acceptable CCV.
Laboratory Blank	In between analysis of standards and project samples.	Results less than laboratory reporting limit.	Repeat the Laboratory Blank. If the re-analysis of the Lab Blank contains compounds above but at less than 5 X the reporting limit, sample analysis may proceed and the associated sample results will be reported with a B flag.
Sample Duplicates	10% of the samples.	≤ 25% for detections > 5X's the RL.	Re-analyze the sample for a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.

6.7 TO-13A AND 8270C – SEMIVOLATILE COMPOUNDS

This method involves GC/MS full scan or SIM mode analysis of semi-volatile organic compounds in ambient air samples collected on PUF/XAD2 cartridges. In relation to the prescribed media, sampling and collection efficiency for compounds not listed in TO-13A has not been evaluated. Samples are prepared by either soxhlet or Pressurized Fluid Extraction (PFE) by EPA Method 3545A and analyzed for Polynuclear Aromatic Hydrocarbons (PAHs) using a quadrupole GC/MS in full scan or SIM mode by TO-13A protocol. In addition, the target compound list is often extended to include analysis of Method 8270 semi-volatile compounds. Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Air Toxics Ltd. also performs semi-volatile analysis by SW-846 Method 8270C. The extraction process of MM5 trains follows SW846 Method 3542, and the QC criteria differ from Method TO-13A analysis. The QC criteria and QC summary tables for Method 8270C analysis are in the section following the TO-13A tables.

Table 6-7.1. Summary of Method Modifications for TO-13A

Requirements	EPA Method TO-13A	Air Toxics Ltd. Modifications
Extraction Solvent	10% ether in hexane for PUF; DCM for XAD sorbent. Final extract in hexane.	DCM for PUF/XAD cartridge and XAD sorbent. Final extract in DCM.
Glassware Cleaning	Muffle furnace is utilized.	Solvent cleaning procedure is used.
Extraction Technique	Soxhlet extraction.	Soxhlet extraction or pressurized fluid extraction (PFE).
Reporting List	19 PAHs.	See Tables 6-7.2 & 6-7.3.
Calibration range:	0.1-2.5 µg/mL in Hexane	1.0-160 µg/mL in Methylene chloride for quad or 0.1-40 µg/mL for SIM.
Surrogate	Field surrogates: Fluoranthene-d10 and Benzo(a)pyrene-d12.	Field surrogates: provided upon request.
Solvent Process Blank	One each analytical batch.	Not performed: each solvent lot is certified.
Method Blank	< MDL.	<Reporting Limit.

Table 6-7.2. Modified Method TO-13A

Analyte	SIM RL (µg)	RL (µg)	Minimum ICAL RRF	ICAL (%RSD)	ISCV (%R)	CCV (%R)	Precision (%RPD)
2-Chloronaphthalene*	0.1	1.0	NA	≤ 30	± 30	± 30	≤ 25%
2-Methylnaphthalene*	0.1	1.0	NA	≤ 30	± 30	± 30	≤ 25%
Acenaphthylene	0.1	1.0	1.3	≤ 30	± 30	± 30	≤ 25%
Acenaphthene	0.1	1.0	0.8	≤ 30	± 30	± 30	≤ 25%
Anthracene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Benzo(a)anthracene	0.1	1.0	0.8	≤ 30	± 30	± 30	≤ 25%
Benzo(e)pyrene*	0.1	1.0	NA	≤ 30	± 30	± 30	≤ 25%
Benzo(a)pyrene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Benzo(b)fluoranthene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Benzo(g,h,i)perylene	0.1	1.0	0.5	≤ 30	± 30	± 30	≤ 25%
Benzo(k)fluoranthene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Chrysene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Dibenz(a,h)anthracene	0.1	1.0	0.4	≤ 30	± 30	± 30	≤ 25%
Fluoranthene	0.1	1.0	0.6	≤ 30	± 30	± 30	≤ 25%
Fluorene	0.1	1.0	0.9	≤ 30	± 30	± 30	≤ 25%
Indeno(1,2,3-c,d)pyrene	0.1	1.0	0.5	≤ 30	± 30	± 30	≤ 25%
Naphthalene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Phenanthrene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Pyrene	0.1	1.0	0.6	≤ 30	± 30	± 30	≤ 25%

*** Not included in the TO-13A method.**

The following two compounds can be analyzed upon client's request.

Analyte	SIM RL (µg)	RL (µg)	Minimum ICAL RRF	ICAL (%RSD)	ISCV (%R)	CCV (%R)	Precision (%RPD)
Perylene	NA	1.0	0.5	≤ 30	± 30	± 30	≤ 25%
Coronene	NA	1.0	0.7	≤ 30	± 30	± 30	≤ 25%

Table 6-7.3. Modified Method TO-13A-Extended

Analyte	Minimum ICAL RRF	RL (µg)	ICAL [(1)] (%RSD)	ISCV (%R)	Precision %RPD
1,2,4-Trichlorobenzene	NA	1.0	≤ 30	± 30	≤ 25%
1,2-Dichlorobenzene	NA	1.0	≤ 30	± 30	≤ 25%
1,3-Dichlorobenzene	NA	1.0	≤ 30	± 30	≤ 25%
1,4-Dichlorobenzene - CCC	NA	1.0	≤ 30	± 30	≤ 25%
2,4,5-Trichlorophenol	NA	5.0	≤ 30	± 30	≤ 25%
2,4,6-Trichlorophenol - CCC	NA	5.0	≤ 30	± 30	≤ 25%
2,4-Dichlorophenol - CCC	NA	5.0	≤ 30	± 30	≤ 25%
2,4-Dimethylphenol	NA	5.0	≤ 30	± 30	≤ 25%

Analyte	Minimum ICAL RRF	RL (µg)	ICAL [1] (%RSD)	ISCV (%R)	Precision %RPD
2,4-Dinitrophenol - SPCC	0.05	20	≤ 30	± 30	≤ 25%
2,4-Dinitrotoluene	NA	5.0	≤ 30	± 30	≤ 25%
2,6-Dinitrotoluene	NA	5.0	≤ 30	± 30	≤ 25%
2-Chloronapthalene	NA	1.0	≤ 30	± 30	≤ 25%
2-Chlorophenol	NA	5.0	≤ 30	± 30	≤ 25%
2-Methylnapthalene	NA	1.0	≤ 30	± 30	≤ 25%
2-Methylphenol	NA	5.0	≤ 30	± 30	≤ 25%
2-Nitroaniline	NA	10	≤ 30	± 30	≤ 25%
2-Nitrophenol – CCC	NA	5.0	≤ 30	± 30	≤ 25%
3,3-Dichlorobenzidine	NA	20	≤ 30	± 30	≤ 25%
3-Nitroaniline	NA	10	≤ 30	± 30	≤ 25%
4,6-Dinitro-2-methylphenol	NA	10	≤ 30	± 30	≤ 25%
4-Bromophenyl-phenyl ether	NA	1.0	≤ 30	± 30	≤ 25%
4-Chloro-3-methylphenol - CCC	NA	5.0	≤ 30	± 30	≤ 25%
4-Chloroaniline	NA	10	≤ 30	± 30	≤ 25%
4-Chlorophenyl-phenyl ether	NA	1.0	≤ 30	± 30	≤ 25%
4-Methylphenol	NA	5.0	≤ 30	± 30	≤ 25%
4-Nitroaniline	NA	10	≤ 30	± 30	≤ 25%
4-Nitrophenol – SPCC	0.05	20	≤ 30	± 30	≤ 25%
Acenaphthylene	1.3	1.0	≤ 30	± 30	≤ 25%
Acenaphthene – CCC	0.8	1.0	≤ 30	± 30	≤ 25%
Anthracene	0.7	1.0	≤ 30	± 30	≤ 25%
Benzo(a)anthracene	NA	1.0	≤ 30	± 30	≤ 25%
Benzo(a)pyrene - CCC	0.7	1.0	≤ 30	± 30	≤ 25%
Benzo(e)pyrene	0.5	1.0	≤ 30	± 30	≤ 25%
Benzo(b)fluoranthene	0.7	1.0	≤ 30	± 30	≤ 25%
Benzo(g,h,i)perylene	NA	1.0	≤ 30	± 30	≤ 25%
Benzo(k)fluoranthene	NA	1.0	≤ 30	± 30	≤ 25%
Benzoic Acid	NA	30	≤ 30	± 30	≤ 25%
Bis(2-Chloroethoxy) Methane	NA	1.0	≤ 30	± 30	≤ 25%
Bis(2-Chloroispropyl) Ether	NA	1.0	≤ 30	± 30	≤ 25%
Bis(2-Chlroethyl) Ether	NA	1.0	≤ 30	± 30	≤ 25%
Bis(2-Ethylhexyl)phthalate	NA	5.0	≤ 30	± 30	≤ 25%
Butylbenzylphthalate	NA	5.0	≤ 30	± 30	≤ 25%
Chrysene	0.7	1.0	≤ 30	± 30	≤ 25%
di-n-Butylphthalate	NA	5.0	≤ 30	± 30	≤ 25%
di-n-Octylphthalate - CCC	NA	5.0	≤ 30	± 30	≤ 25%
Dibenz(a,h)anthracene	0.4	1.0	≤ 30	± 30	≤ 25%
Dibenzofuran	NA	1.0	≤ 30	± 30	≤ 25%
Diethylphthalate	NA	5.0	≤ 30	± 30	≤ 25%
Dimethylphthalate	NA	5.0	≤ 30	± 30	≤ 25%
Fluoranthene – CCC	0.6	1.0	≤ 30	± 30	≤ 25%
Fluorene	0.9	1.0	≤ 30	± 30	≤ 25%

Analyte	Minimum ICAL RRF	RL (µg)	ICAL [1] (%RSD)	ISCV (%R)	Precision %RPD
Hexachlorobenzene	NA	1.0	≤ 30	± 30	≤ 25%
Hexachlorobutadiene - CCC	NA	1.0	≤ 30	± 30	≤ 25%
Hexachlorocylcopentadiene-SPCC	0.05	20	≤ 30	± 30	≤ 25%
Hexachloroethane	NA	1.0	≤ 30	± 30	≤ 25%
Indeno(1,2,3-c,d)pyrene	0.5	1.0	≤ 30	± 30	≤ 25%
Isophorone	NA	1.0	≤ 30	± 30	≤ 25%
n-Nitroso-di-n-propylamine–SPCC	0.05	1.0	≤ 30	± 30	≤ 25%
n-Nitrosodiphenylamine – CCC	NA	10	≤ 30	± 30	≤ 25%
Naphthalene	0.7	1.0	≤ 30	± 30	≤ 25%
Nitrobenzene	NA	1.0	≤ 30	± 30	≤ 25%
Pentachlorophenol – CCC	NA	20	≤ 30	± 30	≤ 25%
Phenanthrene	0.7	1.0	≤ 30	± 30	≤ 25%
Phenol – CCC	NA	5.0	≤ 30	± 30	≤ 25%
Pyrene	0.6	1.0	≤ 30	± 30	≤ 25%

[1] With 10% exception not to exceed 40%

Table 6-7.4. Surrogates (Full Scan)

Analyte	(%R)
2,4,6-Tribromophenol	50 – 150
2-Fluorophenol	50 – 150
Nitrobenzene-d_5	50 – 150
Phenol-d_5	50 – 150
Fluorene-d10	60 – 120
Pyrene-d10	60 – 120

Table 6-7.5. Internal Standards

Analyte	(%)
Acenaphthene-d_{10}	50 – 200
Chrysene-d_{12}	50 – 200
1,4-Dichlorobenzene-d_4	50 – 200
Naphthalene-d_8	50 – 200
Perylene-d_{12}	50 – 200
Phenanthrene-d_{10}	50 – 200

Table 6-7.6. TO-13A-Surrogates (Standard and SIM)

Analyte	Accuracy (% R)*
Fluorene-d_{10}	60 - 120
Pyrene-d_{10}	60 - 120

Table 6-7.7. Extracted Laboratory Control Spikes for Modified TO-13A-Extended

Analyte	(%R)
1,2,4-Trichlorobenzene***	50 – 150
1,4-Dichlorobenzene***	50 – 150
2,4-Dinitrotoluene***	50 – 150
2-Chlorophenol***	50 – 150
4-Chloro-3-methylphenol***	50 – 150
4-Nitrophenol***	50 – 150
Acenaphthene*	60 – 120
N-Nitroso-di-n-propylamine***	50 – 150

Analyte	(%R)
Pentachlorophenol**	22 – 109
Phenol***	50 – 150
Pyrene*	60 – 120

* *The LCS and Surrogate limits are derived from Compendium Method TO-13A Sections 13.3.7.4 and 13.4.6.3 January, 1999. These limits only apply to samples that are extracted by Air Toxics Ltd. When sample extracts are sent to Air Toxics Ltd., limits of 50 – 150 % are applied.*

** *Pentachlorophenol is not included in Compendium Method TO-13A and has been shown to be erratically recovered from XAD media therefore historical Control Limits are used. Limits are updated periodically as needed.*

*** *Compounds outside of the TO-13A method*

Table 6-7.8. Extracted Laboratory Control Samples for TO-13A (PAHs) in Full Scan and SIM

Analyte	(%R)
Napthalene	60 – 120
Acenapthylene	60 – 120
Acenaphtene	60 – 120
Flourene	60 – 120
Phenanthrene	60 – 120
Anthracene	60 – 120
Fluoranthene	60 – 120
Pyrene	60 – 120
Benzo (a) anthracene	60 – 120
Chrysene	60 – 120
Benzo (b) flouranthene	60 – 120
Benzo (k) flouranthene	60 – 120
Benzo (a) pyrene	60 – 120
Indeno (1,2,3-cd) pyrene	60 – 120
Dibenzo (a,h) anthracene	60 – 120
Benoz (g,,h,i) perylene	60 – 120

Table 6-7.9. Summary of Calibration and QC Procedures for EPA Method TO-13A

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at start of every 12 hrs.	SW-846 tuning criteria for semivolatiles analysis. DDT% Breakdown< 20%	Correct problem then repeat tune.
Initial 5-Point Calibration	Prior to sample analysis.	ICAL criteria in tables 6-7.2 and 6-7.3	Correct problem then repeat initial calibration.
ICAL LCS	All analytes – Once per initial calibration.	All target compound recoveries must be between 70 – 130%.	Determine the source of discrepancy between standards. Re-calibrate if needed.
Continuing Calibration Verification (CCV)	At the start of every clock immediately after the DFTPP tune check.	PAHs list: meet min. RRF requirement PAHs list/ short list %D ≤ 30% Semivol full list: SPCCs: RF ≥ 0.050 %D ≤ 30% with 10% exception not to exceed 40%. Flag all results outside of compliance with the exception of high bias associated with non-detects.	Investigate and correct the problem, up to and including re-calibration if necessary. High bias associated with non-detects in samples will not result in re-analysis.
Internal Standards (IS)	As each standard, blank, and sample is being aliquoted.	For CCV: Area count within 50 to 200% of the mid point of ICAL. For blanks, samples and non-CCV QC Checks: retention times within ± 0.33 minutes (20 seconds) and area counts within 50 to 200% of the CCV.	For CCVs: Investigate and correct the problem before proceeding with sample analysis. If interferences are present, a secondary ion may be selected. For blanks: inspect the system and re-analyze the blank. For samples and non-CCV QC: unless there is obvious matrix effect, re-analyze the samples and dilute the sample until the IS meet the criteria, narrate the data to indicate interference.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Surrogates	With all samples and blanks prior to extraction.	See Table 6-7.4.	A new aliquot of the extract is analyzed. If Surrogate recoveries are out-of-control a second time, data is flagged and narrated. Re-analysis is not necessary for obvious matrix effects (data is flagged for out-of-control surrogate recoveries). Air samples cannot be re-extracted.
Extracted LCS	With each set of up to 20 extracted samples.	See LCS Criteria in tables 6-7.7 and 6-7.8.	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise, narrate.
Laboratory Blank	With each set of up to 20 extracted samples.	Results less than laboratory reporting limit.	Flag the data.
Solvent Blanks	When samples that are extracted together are analyzed on different analytical shifts.	All target compounds below the reporting limit.	Flag the data.
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for all hits > 5X RLs.	Narrate the data.

Table 6-7.10. Summary of Method Modifications for EPA Methods 3510/3542 and 8270C

Requirements	EPA Method 8270C	Air Toxics Ltd. Modifications
Linearity of ICAL	Use mean RF for non-CCC compounds if %RSD≤ 15%. If %RSD>15%, use a) linear regression equation that does not pass through the origin. R >/= 0.99, or b) non-linear (i.e., 6 points for a quadratic model).	Use mean RF for non-CCC compounds when %RSD≤ 30%.
RT for CCV	Within +/- 30 seconds of the mid-point standard from the initial curve.	Frequent column maintenance results in RT shift; therefore this requirement is not practical.

Table 6-7.11. SW-846 Modified Method 8270C Standard Analyte List

Analyte	RL (µg)	Acceptance Criteria			
		ICAL (%RSD)[©]	ISCV (%R)[©]	CCV[©]	Precision\% RPF
1,2,4-Trichlorobenzene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
1,2-Dichlorobenzene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
1,3-Dichlorobenzene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
1,4-Dichlorobenzene - CCC	1.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
2,4,5-Trichlorophenol	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2,4,6-Trichlorophenol - CCC	5.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
2,4-Dichlorophenol - CCC	5.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
2,4-Dimethylphenol	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2,4-Dinitrophenol - SPCC	20	≤ 15	± 30	**RF > 0.050**	≤ 25%
2,4-Dinitrotoluene	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2,6-Dinitrotoluene	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2-Chloronaphthalene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2-Chlorophenol	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2-Methylnaphthalene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2-Methylphenol	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
2-Nitroaniline	10	≤ 30	± 30	%D ≤ 20%	≤ 25%
2-Nitrophenol – CCC	5.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
3,3-Dichlorobenzidine	20	≤ 15	± 30	%D ≤ 20%	≤ 25%
3-Nitroaniline	10	≤ 30	± 30	%D ≤ 20%	≤ 25%
4,6-Dinitro-2-methylphenol	10	≤ 30	± 30	%D ≤ 20%	≤ 25%
4-Bromophenyl-phenyl ether	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
4-Chloro-3-methylphenol - CCC	5.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
4-Chloroaniline	10	≤ 30	± 30	%D ≤ 20%	≤ 25%
4-Chlorophenyl-phenyl ether	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
4-Methylphenol	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
4-Nitroaniline	10	≤ 30	± 30	%D ≤ 20%	≤ 25%
4-Nitrophenol – SPCC	20	≤ 15	± 30	**RF > 0.050**	≤ 25%
Acenaphthylene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Acenaphthene – CCC	1.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
Anthracene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Benzo(a)anthracene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Benzo(a)pyrene - CCC	1.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
Benzo(b)fluoranthene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Benzo(g,h,i)perylene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Benzo(k)fluoranthene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Benzoic Acid	30	≤ 30	± 30	%D ≤ 20%	≤ 25%
Bis(2-Chloroethoxy) Methane	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Bis(2-Chloroispropyl) Ether	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Bis(2-Chlroethyl) Ether	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Bis(2-Ethylhexyl)phthalate	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%

Analyte	RL (µg)	Acceptance Criteria			
		ICAL (%RSD)①	ISCV (%R)②	CCV③	Precision\% RPF
Butylbenzylphthalate	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Chrysene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
di-n-Butylphthalate	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
di-n-Octylphthalate - CCC	5.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
Dibenz(a,h)anthracene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Dibenzofuran	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Diethylphthalate	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Dimethylphthalate	5.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Fluoranthene – CCC	1.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
Fluorene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Hexachlorobenzene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Hexachlorobutadiene – CCC	1.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
Hexachlorocylcopentadiene – SPCC	20	≤ 15	± 30	**RF > 0.050**	≤ 25%
Hexachloroethane	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Indeno(1,2,3-c,d)pyrene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Isophorone	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
n-Nitroso-di-n-propylamine – SPCC	1.0	≤ 15	± 30	**RF > 0.050**	≤ 25%
n-Nitrosodiphenylamine – CCC	10	≤ 30	± 30	%D ≤ 20%	≤ 25%
Naphthalene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Nitrobenzene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Pentachlorophenol – CCC	20	≤ 30	± 30	%D ≤ 20%	≤ 25%
Phenanthrene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%
Phenol – CCC	5.0	≤ 30	± 30	%D ≤ 20%	≤ 25%
Pyrene	1.0	≤ 15	± 30	%D ≤ 20%	≤ 25%

① *Can use the mean RSD criterion of ≤ 15% as noted in par. 7.5.1.2.1 of SW-846, 8000B.*

② *No more than 10% of the target compounds are allowed to exceed the limit.*

③ *If %D for all CCC is less than or equal to 20%, then the CCV is assumed to be valid. If the CCCs are not included in the list of analytes for a project, then all analytes must meet the 20% D.*

Table 6-7.12. Surrogates

Analyte	Accuracy④ (% R)
2,4,6-Tribromophenol	10 – 123
2-Fluorobiphenyl	43 – 116
2-Fluorophenol	21 – 110
Nitrobenzene-d_5	35 – 114
Phenol-d_5	10 – 110
p-Terphenyl-d_{14}	33 – 141

Table 6-7.13. Internal Standards

Analyte	Accuracy (% R)
Acenaphthene-d_{10}	-50 to +100
Chrysene-d_{12}	-50 to +100
1,4-Dichlorobenzene-d_4	-50 to +100
Naphthalene-d_8	-50 to +100
Perylene-d_{12}	-50 to +100
Phenanthrene-d_{10}	-50 to +100

④ *The Surrogate limits are derived from USEPA CLP OLM 03.0 and OLM04.2. Air Toxics Ltd. receives a numerically insufficient number of liquid samples for SW 8270C analysis to allow semi-annual updating of in-house Control Limits.*

Table 6-7.14. Extracted Laboratory Control Spikes

Analyte	Accuracy ① (% R)
1,2,4-Trichlorobenzene	39 – 98
1,4-Dichlorobenzene	36 – 97
2,4-Dinitrotoluene	24 – 96
2-Chlorophenol	27 – 123
4-Chloro-3-methylphenol	23 – 97
4-Nitrophenol	10 – 80
Acenaphthene	46 – 118
N-Nitroso-di-n-propylamine	41 – 116
Pentachlorophenol	9 – 103
Phenol	12 – 110
Pyrene	26 – 127

Table 6-7.15. Pre-Spike Surrogates

Analyte	Accuracy ② (%R)
Benzo(a)Pyrene-d_{12}	50 – 150
Fluoranthene- d_{10}	50 – 150

① *The LCS limits are derived from USEPA CLP OLM03.0 and OLM04.2. Air Toxics Ltd. receives a numerically insufficient number of samples for SW 8270C analysis to allow semi-annual updating of in-house Control Limits. These limits only apply to samples that are extracted by Air Toxics Ltd. When sample extracts are sent to Air Toxics Ltd., limits of 50 - 150% are applied.*

② *The pre-spike Surrogates limits are arbitrary. Air Toxics Ltd. received a numerically insufficient number of samples for SW 8270C analysis to allow semi-annual updating of in-house control limits.*

Table 6-7.16. Summary of Calibration and QC Procedures SW-846 Modified Method 8270C

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at start of every 12 hrs.	SW-846 tuning criteria for Semi-volatiles analysis.	Correct problem then repeat tune.
Initial 5-Point Calibration	Prior to sample analysis.	ICAL criteria in Table 6-7.11.	Correct problem then repeat Initial Calibration.
Independent Source Calib. Ver. (ISCV)	All analytes – once per Initial Calibration.	At least 90% of the target compounds recoveries must be between 70 – 130%.	Determine the source of discrepancy between standards. Re-calibrate if needed.
Continuing Calibration Verification (CCV)	At the start of every clock, immediately after the DFTPP tune check.	**SPCCs:** RF≥0.050 **CCCs:** %D ≤20%; Non-CCC's when CCC compounds are not requested %D ≤20%.	Investigate and correct the problem, up to and including re-calibration if necessary. High bias for one or more compounds associated with non-detects in the samples will not result in re-analysis.
Internal Standards (IS)	As each standard, blank, and sample is being aliquoted.	**For CCVs:** area counts within -50% to +100% from the most recent ICAL. **For blanks, samples and non-CCV QC Checks:** Retention Times within ± 0.33 minutes (20 seconds) and area counts within -50% to +100% of the CCV.	**For CCVs:** Investigate and correct the problem before proceeding with sample analysis. **For blanks:** Inspect the system and re-analyze the blank. **For samples and non-CCV QC:** Re-analyze the samples. If the criteria are not met a second time, dilute sample until IS meet criteria.
Surrogates	With all samples and blanks prior to extraction.	See Table 6-7.12.	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise narrate.
Extracted LCS	With each set of up to 20 extracted samples.	See LCS Criteria in Table 6-7.14.	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise narrate.
Laboratory Blank	With each set of up to 20 extracted samples.	Results less than laboratory RL.	Re-aliquot and re-analyze the extract to confirm the presence of the target compound. If it doesn't confirm, investigate and correct the problem before re-analyzing all the affected samples.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Solvent Blanks	When samples that are extracted together are analyzed on different analytical shifts.	All target compounds below the RL.	Investigate and correct the problem before re-analyzing all the affected samples.
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for all detections > 5 X's RLs.	Analyze a third time. Report the closest two results and narrate and report the data if the criteria is still not met.

6.8 TO-14A/TO-15 – VOLATILE ORGANIC COMPOUNDS

This method involves full scan GC/MS analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds using EPA Method TO-14A/TO-15 protocols. An aliquot of the sample is withdrawn from the canister through a mass flow controller and is either concentrated using a cryogenic trap and/or concentrated using a hydrophobic multisorbent bed. The hydrophobic multisorbent bed functions as a drying system which removes water from the sample stream prior to analysis by full scan GC/MS. For low level analysis, the sample is focused onto a cryogenic cooled column for analysis by full scan GC/MS.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-8.1. Summary of Method Modifications

Requirement	TO-14A	TO-15	Air Toxics Ltd. Modifications
Sample Drying System	Nafion Drier.	Multisorbent.	Multisorbent.
Blank acceptance criteria	< 0.2 ppbv.	< RL.	< RL.
Blanks and standards **(applies to Low Level analysis only)**	Zero Air.	Zero air.	Nitrogen.
BFB absolute abundance criteria	Within 10% of that from the previous day.	Not mandated.	CCV internal standard area counts are compared to ICAL, corrective action for > 40 %D.
Method Detection Limit	Not Specified.	Follow 40CFR Pt.136 App. B.	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases.
Initial Calibration	≤ 30 % RSD.	≤ 30 % RSD with 2 compounds allowed out to ≤ 40 % RSD.	≤ 30 % RSD with 2 compounds allowed out to ≤ 40 % for **QUAD and 5&20** analysis and 4 compounds allowed out to ≤ 40 % for **Low Level** analysis.

Requirement	TO-14A	TO-15	Air Toxics Ltd. Modifications
Daily CCV	≤ 30% D.	≤ 30% D.	For **QUAD and 5&20** analysis: 70-130%. Compounds exceeding this criterion and associated data will be flagged and narrated. If more than two compounds from the standard list recover outside of 70-130%, corrective action will be taken. Unless prior client approval; under no circumstances will samples be analyzed if any compound exceeds 60-140%. For **Low Level** analysis the above applies except corrective action will be taken if more than four compounds from the standard list recover outside of 70-130%.
Sample collection media.	Summa canister.	Summa canister.	Methods TO-14A/TO-15 are validated for samples collected in specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of these methods and not recommended for ambient or indoor air samples. Associated results are considered qualified.

Table 6-8.2. Method TO-14A/TO-15 Analyte List

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,1,2-Trichloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,1-Dichloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,1-Dichloroethene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,2,4-Trichlorobenzene	2.0/0.5/20	30%	70 - 130	≤ 25
1,2,4-Trimethylbenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,2-Dibromoethane (EDB)	0.5/0.1/5.0	30%	70 - 130	≤ 25

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits (Max. RPD)
1,2-Dichlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤25
1,2-Dichloroethane	0.5/0.1/5.0	30%	70 - 130	≤25
1,2-Dichloropropane	0.5/0.1/5.0	30%	70 - 130	≤25
1,3,5-Trimethylbenzene	0.5/0.1/5.0	30%	70 - 130	≤25
1,3-Dichlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤25
1,4-Dichlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤25
Benzene	0.5/0.1/5.0	30%	70 - 130	≤25
Bromomethane	0.5/0.1/5.0	30%	70 - 130	≤25
Carbon Tetrachloride	0.5/0.1/5.0	30%	70 - 130	≤25
Chlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤25
Chloroethane	0.5/0.1/5.0	30%	70 - 130	≤25
Chloroform	0.5/0.1/5.0	30%	70 - 130	≤25
Chloromethane	2.0/0.1/20	30%	70 - 130	≤25
Chlorotoluene (Benzyl Chloride)	0.5/0.1/5.0	30%	70 - 130	≤25
cis-1,2-Dichloroethene	0.5/0.1/5.0	30%	70 - 130	≤25
cis-1,3-Dichloropropene	0.5/0.1/5.0	30%	70 - 130	≤25
Dichloromethane	0.5/0.2/5.0	30%	70 - 130	≤25
Ethylbenzene	0.5/0.1/5.0	30%	70 - 130	≤25
Freon 11 (Trichlorofluoromethane)	0.5/0.1/5.0	30%	70 - 130	≤25
Freon 113 (Trichlorotrifluoroethane)	0.5/0.1/5.0	30%	70 - 130	≤25
Freon 114	0.5/0.1/5.0	30%	70 - 130	≤25
Freon 12 (Dichlorodifluoromethane)	0.5/0.1/5.0	30%	70 - 130	≤25
Hexachlorobutadiene	2.0/0.5/20	30%	70 - 130	≤25
m,p-Xylene	0.5/0.1/5.0	30%	70 - 130	≤25
Methyl Chloroform	0.5/0.1/5.0	30%	70 - 130	≤25
o-Xylene	0.5/0.1/5.0	30%	70 - 130	≤25
Styrene	0.5/0.1/5.0	30%	70 - 130	≤25
Tetrachloroethene	0.5/0.1/5.0	30%	70 - 130	≤25
Toluene	0.5/0.1/5.0	30%	70 - 130	≤25
trans-1,3-Dichloropropene	0.5/0.1/5.0	30%	70 - 130	≤25
Trichloroethene	0.5/0.1/5.0	30%	70 - 130	≤25
Vinyl Chloride	0.5/0.1/5.0	30%	70 - 130	≤25

Table 6-8.3. Method TO-14A/TO-15 Analyte List

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits
1,3-Butadiene	0.5/0.1/5.0	30%	60 – 140	≤25
1,4-Dioxane	2.0/0.1/20	30%	60 – 140	≤25
2-Butanone (Methyl Ethyl Ketone)	0.5/0.1/5.0	30%	60 – 140	≤25
2-Hexanone	2.0/0.5/20	30%	60 – 140	≤25
4-Ethyltoluene	0.5/0.1/5.0	30%	60 – 140	≤25
4-Methyl-2-Pentanone (MIBK)	0.5/0.1/20	30%	60 – 140	≤25

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits
Acetone	2.0/0.5/20	30%	60 – 140	≤ 25
Bromodichloromethane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Bromoform	0.5/0.1/5.0	30%	60 – 140	≤ 25
Carbon Disulfide	0.5/0.5/5.0	30%	60 – 140	≤ 25
Cyclohexane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Dibromochloromethane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Ethanol	2.0/0.5/20	30%	60 – 140	≤ 25
Heptane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Hexane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Isopropanol	2.0/0.5/20	30%	60 – 140	≤ 25
Methyl t-Butyl Ether (MTBE)	0.5/0.1/5.0	30%	60 – 140	≤ 25
Propylene	2.0/0.5/20	30%	60 – 140	≤ 25
Tetrahydrofuran	0.5/0.5/5.0	30%	60 – 140	≤ 25
trans-1,2-Dichloroethene	0.5/0.1/5.0	30%	60 – 140	≤ 25
2,2,4-Trimethylpentane	0.5/0.5/5.0	30%	60 – 140	≤ 25
Cumene	0.5/0.1/5.0	30%	60 – 140	≤ 25
Propylbenzene	0.5/0.1/5.0	30%	60 – 140	≤ 25
3-Chloroprene	2.0/0.5/20	30%	60 – 140	≤ 25
Naphthalene	2.0/0.5/20	30%	60 – 140	≤ 25
TPH (Gasoline) or NMOC (Hexane/Heptane)	10/2.0/50	One Point Calibration	NA	≤ 25

Table 6-8.4. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 - 140
1,4-Difluorobenzene	60 - 140
Chlorobenzene-d_5	60 - 140

Table 6-8.5. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

Table 6-8.6. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours, or every 12 hours if project requires.	SW – 846 tune criteria.	Correct problem then repeat tune.
5-Point Calibration	Prior to sample analysis.	% RSD ≤ 30 with two compounds allowed out to ≤ 40% RSD for QUAD and 5&20 (4 allowed out for LL).	Correct problem then repeat Initial Calibration Curve.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
LCS	After each initial calibration curve, and daily, prior to sample analysis.	Recoveries for 90% of "Standard" compounds must be 70-130%; for 80% of "Non-standard" compounds, recoveries must be 60-140%. No recovery may be <50%. * If specified by the client in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	At the start of each day and, if required by a specific project, every 12 hours.	For QUAD and 5&20: 70-130%. Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70-130%, corrective action will be taken. Unless prior client approval; under no circumstances will samples be analyzed if any compound exceeds 60-140%. For **Low Level** analysis the above applies except corrective action will be taken if more than four compounds from the standard list recover outside of 70-130%.	Perform maintenance and repeat test. If the system still fails the CCV, perform a new 5 point calibration curve.
Laboratory Blank	After the CCV/LCS.	Results less than the laboratory reporting limit.	Inspect the system and Re-analyze the blank.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Internal Standard (IS)	As each standard, blank, and sample is being loaded.	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** inspect the system and reanalyze the blank. **For samples:** re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded.	70 - 130%. * If specified by the client in-house generated control limits may be used.	**For blanks:** inspect the system and reanalyze the blank. **For samples:** re-analyze the sample unless obvious matrix interference is documented. If the %R is within limits in the re-analysis, report the second analysis. If %R is out-of-limits a second time, then narrate results.
Laboratory Duplicates	10% of the samples.	RPD ≤25% for detections >5 X's the RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found on the system, narrate results.

6.9 TO-14A/TO-15 VOLATILE ORGANIC COMPOUNDS BY SIM

This method involves Selective Ion Monitoring (SIM) GC/MS analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds using EPA Method TO-14A/TO-15 protocols. An aliquot of the sample is withdrawn from the canister through a mass flow controller and concentrated using a cryogenic trap. The focused air sample is then flash heated through a hydrophobic drying system that removes water from the sample stream. The sample is then focused onto a cryogenic cooled column prior to analysis by GC/MS in the (SIM) mode.

Air Toxics Ltd. performs a modified version of this method. The target analyte list and Limit of Quantitation reflect relevant risk driving compounds and are available upon request. The method modifications, QC criteria, and QC summary may be found in the following tables.

Table 6-9.1. Summary of Method Modifications

Requirement	TO-14A	TO-15	Air Toxics Ltd. Modifications
Sampling/concentrator system	Nafion Drier.	Multi-sorbent concentrator.	Multi-sorbent concentrator
Blank acceptance criteria	< 0.2 ppbv.	< RL.	< RL.
Blank and standards	Zero air.	Zero air.	Nitrogen.
BFB absolute abundance criteria	Within 10% of that from previous day.	Not mandated.	CCV internal standard area counts are compared to ICAL, corrective action for > 40% D.
ICAL %RSD acceptance criteria	< 30% RSD.	≤ 30%, with two compounds allowed to ≤ 40%.	Project specific; default criteria is ≤30% RSD with 10% of compounds allowed out to ≤ 40% RSD.
Daily CCV	≤30% D.	≤30% D.	Project specific; default criteria is 70-130%. Compounds exceeding this criterion and associated data will be flagged and narrated. If more than 10% of compounds from the standard list recover outside of 70-130%, corrective action will be taken. Unless prior client approval; under no circumstances will samples be analyzed if any compound exceeds 60-140%.

Requirement	TO-14A	TO-15	Air Toxics Ltd. Modifications
Method Detection Limit	Not Specified.	Follow 40CFR Pt.136 App. B.	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases.

Table 6-9.2. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 - 140
1,4-Difluorobenzene	60 - 140
Chlorobenzene-d_5	60 - 140

Table 6-9.3. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

Table 6-9.4 Summary of Calibration and QC Procedures for Methods TO-14A/TO-15 by SIM

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours, or every 12 hours if project requires.	SW – 846 tune criteria.	Correct problem then repeat tune.
5-6-Point Calibration	Prior to sample analysis	≤ 30% for standard compounds with 10% of the compound list allowed out to ≤ 40% RSD.	Correct problem then repeat Initial Calibration Curve.
Laboratory Control Standard (LCS)	After each initial calibration curve, and daily prior to sample analysis.	Recoveries for 90% of "Standard" compounds must be ±30%; for 80% of "Non-standard" compounds, recoveries must be ±40%. No recovery may be <50%. * If specified by the client in-house generated control limits may be used.	Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification (CCV)	At the start of each day and, if required by a specific project, every 12 hours.	70-130%. Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than 10% of compounds from the standard list recover outside of 70-130%, corrective action will be taken. Unless prior client approval; under no circumstances will samples be analyzed if any compound exceeds 60-140%.	Perform maintenance and repeat test. If the system still fails the CCV, perform a new calibration curve.
Laboratory Blank	After the LCS.	Results less than the laboratory reporting limit.	Inspect the system and re-analyze the blank.
Internal Standard (IS)	As each standard, blank, and sample is being loaded.	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** inspect the system and re-analyze the blank. **For samples:** re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded.	70 - 130%. * If specified by the client in-house generated control limits may be used.	**For blanks:** inspect the system and re-analyze the blank. **For samples:** re-analyze the sample unless obvious matrix interference is documented. If the %R is within limits in the re-analysis, report the second analysis. If %R is out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for detections >5 X's the RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.

6.10 ASTM D-1945 - FIXED GASES

This method involves GC analysis of landfill gas, ambient air, or stack gas collected in Summa™ canisters, Tedlar bags, or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for Methane and fixed gases and can be used to speciate individual light hydrocarbons up to C6. This method is also used to determine caloric content of the gas. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using UHP Helium or Nitrogen. Samples are then analyzed using a GC equipped with a FID and a Thermal Conductivity Detector (TCD).

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-10.1. Summary of Method Modifications

Requirement	ASTM D-1945	Air Toxics Ltd. Modifications
Sample Injection Volume	0.50 mL to achieve Methane linearity.	1.0 mL.
Reference Standard	Concentration should not be < half of nor differ by more than 2X the concentration of the sample. Run 2 consecutive checks; must agree within 1%.	A minimum 3-point linear calibration. The acceptance criterion is RSD ≤15%. All target analytes must be within the linear range of calibration (with the exception of O_2, N_2, and C6+ Hydrocarbons).
Sample Analysis	Equilibrate samples to 20-50° F. above source temperature at field sampling.	Heating of samples is not performed.
Sample Calculation	Response factor is calculated using peak height for C5 and lighter compounds.	Peak areas are used for all target analytes to quantitate concentrations.
Normalization	Sum of original values Should not differ from 100.0% by more than 1.0%.	Sum of original values may range between 85-115%; normalization of data not performed, unless requested by client.

Table 6-10.2. ASTM Modified Method D-1945 Standard Analyte List

Analyte	RL (%)	Acceptance Criteria		
		Initial Calibration (%RSD)	CCV/LCS (%R)	Precision (%RPD)
Carbon Dioxide	0.01	≤ 15%	85 – 115	≤ 25%
Carbon Monoxide	0.01	≤ 15%	85 – 115	≤ 25%
Ethene	0.001	≤ 15%	85 – 115	≤ 25%
Ethane	0.001	≤ 15%	85 – 115	≤ 25%
Acetylene	0.001	≤ 15%	85 – 115	≤ 25%
Isobutane	0.001	≤ 15%	85 – 115	≤ 25%
Methane	0.0001	≤ 15%	85 – 115	≤ 25%
n-Butane	0.001	≤ 15%	85 – 115	≤ 25%
Neopentane	0.001	≤ 15%	85 – 115	≤ 25%
Isopentane	0.001	≤ 15%	85 – 115	≤ 25%
n-Pentane	0.001	≤ 15%	85 – 115	≤ 25%
Nitrogen*	0.10	≤ 15%	85 – 115	≤ 25%
NMOC (C6+)	0.01	≤ 15%	85 – 115	≤ 25%
Oxygen	0.10	≤ 15%	85 – 115	≤ 25%
Propane	0.001	≤ 15%	85 – 115	≤ 25%
Hydrogen	0.01***	≤ 15%	85 – 115	≤ 25%
Helium	0.01**	≤ 15%	85 – 115	≤ 25%

* *For samples that have been pressurized with N_2, the amount of N_2 in the sample is determined by subtraction.*

** *Included by special request only.*

*** *RL is 1.0% when sample is pressurized with Helium.*

Table 6-10.3. Summary of Calibration and QC Procedures ASTM Modified Method D-1945

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to Sample Analysis.	ICAL criteria in Table 6-10.2.	Correct problem, then repeat Initial Calibration.
Independent Source Check Verification (LCS)	Once per analytical batch.	LCS criteria in Table 6-10.2.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 samples or at the end of the analytical batch.	CCV criteria in Table 6-10.2.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met. If the closing CCV fails, the system is checked and the standard is re-analyzed. If the second analysis fails, identify and correct the problem, then re-analyze all samples since the last acceptable CCV.
Laboratory Blank	Daily.	Results less than the laboratory RL.	Inspect the system and troubleshoot until the system is free of contamination.
Sample Duplicates	10%.	RPD ≤25% for detections >5 times the RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.

6.11 ASTM D-1946 - ATMOSPHERIC GASES

This method involves GC analysis of landfill gas, ambient air, or stack gas collected in Summa™ canisters, Tedlar bags, or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for Methane, fixed gases, and Non-Methane Organic Carbon (NMOC) using ASTM D-1946 protocols. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using UHP Helium or Nitrogen. Samples are then analyzed using a GC equipped with a FID and a TCD.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-11.1. Summary of Method Modifications

Requirement	ASTM D-1946	Air Toxics Ltd. Modifications
Calibration	A single point calibration is performed using a reference standard closely matching the composition of the unknown.	A minimum 3-point calibration curve is performed. Quantitation is based on a daily calibration standard, which may or may not resemble the composition of the associated samples.
Reference Standard	The composition of any reference standard must be known to within 0.01 mol % for any component.	The standards used by Air Toxics Ltd. are blended to a ≥ 95% accuracy.
Sample Injection Volume	Components whose concentrations are in excess of 5 % should not be analyzed by using sample volumes greater than 0.5 mL.	The sample container is connected directly to a fixed volume sample loop of 1.0 mL. Linear range is defined by the calibration curve. Bags may be loaded by vacuum or by positive pressure.
Normalization	Normalize the mole percent values by multiplying each value by 100 and dividing by the sum of the original values. The sum of the original values should not differ from 100% by more than 1.0%.	Results are not normalized. The sum of the reported values can differ from 100% by as much as 15%, either due to analytical variability or an unusual sample matrix.
Precision	Precision requirements established at each concentration level.	Duplicates should agree within 25 % RPD for detections >5 X's the RL.

Table 6-11.2. ASTM Modified Method D-1946 Standard Analyte List

Compound	RL (%)	ICAL Criteria (%RSD)	LCS Criteria (%R)	CCV Criteria (%D)	Precision Limits (RPD)
Carbon Dioxide***	0.010	≤ 15%	85 – 115	±15	≤ 25%
Carbon Monoxide***	0.010	≤ 15%	85 – 115	±15	≤ 25%
Methane	0.00010	≤ 15%	85 – 115	±15	≤ 25%
Ethene*	0.0010	≤ 15%	85 – 115	±15	≤ 25%
Ethane*	0.0010	≤ 15%	85 – 115	±15	≤ 25%
Nitrogen	0.10	≤ 15%	85 – 115	±15	≤ 25%
NMOC (C2+)	0.010	≤ 15%	85 – 115	±15	≤ 25%
Oxygen	0.10	≤ 15%	85 – 115	±15	≤ 25%
Hydrogen*	0.010**	≤ 15%	85 – 115	±15	≤ 25%

* *Ethene, Ethane and Hydrogen are included by special request only.*

** *RL is 1.0 % when sample is pressurized with He.*

*** *RL can be lowered to 0.001% using a Nickel catalyst and reporting from the FID by special request.*

Table 6-11.3. Summary of Calibration and QC Procedures ASTM Modified Method D-1946

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to Sample analysis.	RSD ≤ 15 %.	Correct problem then repeat Initial Calibration.
Second Source Verification (LCS)	All analytes - once per Initial Calibration, and with each analytical batch.	%R 85 – 115 %.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 samples.	%R 85 – 115 %.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Laboratory Blank (He) (N_2 for He and H_2 analysis)	Immediately after each daily check standard and prior to sample analysis, or when contamination is present.	Results < RL.	Inspect the system and re-analyze the Blank.
End Check	At the end of analytical sequence. It can be primary (CCV) or second source (LCS).	%R 85 – 115 %.	Check system and re-analyze the standard. If the 2nd analysis fails, correct the problem. Reanalyze all samples since the last acceptable CCV.
Sample Duplicates	10% of the samples.	RPD ≤ 25 % for detections > 5 X's the RL.	Re-analyze the sample a third time. Correct the problem. If no problem is found, narrate.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Chromatographic Resolution of CH_4 from CO (FID)	As needed.	< 50 % valley.	Re-condition the molecular sieve column at similar levels.
Response of CO And CO_2 (FID)	As needed.	< 30 %.	Re-pack the tube with fresh catalyst and allow to stabilize.

6.12 ASTM D-5504 - SULFUR COMPOUNDS

This method involves GC analysis of whole air samples collected in Tedlar bags. Samples are analyzed for reduced sulfur compounds using ASTM D-5504 protocols using a Sulfur Chemiluminescence Detector (SCD).

ASTM D-5504 is not a prescriptive method therefore modification documentation is not necessary.

Table 6-12.1. ASTM Modified Method D-5504 (Sulfur Compounds) Standard Analyte List

Analyte	RL (ppbv)	Acceptance Criteria		
		ICAL ① (% RSD)	LCS/ CCV ② (% R)	Precision (% RPD)
2,5-Dimethylthiophene	4.0	≤ 30	70 -130	≤ 25
2-Ethylthiophene	4.0	≤ 30	70 -130	≤ 25
3-Methylthiophene**	4.0	≤ 30	70 -130	≤ 25
Carbon Disulfide	4.0	≤ 30	70 -130	≤ 25
Carbonyl Sulfide	4.0	≤ 30	70 -130	≤ 25
Diethyl Disulfide	4.0	≤ 30	70 -130	≤ 25
Diethyl Sulfide	4.0	≤ 30	70 -130	≤ 25
Dimethyl Disulfide	4.0	≤ 30	70 -130	≤ 25
Dimethyl Sulfide	4.0	≤ 30	70 -130	≤ 25
Ethyl Mercaptan	4.0	≤ 30	70 -130	≤ 25
Ethyl Methyl Sulfide**	4.0	≤ 30	70 -130	≤ 25
Hydrogen Sulfide	4.0	≤ 30	70 -130	≤ 25
Isobutyl Mercaptan	4.0	≤ 30	70 -130	≤ 25
Isopropyl Mercaptan	4.0	≤ 30	70 -130	≤ 25
Methyl Mercaptan	4.0	≤ 30	70 -130	≤ 25
n-Butyl Mercaptan**	4.0	≤ 30	70 -130	≤ 25
n-Propyl Mercaptan	4.0	≤ 30	70 -130	≤ 25
tert-Butyl Mercaptan	4.0	≤ 30	70 -130	≤ 25
Tetrahydrothiophene	4.0	≤ 30	70 -130	≤ 25
Thiophene	4.0	≤ 30	70 -130	≤ 25

① *Average %RSD ≤ 30%, not to exceed 40% for any individual compounds. H_2S %RSD must be ≤ 30%.*

② *Up to 10% allowed to exceed %R criterion (not to exceed ±50%); end check may have 20% exceed criterion. All compounds must be within %R limit for short list (five compounds or less)*

** *Compounds co-elute*

Table 6-12.2. Summary of Calibration and QC Procedures for Modified ASTM Method D 5504

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Min of 3 or more points Calibration (ICAL)	Prior to sample analysis.	RSD ≤ 30% (average). H_2S must be ≤ 30%. All others must be ≤ 40%.	Repeat calibration.
Second Source Verification (LCS)	With each Initial Calibration; with each analytical batch.	70 - 130 % of the expected values for at least 18 of the 20 target compounds. H_2S must be within ±30%. Recovery < 50% or > 150% will require corrective action. If less than five compounds, all compounds must meet criteria.	Check the system, re-prepare and/or re-analyze standard. Re-calibrate instrument if criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis.	**Full list:** % R for at least 18 out of the 20 compounds within 70 – 130 %. H_2S must meet limits. **Short list:** 5 compounds or less, % R for all compounds within 70 – 130 %. 5 – 19 compounds, %R for 1 compound or 10% of the compounds allowed out. H_2S must meet limits.	Check the system and re-analyze the standard. If the 2nd analysis fails, identify and correct the problem. Corrective action may include re-analysis of affected samples out of Hold Time per client request.
Laboratory Blank	In between analysis of standards and project samples.	Results less than the laboratory Limit of Quantitation.	Inspect the system and re-analyze the blank. If the third blank still has contamination, consult a Scientist or Team Leader.
End Check	At the end of the analytical sequence.	Recoveries within 70 - 130% with 20% (4 target analytes) allowed out.	Check system and re-analyze the standard. If the 2nd analysis fails, identify and correct the problem. Corrective action may include re-analysis of affected samples out of Hold Time per client request.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Laboratory Duplicates	10% of the samples.	RPD ≤ 25 % for detections > 5X LOQ.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.

6.13 RSK-175 - GC HEADSPACE EQUILIBRATION TECHNIQUE

This method involves GC analysis of the dissolved gases in water samples collected in 40 mL VOA vials. In the laboratory, an aliquot of the sample is injected into a Nitrogen-purged vial and placed into a headspace autosampler where each sample is shaken and heated prior to injection. The autosampler then injects an aliquot of headspace onto a gas chromatographic column where the gaseous components are separated and detected by a FID or TCD. Analysis is conducted for analytes listed in Table 6-13.2.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-13.1. Summary of Method Modifications

Variance	EPA SOP RSK-175	Air Toxics Ltd. SOP
Sample Collection	Collect sample in 60 mL crimp-top vial.	Collect sample in 40 mL VOA vial. Or pressurized sample cylinder.
Headspace Generation	Headspace is generated in 60 mL sample vial by displacing volume of liquid with Helium. The amount of liquid should be 10% of sample volume in bottle, up to 10 mL.	5.0 mL of sample is displaced with 5.0 mL Nitrogen and transferred to a Nitrogen purged and capped autosampler vial. Headspace is then generated in the auto-sampler vial.
Headspace Injection	Syringe injection of 300 µL headspace into GC.	Autosampler pressurizes sample to fill 1.0 mL loop with headspace sample.
Calibration and Quantitation	Direct injections of gas phase standards are used to obtain a Calibration Curve. Henry's Law is used to calculate mg of gas per Liter of water. Calculation requires recording total volume of serum bottle and headspace, and sample temperature.	Calibration is obtained by spiking headspace samples with gas phase analyte and analyzing using the same procedure as the samples. Quantitation of samples is directly obtained using the Calibration Curve that relates µg analyte/mL water sample to peak area.
Initial Calibration Curve (ICAL)	Linear regression.	Average Response Factor.
Lab Blanks	Blank subtraction is performed.	No blank subtraction; Lab Blank must be less than the Reporting Limit.

Table 6-13.2. RSK-175 Headspace by GC Standard Analyte List

Analyte	RL (µg/mL)	Acceptance Criteria		
		ICAL (% RSD)	LCS/ CCV (% R)	Precision (% RPD)
Methane	0.005	≤ 30	70 - 130	≤ 25
Ethane	0.01	≤ 30	70 - 130	≤ 25
Ethene	0.01	≤ 30	70 - 130	≤ 25
Propane	0.001	≤ 30	70 - 130	≤ 25
Propene	0.001	≤ 30	70 - 130	≤ 25
Carbon Dioxide	1.0	≤ 30	70 - 130	≤ 25

Table 6-13.3. Summary of Calibration and QC Procedures for RSK-175 Headspace by GC

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Calibration (ICAL)	Prior to sample analysis.	% RSD ≤ 30.	Repeat the calibration.
Second Source Verification (LCS)	With each Initial Calibration; and analytical batch.	70 – 130 % of the expected value.	Check the system and re-analyze the standard. Re-calibrate if necessary.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, and after every 20 samples.	70 – 130 % of the expected value.	Check the system and re-analyze the standard. Re-calibrate if necessary.
Laboratory Blank	In between analysis of standards and project samples.	Results less than the laboratory Report Limit.	Inspect the system and re-analyze the Laboratory Blank.
Matrix Spike (MS)	By client request.	Recoveries within 50 – 150 %.	If unopened sample vial remains, re-prepare MS. If none available, flag result and narrate.
Matrix Spike Duplicate (MSD)	By client request.	RPD ≤ 25%.	If unopened sample vial remains, re-prepare MSD. If none available, narrate.
End Check	At the end of analytical sequence.	70 - 130 % of the expected value.	Check system and re-analyze the standard. If the 2nd analysis fails, identify and correct the problem. All suspect samples are re-prepared from the available hold vials and analyzed.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for Detections > 5X RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.
Preparation LCS	With each batch up to 20 samples.	70 – 130% of the expected value.	Re-prepare and analyze the LCS along with associated samples if hold vials are available. If not, flag and narrate the data.

6.14 TO-17 VOLATILE ORGANIC COMPOUNDS

This method is an alternative to the canister based sampling and analysis methods that are presented in EPA Compendium Methods TO-14 and TO-15. Samples are collected by drawing a volume of air through a sorbent packed tube. The sample cartridges are thermally desorbed by heating and purging with organic-free Helium. The resulting gaseous effluent is then trapped on the secondary trap. The secondary trap is then thermally desorbed for GC/MS analysis.

The procedures in this method outline the use of EPA Method TO-17 protocols to determine the concentrations of volatile organic compounds in air samples collected on sorbent tubes.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6-14.1. Summary of Method Modifications

Requirements	EPA Method TO-17	Air Toxics Ltd. Modifications
Lab Blank	At least 2 tubes from the same cleaning batch as the samples are analyzed at the beginning and end of the analytical sequence. Do not dry purge Lab Blanks.	Tubes used for daily lab blank may or may not be from the same batch or sampling media. Only 1 lab blank is analyzed prior to sample analysis. Lab blanks are dry purged to eliminate the possibility of sample anomaly attributed to Dry purge process.
*Tune Check	BFB.	Modification applies only to semivolatile lists such as PAHs in which a DFTPP tune check is more appropriate to demonstrate accurate spectral performance.
*Sample desorption	Method involves primary and secondary desorption.	Modification applies only when using a Tekmar P&T system. After primary desorption, the stream of effluent gas is passed through 5ml of clean purged D.I. water before the secondary desorption. D.I. water acts as a filter for excessive acidic moisture in the samples.

*Modifications are dependent on application.

Table 6-14.2. Summary of Sorbent Applications

Sorbent	Typical Analyte Range	Water management	Primary Applications
Carbotrap 300	C3 – C12	High levels of moisture may interfere with analysis.	Indoor air and outdoor air.
Tenax TA	C7 – C26	Hydrophobic.	All vapors including soil gas.
Tenax GR	C7 – C30	Hydrophobic.	All vapors including soil gas.

Table 6-14.3. TO-17 Carbotrap 300 Analyte List

Analytes	RL (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV (%D)
1,1,1-Trichloroethane	10	30	70 – 130	30
1,1,1,2-Tetrachloroethane	10	30	70 – 130	30
1,1,2,2-Tetrachloroethane	10	30	70 – 130	30
1,1,2-Trichloroethane	10	30	70 – 130	30
1,1-Dichloroethane	10	30	70 – 130	30
1,1-Dichloroethene	10	30	70 – 130	30
1,1-Dichloropropene	10	30	70 – 130	30
1,2,3-Trichlorobenzene	50	30	70 – 130	30
1,2,3-Trichloropropane	10	30	70 – 130	30
1,2,4-Trichlorobenzene	50	30	70 – 130	30
1,2,4-Trimethylbenzene	10	30	70 – 130	30
1,2-Dibromo-3-chloropropane	50	30	70 – 130	30
1,2-Dichlorobenzene	10	30	70 – 130	30
1,2-Dichloroethane	10	30	70 – 130	30
1,2-Dichloropropane	10	30	70 – 130	30
1,3,5-Trimethylbenzene	10	30	70 – 130	30
1,3-Butadiene	50	30	50 – 150	30
1,3-Dichlorobenzene	10	30	70 – 130	30
1,3-Dichloropropane	10	30	70 – 130	30
1,4-Dichlorobenzene	10	30	70 – 130	30
2,2-Dichloropropane	10	30	70 – 130	30
2-Chloropropane	10	30	70 – 130	30
2-Chlorotoluene	10	30	70 – 130	30
Allyl chloride	10	30	70 – 130	30
4-Chlorotoluene	10	30	70 – 130	30
Acrylonitrile	10	30	70 – 130	30
Benzene	10	30	70 – 130	30
Bromobenzene	10	30	70 – 130	30
Bromochloromethane	10	30	70 – 130	30
Bromodichloromethane	10	30	70 – 130	30
Bromoform	10	30	70 – 130	30
Bromomethane	10	30	50 – 150	30
Butylbenzene	10	30	70 – 130	30
Carbon Disulfide	10	30	70 – 130	30
Carbon Tetrachloride	10	30	70 – 130	30
Chlorobenzene	10	30	70 – 130	30
Chloroethane	10	30	50 – 150	30
Chloroform	10	30	70 – 130	30
Chloromethane	10	30	50 – 150	30
cis-1,2-Dichloroethene	10	30	70 – 130	30

Analytes	RL (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV (%D)
cis-1,3-Dichloropropene	10	30	70 – 130	30
cis-1,4-Dichloro-2-butene	50	30	70 – 130	30
Cumene	10	30	70 – 130	30
Dibromochloromethane	10	30	70 – 130	30
Dibromomethane	10	30	70 – 130	30
Dichlorodifluoromethane	10	30	50 – 150	30
Ethylbenzene	10	30	70 – 130	30
Ethylene Dibromide	10	30	70 – 130	30
Freon 11	10	30	70 – 130	30
Freon 113	10	30	70 – 130	30
Hexachlorobutadiene	50	30	70 – 130	30
Hexane	10	30	70 – 130	30
Iodomethane	10	30	70 – 130	30
Methylene Chloride	10	30	70 – 130	30
Methyl t-butyl ether (MTBE)	10	30	70 – 130	30
Naphthalene	50	30	70 – 130	30
m,p-Xylene	10	30	70 – 130	30
o-Xylene	10	30	70 – 130	30
p-Cymene	10	30	70 – 130	30
Propylbenzene	10	30	70 – 130	30
sec-Butylbenzene	10	30	70 – 130	30
Styrene	10	30	70 – 130	30
tert-Butylbenzene	10	30	70 – 130	30
Tetrachloroethene	10	30	70 – 130	30
Toluene	10	30	70 – 130	30
trans-1,2-Dichloroethene	10	30	70 – 130	30
trans-1,3-Dichloropropene	10	30	70 – 130	30
trans-1,4-Dichloro-2-butene	50	30	70 – 130	30
Trichloroethene	10	30	70 – 130	30
Vinyl Bromide *	50	30	50 – 150	30
Vinyl Chloride	10	30	50 – 150	30

* *Independent Source Verification Check not available for this compounds.*

Table 6-14.4. Internal Standard Recovery Limits Limits (Carbotrap 300)

Analyte	CCV IS (%R)	Sample IS (%R)
1,4-Dichlorobenzene-d_4	50 – 200	60 – 140
Chlorobenzene-d_5	50 – 200	60 – 140
Fluorobenzene	50 – 200	60 – 140

Table 6-14.5. Surrogate Recovery (Carbotrap 300)

Analyte	Accuracy (%R)
1,2-Dichloroethane-d_4	70 – 130
4-Bromofluorobenzene	70 – 130
Dibromofluoromethane	70 – 130
Toluene-d_8	70 – 130

Table 6-14-6. TO-17 (Tenax GR/TA)

Analytes	Reporting Limit (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV
1,1,1-Trichloroethane	5.0	30	70 – 130	30
1,1,1,2-Tetrachloroethane	5.0	30	70 – 130	30
1,1,2,2-Tetrachloroethane	5.0	30	70 – 130	30
1,1,2-Trichloroethane	5.0	30	70 – 130	30
1,1-Dichloropropene	5.0	30	70 – 130	30
1,2,3-Trichlorobenzene	5.0	30	70 – 130	30
1,2,3-Trichloropropane	5.0	30	70 – 130	30
1,2,4-Trichlorobenzene	5.0	30	70 – 130	30
1,2,4-Trimethylbenzene	5.0	30	70 – 130	30
1,2-Dibromo-3-chloropropane	5.0	30	70 – 130	30
1,2-Dichlorobenzene	5.0	30	70 – 130	30
1,2-Dichloroethane	5.0	30	70 – 130	30
1,2-Dichloropropane	5.0	30	70 – 130	30
1,3,5-Trimethylbenzene	5.0	30	70 – 130	30
1,3-Dichlorobenzene	5.0	30	70 – 130	30
1,3-Dichloropropane	5.0	30	70 – 130	30
1,4-Dichlorobenzene	5.0	30	70 – 130	30
2-Chlorotoluene	5.0	30	70 – 130	30
4-Chlorotoluene	5.0	30	70 – 130	30
Benzene	5.0	30	70 – 130	30
Bromobenzene	5.0	30	70 – 130	30
Bromodichloromethane	5.0	30	70 – 130	30
Bromoform	5.0	30	70 – 130	30
Butylbenzene	5.0	30	70 – 130	30
Carbon Tetrachloride	5.0	30	70 – 130	30
Chlorobenzene	5.0	30	70 – 130	30
Chloroform	5.0	30	70 – 130	30
cis-1,3-Dichloropropene	5.0	30	70 – 130	30
cis-1,4-Dichloro-2-butene	5.0	30	70 – 130	30
Cumene	5.0	30	70 – 130	30
Dibromochloromethane	5.0	30	70 – 130	30
Dibromomethane	5.0	30	70 – 130	30
Ethylbenzene	5.0	30	70 – 130	30
Ethylene Dibromide	5.0	30	70 – 130	30
Hexachlorobutadiene	5.0	30	70 – 130	30
Naphthalene	5.0	30	70 – 130	30
m,p-Xylene	10	30	70 – 130	30
o-Xylene	5.0	30	70 – 130	30
p-Cymene	5.0	30	70 – 130	30
Propylbenzene	5.0	30	70 – 130	30
sec-Butylbenzene	5.0	30	70 – 130	30

Analytes	Reporting Limit (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV
Styrene	5.0	30	70 – 130	30
tert-Butylbenzene	5.0	30	70 – 130	30
Tetrachloroethene	5.0	30	70 – 130	30
Toluene	5.0	30	70 – 130	30
trans-1,3-Dichloropropene	5.0	30	70 – 130	30
trans-1,4-Dichloro-2-butene	5.0	30	70 – 130	30
Trichloroethene	5.0	30	70 – 130	30

Table 6-14.7. Internal Standard Recovery Limits Limits (Tenax GR/TA)

Analyte	CCV IS (%R)	Sample IS (%R)
1,4-Dichlorobenzene-d_4	50 – 200	60 – 140
Chlorobenzene-d_5	50 – 200	60 – 140
Fluorobenzene	50 – 200	60 – 140

Table 6-14.8. Surrogate Recovery (Tenax GR/TA)

Analyte	Accuracy (%R)
1,2-Dichloroethane-d_4	70 – 130
4-Bromofluorobenzene	70 – 130
Dibromofluoromethane	70 – 130
Naphthalene-d8 (optional)	70 – 130

Table 6-14.9. TO-17 TPH External Calibration (Tenax GR/TA)

Analytes	Reporting Limit (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV
Mineral Spirits (C9 – C12 range)	500	30	70 – 130	30
Surrogates	**% Recovery**			
Chlorobenzene-d5	70 – 140			
Naphthalene – d8	70 - 140			
Analytes	**Reporting Limit (ng)**	**Acceptance Criteria**		
		ICAL (%RSD)	**LCS (% R)**	**CCV**
Diesel	1000	30	70 – 130	30
Surrogates	**% Recovery**			
Toluene-d8	70 – 140			
4-Bromofluorobenzene	70 - 140			
Naphthalene – d8	70 - 140			

Table 6-14.10. TO-17 (Tenax TA - Passive)

Analytes	Reporting Limit (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV
Benzene	5.0	30	70 – 130	30

Toluene	5.0	30	70 – 130	30
Ethyl benzene	1.0	30	70 – 130	30
m,p-xylene	2.0	30	70 – 130	30
o-Xylene	1.0	30	70 – 130	30
Trichloroethene	1.0	30	70 – 130	30
Tetrachloroethene	1.0	30	70 – 130	30
Cis-1,2-Dichloroethene	1.0	30	70 – 130	30
Trans-1,2-Dichloroethene	1.0	30	70 – 130	30
1,1-Dichloroethene	1.0	30	70-130	30
Internal Standards				
Analyte	**CCV IS % Recovery**		**Sample IS % Recovery**	
1,4-Dichlorobenzene-d_4	50 – 200		60 – 140	
Chlorobenzene-d_5	50 – 200		60 – 140	
Fluorobenzene	50 – 200		60 – 140	
Surrogates				
Analyte	**% Recovery**			
1,2-Dichloroethane-d_4	70 – 130			
4-Bromofluorobenzene	70 – 130			
Dibromofluoromethane	70 – 130			

Table 6-14-11. TO-17 (Tenax GR-SVOC)

Analytes	**Reporting Limit (ng)**	**Acceptance Criteria**		
		ICAL (%RSD)	**LCS (% R)**	**CCV**
Naphthalene	5.0	30	70 – 130	30
2-Methylnaphthalene	5.0	30	70 – 130	30
Acenaphthylene	5.0	30	70 – 130	30
Acenaphthene	5.0	30	70 – 130	30
Fluorene	5.0	30	70 – 130	30
Phenanthrene	5.0	30	70 – 130	30
Anthracene	5.0	30	70 – 130	30
Fluoranthene	5.0	30	70 – 130	30
Pyrene	10	30	70 – 130	30
Internal Standards				
Analyte	**CCV IS % Recovery**		**Sample IS % Recovery**	
Naphthalene-d8	50 – 200		60 – 140	
Acenaphthene-d10	50 – 200		60 – 140	
Phenanthrene-d10	50 – 200		60 – 140	
Surrogates				
Analyte	**% Recovery**			
Fluorene-d10	70 – 130			
Pyrene-d10	70 – 130			

Table 6-14.12. Summary of Calibration and QC Procedures for Method TO-17 (Volatile Organic Compounds)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours, or every 12 hours if project requires.	SW - 846 tune criteria.	Correct problem then repeat tune.
5-Point Calibration	Prior to sample Analysis.	%RSD ≤ 30%, 2 allowed out up to 40%	Correct problem then repeat Initial Calibration Curve.
LCS	After each initial Calibration Curve and daily prior to analysis.	Recovery 70- 130% or 50- 150% as noted in Table 6-14.3.	Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	At the start of each day and, if required by a specific project, every 12 hours.	70 - 130 %	If project specified risk drivers exceed this criteria, more than 5% of the compounds exceed this criteria, or any VOC exceeds 50-150% recovery, maintenance is performed and the CCV test repeated. If the system still fails the CCV, perform a new 5-point Calibration Curve.
Laboratory Blank	After the CCV.	Results less than the RL.	Inspect the system and re-analyze the Blank.
Internal Standard (IS)	As each standard, Blank, and sample is being loaded.	**CCVs:** area counts 50% - 200%, RT w/in 30 sec of mid-point in ICAL. **Blanks and samples**: Retention time (RT) must be within ±0.33 minutes of the RT in the CCV. The IS area must be within ±40% of the CCV's IS area for the Blanks and samples.	**CCV:** inspect and correct system prior to sample analysis. **Blanks:** inspect the system and re-analyze the Blank. **Samples:** samples cannot be re-analyzed due to the nature of the sorbent cartridges. However investigate the problem by reviewing the data. If necessary, run a Lab Blank to check the instrument performance. Report the data and narrate.
Surrogates	As each standard, Blank, and sample is being loaded.	70 – 130%.	**For blanks:** inspect the system and re-analyze the Blank. **For samples:** samples cannot be re-analyzed due to the nature of sorbent cartridges. However investigate the problem by reviewing the data. If necessary, run a Lab Blank to check the instrument performance. Report the data and narrate the problem.

6.15 ANALYSIS OF C2-C5 HYDROCARBONS BY GC/FID

This section describes the use of modified EPA Method TO-14A to determine the concentration of Highly Reactive Volatile Organic Compounds (HRVOC) in air using an evacuated Silonite or Summa canister, or a Tedlar bag.

Up to 50 mL of sample is introduced into a GC system from a SUMMA canister or a Tedlar bag using a Mass Flow Controller and a vacuum system. A digital meter readout provides a visual indication of the sample flow during sampling. The sample is focused onto an Air Toxics Ltd. designed sorbent-based interface. The concentrated sample is then flash heated through a de-humidification system that removes background moisture from the sample stream. The sample stream is then analyzed by a FID detector GC system.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 6.15-1. Summary of Method Modifications

Requirement	TO-14A	Air Toxics Ltd. Modifications
Sample Drying System	Nafion Drier.	Multi-sorbent.
Sample load volume	400 mL.	Up to 50 mL.
Blank acceptance criteria	< 0.2 ppbv.	< RL.
Sample collection media	Summa canister.	Air Toxics Ltd. recommends use of summa canisters to insure data defensibility, but will report results from Tedlar bags at client request.
RT window study	Mean +/- 3 X STD within 72 hours.	+/- 0.08 mins (Mean+/-3X STD <0.08).

Table 6.15-2. Modified TO-14A HRVOC by GC/FID Direct Injection (Standard List of Analytes)

Analyte	RL (ppbv)	QA Acceptance Criteria	
		Accuracy Limits (%R)	Precision Limits (Max. RPD)
Ethane	5.0	70 - 130	≤ 25
Ethene	5.0	70 - 130	≤ 25
Propane	5.0	70 - 130	≤ 25
Propene	5.0	70 - 130	≤ 25
Acetylene	5.0	70 - 130	≤ 25
Isobutane	2.0	70 - 130	≤ 25
Butane	2.0	70 - 130	≤ 25
trans-2-Butene	2.0	70 - 130	≤ 25
1-Butene	2.0	70 - 130	≤ 25
Isobutylene	2.0	70 - 130	≤ 25
cis-2-Butene	2.0	70 - 130	≤ 25
Isopentane	2.0	70 - 130	≤ 25
Pentane	2.0	70 - 130	≤ 25
1,3-Butadiene	2.0	70 - 130	≤ 25
NMOC	25	70 - 130	≤ 25

Table 6.15-3. Summary of Calibration and QC procedures

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
3 Point (min) Calibration	Prior to sample analysis.	%RSD ≤ 30%.	Correct problem then repeat Initial Calibration.
Lab Control Standard (LCS)	With each ICAL and each analytical batch.	± 30%R.	Investigate the problem and, if warranted, analyze a new analytical curve.
Continuing Calibration Verification (CCV)	At the start and end of each analytical batch, or every twenty samples.	%D ≤ 30%.	Perform maintenance and repeat tests, or re-calibrate instrument.
Laboratory Blank	After the standards and before samples.	Results less than the laboratory RL.	Inspect the system and re-analyze the blank. Perform maintenance or report with a B flag.
Laboratory Duplicates	10% of the samples.	RPD ≤ 25% for compounds detected at >5X RL.	Investigate and correct problem. Otherwise, narrate the non-conforming event.

6.16 SULFURHEXAFLUORIDE (SF6) BY SINGLE OR DUAL COLUMN GC

This method is generally applied to the analysis of landfill gas, soil gas and industrial and other sources and is typically designed for sub ppbv to ppmv level concentrations. The method involves the use of either an Electron Capture Detector (ECD) or Sulfur Chemiluminescence Detector (SCD) depending on the expected analyte concentration in the matrix.

Analysis using the ECD will provide a Limit of Quantitation of 0.2 ppbv. It involves direct injection of a 2 mL sample onto dual GC columns configured in series. This assures separation of SF6 from associated hydrocarbons or other interfering material that may be present in the matrix. The SCD method has a Limit of Quantitation of 10 ppbv and involves direct injection of a 1 mL sample onto a single GC column.

Table 6.16-1. Sulfurhexafluoride LOQ and QC

Analyte	RL (ppbv)	Low Point Of the Curve (ppbv)	Acceptance Criteria		
			ICAL (% RSD)	LCS/ CCV/End Check (% R)	Precision (% RPD)
Sulfurhexafluoride (ECD)	0.2	0.2	≤ 30	70 - 130	≤ 25
Sulfurhexafluoride (SCD)	10	10	≤ 30	70 - 130	≤ 25

Table 6.16-2. Summary of Calibration and QC Procedures for Sulfurhexafluoride by GC

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Min. Five Point Calibration	Prior to sample analysis.	% RSD ≤ 30.	Repeat the calibration.
Second Source Verification (LCS)	With each Initial Calibration; with each analytical batch.	70 – 130 % of the expected value.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification	Daily prior to sample analysis, and after every 20 samples.	70 – 130 % of the expected value.	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Laboratory Blank	Daily.	Results less than the laboratory RL.	Inspect the system and re-analyze the Laboratory Blank.
End Check	At the end of analytical sequence.	70 - 130 % of the expected value.	Check system and re-analyze the standard. If the 2nd analysis fails, identify and correct the problem. All suspect samples are re-analyzed.

6.17 ANALYSIS OF C2-C12 HYDROCARBONS USING PAMS METHOD GC/FID/FID

The method is developed and based on EPA Method 600-R-98/161 (Technical Assistance Document for Sampling and Analysis of Ozone Precursors). This method identifies and quantifies volatile organic compounds (VOCs) that play a critical role in the photochemical formation of ozone in the atmosphere. These non-polar VOCs range in volatility from C_2 to C_{12} and are comprised of aromatics, olefins, and paraffins. Up to 50 mL of sample is introduced into a GC system from a SUMMA canister or a Tedlar bag using a Mass Flow Controller and a vacuum system. A digital meter readout provides a visual indication of the sample flow during sampling. The sample is focused onto an Air Toxics Ltd. designed sorbent-based interface. The concentrated sample is then flash heated through a de-humidification system that removes background moisture from the sample stream. The sample stream is then split into two directions and analyzed by a dual-column and dual-FID detector GC system.

Table 6.17-1 Standard List of Controlled Compounds

Analyte	Accuracy Limits (%R)
Ethane	80-120
Propane	80-120
Propene	80-120
Isobutane	80-120
Butane	80-120
Isobutene or 1-butene	80-120
Isopentane	80-120
n-Pentane	80-120
1-Pentene	80-120
n-Hexane	80-120
Benzene	80-120
n-Octane	80-120
Toluene	80-120
o-Xylene	80-120
n-Decane	80-120

Table 6.17-2. Standard List of Analytes (AL-2O3/KCL Column)

Analyte		QA Acceptance Criteria	
	RL PpbC (LOQ)	Accuracy Limits (%R)	Precision Limits (Max. RPD)
Ethane *	10	80-120	≤ 25
Ethene	10	NA	≤ 25
Propane*	10	80-120	≤ 25
Propene*	10	80-120	≤ 25
Isobutane*	10	80-120	≤ 25
Acetylene	10	NA	≤ 25
Butane*	10	80-120	≤ 25
Trans-2-butene	10	NA	≤ 25
1-Butene*	10	80-120	≤ 25
Cis-2-Butene	10	NA	≤ 25
Cyclopentane	10	NA	≤ 25
Isopentane*	10	80-120	≤ 25
Pentane*	10	80-120	≤ 25
1,3-Butadiene	10	NA	≤ 25
Trans-2-Pentene	10	NA	≤ 25
1-Pentene*	10	80-120	≤ 25
Cis-2-Pentene	10	NA	≤ 25
2,2-Dimethylbutane	10	NA	≤ 25
2,3-Dimethylbutane	10	NA	≤ 25
Isoprene	10	NA	≤ 25
2-Methylpentane	10	NA	≤ 25
3-Methylpentane	10	NA	≤ 25

* *controlled analytes*

Table 6.17-3. Standard List of Analytes (RTX-1 Column)

Analyte	RL PpbC (LOQ)	QA Acceptance Criteria	
		Accuracy Limits (%R)	Precision Limits (Max. RPD)
1-Hexene	10	NA	≤ 25
Hexane*	10	80-120	≤ 25
Methylcyclopentane/2,4-Dimethylpentane	10	NA	≤ 25
Benzene*	10	80-120	≤ 25
Cyclohexane	10	NA	≤ 25
2-Methylhexane/2,3-Dimethylpentane	10	NA	≤ 25
3-Methylhexane	10	NA	≤ 25
2,2,4-Trimethylpentane	10	NA	≤ 25
Heptane	10	NA	≤ 25
Methylcyclohexane	10	NA	≤ 25
2,3,4-Trimethylpentane	10	NA	≤ 25
Toluene*	10	80-120	≤ 25
2-Methylheptane	10	NA	≤ 25
3-Methylheptane	10	NA	≤ 25
Octane*	10	80-120	≤ 25
Ethylbenzene	10	NA	≤ 25
m,p-Xylene	10	NA	≤ 25
Styrene	10	NA	≤ 25
o-Xylene*	10	80-120	≤ 25
Nonane	10	NA	≤ 25
Cumene	10	NA	≤ 25
n-Propylbenzene	10	NA	≤ 25
m,p-Ethyltoluene	10	NA	≤ 25
1,3,5-Trimethylbenzene	10	NA	≤ 25
o-Ethyltoluene	10	NA	≤ 25
1,2,4-Trimethylbenzene	10	NA	≤ 25
Decane*	10	80-120	≤ 25
1,2,3-Trimethylbenzene	10	NA	≤ 25
m-Diethylbenzene	10	NA	≤ 25
p-Diethylbenzene	10	NA	≤ 25
Undecane	10	NA	≤ 25

** controlled analytes*

Analyte	RL PpbC (LOQ)	QA Acceptance Criteria	
		Accuracy Limits (%R)	Precision Limits (Max. RPD)
NMOC	**20**	**NA**	**< 25%**

Table 6.17-4. Summary of Calibration and QC Procedures for PAMS Hydrocarbons

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Pre-measurement Chromatographic system Verification	During initial setup, a minimum of 3 Retention Time standards containing all target VOCs, analyzed over a period of days to establish retention time windows for each components.	RT drift must be less than 0.1 minutes.	Correct the problem, re-calibrate the analytical system.
Method Detection Limits	Annually, using 40CFR, Part 136, Appendix B.	Must meet the DQO limit.	Re-evaluate and improve the system. Repeat the study.
ICAL	Prior to sample analysis, and when major system maintenance is performed. Use primary calibration standard, containing propane and benzene. Analyze a minimum of three points to bracket the calibration range. Generate per Carbon response factor for each column.	Correlation coefficient 0.995.	Repeat individual standard analysis. Correct system problem if any. Re-prepare standards and repeat Initial Calibration.
LCS	Contain analytes listed as controlled in Tables 6.17-2 and 6.17-3 Analyzed after each calibration curve.	Recoveries must be within ± 20%D.	Repeat sample analysis. Investigate the problem and if warranted, analyze a new analytical curve.
Continuing Calibration Verification (CCV)	Daily mid-point standard before sample analysis.	RF within 10% RPD of calibration curve average RF.	Repeat sample analysis. Perform maintenance and or re-calibrate instrument.
Retention time standard containing all target VOCs	Daily before sample analysis.	Retention time is used for daily RT calibration. Recovery of Table 6.17-1. analytes must be 80-120%.	Repeat sample analysis. Perform maintenance and or re-calibrate instrument.
System Background and Carry-over check (Humid zero air)	Daily. After the standards and before samples, and whenever a sample exceeds the established carryover limit.	Less than 20 ppbC total or less than 10 ppbC per column.	Repeat analysis, check system for leaks, clean system with humid air, condition sample trap. Re-analyze system blank.
Canister cleaning certification	All canisters prior to use.	Less than 10ppbC total.	Re-clean canister and re-certify.
Field Duplicate	10% of field sample.	RPD $\leq$ 25% for compounds detected at >5X RL or per DQO.	None in the Lab.
Laboratory Duplicates	10 % of samples.	RPD $\leq$ 25% for compounds detected at >5X RL or per DQO.	Re-analyze the sample for a third time. If it fails again, investigate the cause and correct problem. Otherwise, narrate the non-conforming event.

7.0 DATA COLLECTION, REVIEW, REPORTING, AND RECORDS

7.1 DATA COLLECTION

All analytical results are generated from the instrument software. Data is acquired using a PC/Windows based platform. Data processing occurs on a UNIX based network system. Desktop PCs configured with HP Chemstation software acquire the sample analysis results. Once the acquisition is complete, a post-run macro automatically transfers the raw data files from the hard drive of the acquisition PC to the UNIX server. The UNIX server is a HP D390 server with a full RAID system. This fault tolerant server is configured to manage hot-swappable hard drives and memory cards to avoid any serious downtime. This server is configured with HP-UX 10.2, Thermo Lab Systems Target Software, and Omniback software.

All sample data is stored and processed on the UNIX server. Access to this server is limited based on the privileges associated with the users' passwords. Only the Systems Administrator and the IT Manager maintain full access to the system (which includes exclusive privilege for the adjustment of acquisition station clock times). The system servers are physically located in a secured office, which is locked during off-hours. The data stored on the UNIX server is backed up nightly, weekly, and monthly using a modified grandfather-father-son (GFS) backup rotation. All permanent backup tapes are stored in a secure fireproof safe.

Data reduction of analytical files is accomplished using Thermo Lab Systems' Target software, which allows for complete traceability of the data results. Additionally, multiple permanent records of the data reduction files are maintained through the data back up procedures, minimizing the threat of any lost data trail evidence. Chemists must login to the data reduction software using a unique password in order to access and work with the sample data files. Once the chemists have successfully logged-in to the working environment, all of their activities are tracked and logged by the Target software's electronic assessment trail. The assessment trail file is a tamper proof record of each event that occurred with the data file. The assessment history for a data file contains:

- Date of Change
- Time of Change
- Name of User who made the Change
- Parameter Changed
- Old Value
- New Value
- Reason for Change (if applicable)

The assessment trail file is completely secure within the Target software and cannot be modified or deleted by any user. A hardcopy of the sample assessment trail can be provided upon request for specialized data validation packages. Whenever an electronic raw data assessment is requested, the assessment trail file is automatically included.

Once data reduction is complete, the Scientist or Analyst transfers a copy of the sample results file along with all associated batch QC results into the laboratory's SQL database from which reports are ultimately generated.

7.2 DATA REVIEW

Following analysis, the bench chemist verifies that the computer generated data reduction is correct using the Data Review Checklist (Exhibit 7.2). There are five categories of data review performed in the laboratory.

These categories include:

I. Analytical review performed by the bench reporting chemist. This review includes a review of raw data, verification of all method and project specific QC requirements, the addition of data qualifier

flags when needed, and documentation of any unusual circumstances.

II. Technical review performed by team leader or QA-approved peer e.g., analysts who have demonstrated proficiency. This is the same type of review performed in Category I, however, it may be performed either by the same person that performed the analysis or by a second individual if specified by the project profile.

III. QA review performed by a quality assurance specialist. This review is similar to that performed in Categories I and II, however is done with an emphasis on overall quality of the data and verification that standard quality assurance systems are functioning. Data integrity surveillance checks are performed at this level.

IV. Management review by a Director, Department Manager, Team Leader or approved peer. This is a review to ensure the accuracy of the final hardcopy or electronic report. Data integrity surveillance checks are performed at this level.

V. Electronic deliverable review. This review is performed when electronic data deliverables are requested. This review ensures the accuracy of the final electronic report.

Regardless of the TAT, categories I, II, and IV (or I, II, and V if only electronic reporting is requested) are performed on every data package. As noted earlier analysts who have demonstrated proficiency may perform a category II review. Clients requesting 100% QA review of their data packages receive category III review. Some clients request that 100% of their final data packages undergo an additional review. The review in this case is performed by the team leader, QA-approved peer, or QA personnel. Technical peer review (Category II), must be performed by a different individual than the original analyst, even when that person has the classification of scientist or higher. A request for Technical peer review shall be documented in the project profile.

7.3 FINAL REPORT PRODUCTION

7.3.1 Automatic Data Transfer (ADT) System

Most data reports are created using ADT from the analytical instrument to a custom-reporting module. Approved bench analysts on each team review the raw data at the instrument and then transfer a copy of the sample results file electronically through a network server to the main database. Once in the database, the data results are automatically formatted into pre-designed method templates using the reporting module. The method templates are designed at sample login and a review copy is faxed for client approval prior to reporting. Analysts/Scientists on each analytical team, batch samples results with QA results and any additional information such as any sample duplicates or re-analysis.

7.3.2 Manual Data Entry System

Results that cannot be reported using the ADT system are manually entered into a validated, pre-programmed EXCEL spreadsheet. The final report is thoroughly reviewed by an approved team member.

7.3.3 Report Compilation

Data reports are designed to include all necessary information which would be required for traceability including:

- Analytical laboratory name, address, and phone number
- Name and address of the client
- Project name or number (title)
- Total number of pages
- Sample field I.D. number

- Laboratory I.D. number
- Receipt pressure
- Dates of collection and receipt
- Date of extraction (if applicable)
- Date and time of analysis
- Applicable method reference
- Instrument number
- Analytical run file name
- Analyte list
- Dilution factor
- Reporting Limit
- Amount detected in units specified
- Surrogate percent recovery
- Laboratory Director signature
- Chain-of-Custody Record

Each report contains a comprehensive Laboratory Narrative which describes the number of samples received in that batch, any abnormal receipt conditions, any deviations from method specific hold times, the analytical method used, any modifications taken by the lab to the referenced method, and any deviations from standard protocol experienced during sample receiving and analysis. Expected and unexpected deviations that may occur during the analysis of the samples are contained in template format. The Narrative is unambiguous and clearly defines both the nature and substance of the variation.

The QA Manager is responsible for creating, and publishing the templates on a secured and shared network drive. The laboratory staff copies appropriate portions of the template into the Laboratory Narrative document. This approach standardizes the language used in the narratives. The narrative is reviewed using the check sheet in Exhibit 7.2.

The final report is compiled in such a fashion that each subsection is unambiguous and inseparable from the body of the report. A unique page number appears on every page of the report. The estimated uncertainty of the test results may be included on the report at client request (see Section 8.4).

After all QC results have been reviewed and any deviations from the acceptance criteria are noted in the Laboratory Narrative section of the report, the Laboratory Director, Department Managers, Team/Task Leaders or Scientists who are approved by the QA Department for relevant analytical procedures may apply an electronic signature to the final reports. The electronic signature on the report cover page means that the signatory accepts responsibility for the accuracy and completeness of the data generated. The approved signatory corresponds to the Chief Executive Officer. The QA manager keeps a log of the approved applicators of electronic signature to final reports, and ensures that each applicator has the necessary education and experience.

Application of the electronic signature will automatically lock the workorder thus preventing changes to the original report. If amendments are required due to omissions, errors or additional requests a workorder reissue is initiated. All reissues receive a unique workorder number to distinguish them from the original issue. Reissued reports require a reason for the reissue and date of the reissue in the Laboratory Narrative. The laboratory maintains all supporting documentation for the revision including corrections, additions, or deletions relative to the original report.

7.4 ELECTRONIC REPORTING AND REVIEW

The ATLAS Electronic Diskette Deliverable (EDD) software allows the user to create EDDs in the ATL standard format and more complex custom/client-specific formats. The ATLAS EDD software uses the data from the SQL database for these deliverables, while allowing the users to add custom fields when necessary. The laboratory can produce ERPIMS, JEMS, IRDMIS, and COELT deliverables. The ATL standard EDD format

is delivered in Excel (.xls) format. Other client-specific formats can also be generated.

7.5 eCVP/EDD and Reporting in Adobe Format or Diskette

eCVP refers to the electronic conversion of laboratory data compiled as a Comprehensive Validation Package in Adobe Acrobat Portable Document Format (.pdf) and archival onto CD-ROM. The eCVP simultaneously meets the requirements of a Level III or IV data validation package. Adobe Corporation's .pdf documents are an exact replica of the original document, but are smaller in file size than the original document format, thereby reducing the amount of storage space required. Adobe Acrobat .pdf provides a convenient way to view and print images at high resolution. The .pdf document is then recorded onto read-only compact discs (CD). The digital information on this type of disc is injection-molded into the substrate against an aluminum reflective coating. The CDs are then archived.

In addition, Electronic Data Deliverables (EDD) can be generated on diskette or as a compressed WinZip file according to client specifications. An EDD is a flat file (i.e., a spreadsheet with data in fields and records) that can be imported easily by most database management system (DBMS) software. Air Toxics' standard EDD fields are summarized in Table 1. The EDD is created in Microsoft Excel® and converted to a comma delimited (.csv) format.

Table 1. ATL DISKETTE DELIVERABLE STANDARD FORMAT

FIELD NAMES	FORMAT	WIDTH
LABSAMPLEID	CHAR	15
LABCODE	CHAR	3
MATRIX	CHAR	3
METHOD	CHAR	10
CLIENTSAMPID	CHAR	15
SAMPDATE	DATE	8
ANALDATE	DATE	8
ANALTIME	TIME	4
LABCTLID	CHAR	8
DILUTION	NUMBER	5
REPLMT	NUMBER	5
UNITS	CHAR	4
RESULTS	NUMBER	5
DATAFLAGS	CHAR	2
COMPOUND NAME	CHAR	40
CAS#	CHAR	12
COMMENTS	CHAR	50

LABSAMPLEID:	Sample identifier assigned by ATL.
LABCODE:	Laboratory identifier (ATL).
MATRIX:	Sample Matrix.
METHOD:	Analytical method of analysis.
CLIENTSAMPID:	Sample identifier from Chain of Custody.
SAMPDATE:	The date the sample was collected.
ANALDATE:	The date the sample was analyzed.
ANALTIME:	The time the sample was analyzed.
LABCTLID:	Laboratory batch number.
DILUTION:	Dilution factor.
REPLMT:	Detection limit for sample.
UNITS:	Reporting units of measure.
RESULTS:	Parameter value or result.
DATAFLAGS:	Data qualifiers.
COMPOUND NAME:	The name of each compound analyzed.
CAS#:	The CAS registry number for each compound.
COMMENTS:	General comments field.

Exhibit 7.1. Example eCVP Cover Page

AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

COMPREHENSIVE VALIDATION PACKAGE
Modified TO-15
INVENTORY SHEET
Work Order #: 0605678

	Page Nos. From	To
1. Work Order Cover Page & Laboratory Narrative	1	4
a. Lumen Validation Report	--	--
2. Sample Results and Raw Data (Organized by Sample)	5	81
a. ATL Sample Results Form		
b. Target Compound Raw Data		
-Internal Standard Area and Retention Time Summary		
-Surrogate Recovery Summary (If Applicable)		
-Chromatogram(s) and Ion Profiles (If Applicable)		
3. QC Results and Raw Data		
a. Method Blank (Results+ Raw Data)	82	89
b. Surrogate Recover Summary Form (If Applicable)	90	90
c. Internal Standard Summary Form (If Applicable)	91	91
d. Duplicate Results Summary Sheet	--	--
e. Matrix Spike/Matrix Spike Duplicate (Results + Raw Data	--	--
f. Initial Calibration Data (Summary Sheet + Raw Data)	92	245
g. MDL Study (If Applicable)	--	--
h. Continuing Calibration Verification Data (Summary Sheet	246	259
i. Second Source LCS(Summary + Raw Data)	260	278
j. Extraction Logs	--	--
k. Instrument Run Logs/Software Verification	279	280
l. GC/MS Tune (Results + Raw Data)	281	300
4. Shipping/Receiving Documents		
a. Login Receipt Summary Sheet	301	302
b. Chain-of-Custody Records	303	303
c. Sample Log-In Sheet	304	304
d. Misc Shipping/Receiving Records (list of individual records)		
Sample Receipt Discrepancy Report	305	306
5. Other Records (describe or list)		
a. Manual Spectral Defense	--	--
b. Manual Integrations	--	--
c. Manual Calculations	--	--
d. Canister Dilution Factors	307	309
e. Laboratory Corrective Action Request	--	--
f. CAS Number Reference	310	311
g. Variance Table	--	--
h. Canister Certification	--	--
i. Data Review Check Sheet	312	312

Comments:

Completed by:

Theresa Laflesh (Signature) | Theresa Laflesh / Document Control (Print Name & Title) | 6/15/06 (Date)

7.6 RECORDS OF METHOD CAPABILITY

Prior to sample analysis, the laboratory must demonstrate the ability to meet method accuracy and precision objectives. This is accomplished through an initial multi-point calibration, analysis of four consecutive second source check standards, and completion of a Limit of Detection (MDL) study. The mean recovery for each target analyte must be within current laboratory generated control limits with regard to test and compound. Following this initial set-up, there is a continuing requirement for the demonstration of method capability any time the equipment undergoes significant change, such as different column phase and different concentrator design. Records of these tests are kept for a period of at least 5 years.

There is also a requirement for personnel involved with sample analysis to demonstrate both initial capability and on-going proficiency in the specific test method. Staff proficiency is accomplished by analyzing any of the following:

- Analysis of four replicate second source check standards either on the same day or on four separate days.

- Successful completion of an independent PT sample (can be used for both initial and on-going proficiency).

The demonstration of capability is considered acceptable if the accuracy and precision objectives of the test method are met. Demonstration of proficiency must occur at least once per year to be considered current. Personnel may not proceed with sample analysis unless the demonstration of proficiency is current. Documentation of method proficiency is kept in each analyst's training record. Documentation must be kept for a period of 5 years. The 'Demonstration of Capability Certification Statement' is completed each time a demonstration of proficiency study is completed and appears in the analyst's training record along with the relevant raw data summary.

As mentioned previously, the Continuing Demonstration of Proficiency is required on a yearly basis. The scientist/analyst is required to perform 4 consecutive LCS analyses, or if this is not possible due to the nature of the work assignment schedule, such as working second shift, a duplicate analysis paired with another analyst's or scientist's results that demonstrate acceptable %RPD will be acceptable. Successful completion of an independent PT sample is also acceptable.

7.7 RECORD STORAGE

The laboratory has a system for record storage such that historical reconstruction of all activities can be made. Raw data includes:

- Instrument run logs
- Instrument calibrations
- Data acquisition files
- Assessment trails
- Manual and spreadsheet calculations
- Date of analysis
- Instrument used
- Sample chain of custody
- Analyst initials and date
- Data review checklists
- Corrective action reports

The laboratory also maintains files dealing with client correspondence. The Client Contact database stores the date and time of the contact along with a brief summary of the conversation and any decisions made affecting sample status. When a decision is made to proceed with analysis of compromised samples, the contact is logged into the database and a note is made on the Sample Discrepancy Log. Both the electronic and hardcopy files are maintained for a period of at least 5 years. Additional project management information stored includes:

- The Project Profile
- Client contact database
- Correspondence relating to sample disposition
- Contracts
- SOWs and/or QAPPs

The laboratory maintains electronic and hardcopy reports, as well as supporting information including calibrations, Limit of Detection (MDL) studies, logbooks, and SOPs for a minimum of 5 years. Records stored on electronic media are supported by both hardware and software necessary for retrieval. If the laboratory changes ownership, then responsibility for file storage transfers to the new entity. If the laboratory were to close its doors entirely, then allowance would be made to return files to those clients who contact the laboratory within 30 days of when notice is given. Under either scenario, the transfer of ownership notice would be provided to clients through the NELAP national database and on the ATL web page.

The record keeping system allows for historical reconstruction of all laboratory activities from sample receipt to reporting. The record system includes:

- The identity of personnel involved in sample receiving, preparation, calibration, and analysis.

- A log of names, initials, and signatures for individuals who are responsible for signing or initialing any laboratory record.

- A unique identifier for each piece of equipment used.

- Initials and date for responsible staff at each step in the analytical process.

- Direct, prompt, and legible manual recording in bound logs using permanent black ink.

- Entries in logs that are not obliterated by erasures, over-writing, or markings. All corrections are made by single line strike out of the error. Each strike out is initialed and dated by the person making the correction. Any items, such as computer generated logs or spreadsheets that are pasted into the bound logbook, have initials and date appearing across the item boundary in such a fashion that removal is apparent.

- Records generated by a computer have either hardcopy or write protected back-up copy.

- The QA Department creates and tracks all logbooks throughout their lifetime. Each logbook contains a new logbook request form which is filled out by laboratory personnel and submitted to the QA Department. QA personnel create the logbook by first entering the new logbook into the Inventory Database. This database contains information such as the Book #, its Title, the person's initials and date that created the logbook, the start date, the date it was finished being used and the Location of the logbook. Once the necessary information is entered into the database, the logbook is created and given to either the team/task leader or the person that submitted the request. When the logbook is completed or no longer in use, it is submitted to the QA Department. QA personnel update the Inventory Database with the finished date, the location and the logbook is archived.

7.8 CONFIDENTIALITY OF DATA

The data generated by analyzing a sample is considered to be the property of the entity appearing in the **"BILL TO:"** field of the work order request unless other contractual arrangements have been made. Accordingly, that data is treated as confidential information and released only to that client, as identified

by associated contractual agreements unless written permission is given to proceed otherwise. All data generated under NELAP related fields of testing shall be made available to recognized agents of any laboratory accrediting authority for purposes of inspection and verification during an onsite visit. Clients will not be notified when the accrediting authority reviews data during the normal course of the onsite assessment. Clients will be notified any time a request is made by the accrediting authority to remove copies of sample files, either electronic or hardcopy, from the laboratory. Client written approval must be arranged prior to removal of the files from the laboratory unless the request is accompanied by appropriate court order. Both e-mail and facsimile data are treated as confidential by noting on the cover page:

"The information contained in this communication is confidential and intended only for the use of the individual or entity named above. Any other use, dissemination, distribution, or copying of this communication is prohibited. If you have received this communication in error, please notify us by telephone and return the original message to us via US mail."

Client confidentiality is observed in accordance with guidelines described in NELAC Chapter 5.5.10.6 (2003):

"The laboratory shall ensure that, where clients require transmission of test results by telephone, telex, facsimile or other electronic or electromagnetic means, staff will follow documented procedures that ensure the requirements of this Standard are met and that confidentiality is preserved."

Exhibit 7.2.

DATA REVIEW CHECKLIST Work Order #:

A	R	T	M	Q	
☐	☐	☐	☐	☐	Analysis/Reporting vs. Project Profile/SOP requirements checked (i.e. 100% Dups, J-Flag to MDL, etc)
	☐	☐	☐	☐	The final report has the correct reporting list, special units, and header info.
	☐	☐	☐	☐	Lab Narrative is correct (proper method & description/Receiving & Analytical notes correct)
☐	☐	☐	☐	☐	Corrective Action issued - #
☐	☐	☐	☐	☐	Unusual circumstances have been documented in the notes section below

LUMEN *validation report present and initialed* ***CIRCLE (YES / NO)***

☐	☐	☐	☐	☐	Lab Blank, CCV, LCS and DUP met QC criteria
☐	☐	☐	☐	☐	Hold time is met for all samples
	☐	☐	☐	☐	Appropriate data qualifier flags are applied
	☐	☐	☐	☐	Manual integrations for samples and QC are properly documented
☐	☐	☐		☐	Samples analyzed within the project or method specific clock
	☐	☐			Retention times have been verified
☐	☐	☐		☐	Appropriate ICAL(s) included
	☐	☐	☐	☐	At least one result per sample is verified against the target quant sheets/raw data
☐	☐	☐		☐	Dilution factor correctly calculated (sample load volume, syringe and bag dilutions, can pressurization(s))
☐	☐	☐			Correct amount of sample analyzed (i.e. sample not over-diluted)
	☐	☐			Spectra verified - documentation of spectral defense included (Section 5A of eCVP pkg)
	☐	☐			TICs resemble reference spectra
	☐	☐			TICs between duplicate samples are consistent
☐	☐	☐	☐		Checked samples for trends (i.e. Influent>Effluent, Landfill or Ambient etc)
	☐		☐		Special units for all samples in the final report are correctly calculated
	☐	☐	☐		Manually entered results checked (i.e. special CCV compounds)
	☐	☐	☐		TPH/NMOC (verify calculations and correct reference compound used)
	☐				Chain of Custody scanned correctly
				☐	Verify sample id's vs. chain of custody
☐	☐				Samples pressurized w/ appropriate gas (N_2 or He) ☐ Tedlar Bag only
☐	☐				Final pressure consistent with canister size (6L vs. 1L)
☐	☐				Verify receipt pressures against logbook and Target
☐	☐				Verify canister ID #'s
	☐		☐		Extra printed copies are provided per client profile
	☐		☐		Final invoice amount correct (adjusted for TAT, Penalties, Re-issue Charges etc.)
	☐	☐	☐	☐	Client LUMEN report reviewed for accuracy and completeness

Notes: *(to include: noting samples with QA/QC problems, Blanks with positive hits, narratives, etc.)*

A/R:

M/Q:

A	R/T	M	Q
(Analytical Review/Date)	(Reporting Review/Date)	(Management Review/Date)	(QA Review/Date)
	R:		
	T:		

8.0 ESTABLISHING ACCEPTANCE CRITERIA

8.1 CONTROL CHART PROGRAM

Air Toxics Ltd. complies with guidance from ISO/IEC 17025:1999(E), Section 5.9, to determine quality control limits. This regulation suggests that statistical techniques may be used to detect trends, but does not mandate acceptance or rejection of analytical results based on use of historically derived control limits. Additionally, NELAP does not address the issue of control charting. Therefore, in accordance with ISO/IEC 17025:1999(E), Section 5.9, quality controls are in place to monitor validity of tests and calibrations only.

Historically derived control limits are generated twice annually by the QA Department, or whenever a procedure has been changed significantly. Control Limits may be updated less often (or not at all) for methods which are performed so infrequently that it is difficult or impossible to gather at least 20 data points. These limits, however, are not used to validate data unless required by specific client request. (Refer to SOP #48).

8.2 ESTABLISHING CONTROL LIMITS

Control limits are generated from a minimum of 20 randomly chosen data points. The calculations used to establish and update these investigative limits include:

Upper Control Limit	= M	+3S
Lower Control Limit	= M	-3S
Upper Warning Limit	= M	+2S
Lower Warning Limit	= M	-2S

Where:

M: The population mean recovery of at least 20 points, and
S: The standard deviation of the population.

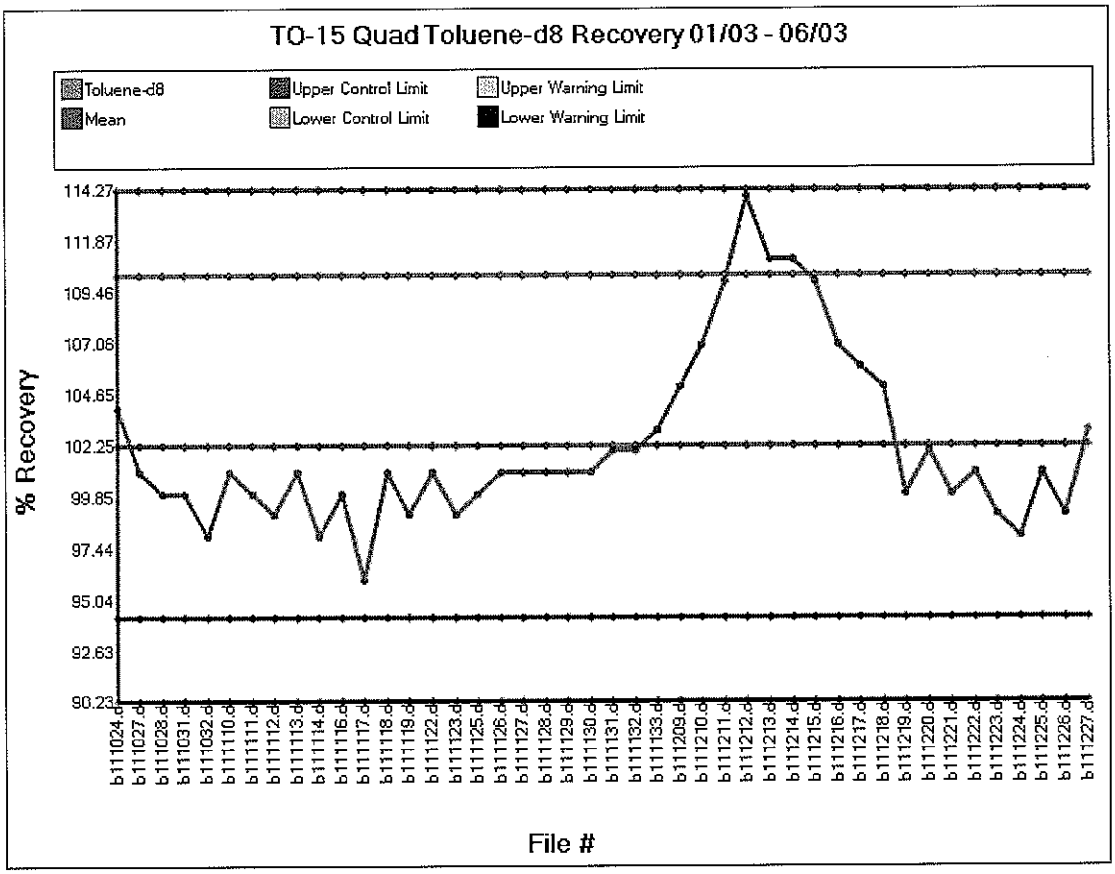
8.3 INTERPRETING CONTROL LIMITS

Calculated control limits based on historical data for surrogate and LCS recoveries are used to demonstrate statistical control and display method variability, and are not used to qualify actual sample recoveries. Additionally, control limits may not be representative of the analytical process if less than 20 points are generated for a given method. As a result, Air Toxics Ltd. uses the default limits prescribed for each method in the corresponding SOP and Section 6.0 of this document. Historically derived control limits are used to evaluate LCS or surrogate results only when requested by clients or certifying agencies.

8.4 MEASUREMENT UNCERTAINTY

Upon request from a client, Air Toxics Limited will report measurement uncertainty for a given analyte reported by a specific method. Measurement uncertainty is calculated as a function of historical LCS Control Limits (suggested by the American Association For Laboratory Accreditation Interim Policy on Measurement Uncertainty for Testing Laboratories, August 2000). This policy is valid for environmental test methods in which measurement uncertainty is not defined. Uncertainty is estimated using standard deviation of laboratory control samples of more than 20 points. Measurement uncertainty is estimated to the 95% confidence interval and expressed as ± 2X the standard deviation of the mean percent recovery of each given analyte. If 20 points do not exist from the current control limit calculation, the collection period may be expanded.

Exhibit 8.1. Control Chart



9.0 PREVENTIVE MAINTENANCE

The best form of preventive maintenance is to have good, new stuff and a lot of it. If the customer expectations for quality, turn around time, and price are to be met, then the instrumentation must be maintained in a fashion that supports the quality objective. The program is designed to adequately protect the laboratory from unexpected instrument failure and minimize scheduled instrument down time. Preventive maintenance consists of an on-going program of routine maintenance, service contracts, and a comprehensive inventory of spare parts.

The likelihood of unscheduled down time tends to increase as instrumentation ages. A three year lease term provides nearly optimum instrument life cycles. At the end of the lease term, the equipment will be exchanged for new models.

9.1 ROUTINE MAINTENANCE

The bench analyst monitors instruments for potential failure on a daily basis. The analysis of blanks and control standards at the start of the day and as analysis continues helps to provide real time feedback to the analyst on the condition of the instruments. Routine maintenance, specific to the various types of instruments, is covered in the method SOPs.

Any routine or major maintenance is documented in the bound maintenance logbook assigned to each instrument. The date of the maintenance, work performed, and analyst's initials are included.

If a malfunction occurs and control of the analytical system cannot be demonstrated using the QC parameters, discussed in section 4.3, the instrument is removed from production until analytical control can again be demonstrated.

9.2 SERVICE CONTRACTS

Some analytical systems are covered under manufacturer service agreements. These agreements cover all forms of hardware failure and include regular hardware upgrades as needed. The response time is guaranteed to be within 48 hours under the agreement and includes parts and labor.

Some contracts cover regularly scheduled routine maintenance. Leased instrumentation is similarly covered by service agreements either through the leasing agency or directly with the manufacturer.

In addition, the Technical Services group performs biannual (every six months) preventative maintenance on the mass spectrometers. These records are kept in the individual instrument's maintenance logbooks.

9.3 SPARE PARTS INVENTORY

A normal inventory of analytical consumable parts most frequently required is maintained in the laboratory. These parts are typically not covered by the service agreements and may take several weeks to acquire on an as needed basis. An inventory is required to minimize instrument down time and facilitate routine maintenance. An inventory of design parts is also maintained including:

- Stainless steel valves
- Tubing
- Various connecting nuts and ferrules
- Tools
- Flow controllers
- Flow sensors
- Electrical connectors
- Sheet metal
- Abundance of miscellaneous items
- Multipliers and other MS source parts

The laboratory invests a significant amount of money every year in lab/computer and research supplies.

9.4 CONTROL OF MISCELLANEOUS MONITORING, MEASURING, TESTING, AND DATA COLLECTION EQUIPMENT

In addition to the equipment used directly in the analysis of samples, ATL uses various other monitoring, measuring, testing, and data collection equipment. This equipment includes: analytical balances and weight sets, pressure gauges, flow meters, fume hood testing devices, thermometers, temperature and humidity recorders, mechanical volumetric devices, oven vacuum gauges, and sampling interface flow controllers. The procedures for ensuring the accuracy of the test equipment are summarized in the following sections. Additional information can be found in ATL Certification of Test Equipment SOP, #34, and Refrigerator and Freezer Temperature Monitoring SOP #19.

9.4.1 Analytical Balances and Weight Sets

The analytical balances are certified and serviced once a year by an independent balance maintenance company. A sticker is put on the side of the balance to indicate the date of certification and the company performing the certification. The certificates are maintained in the Quality Assurance (QA) Department. The certificate must indicate that the reference standards are traceable to NIST standards and indicate the tolerances of the balance.

In addition, each time a balance is used; it is first checked with Class 1 weights. The weights used must bracket the final amount being weighed. The result must be within acceptance criteria. If the acceptance criteria are not met, a Corrective Action Request (CAR) form is initiated and given to the QA Department. The balance and/or weight set may require servicing to correct the problem.

Annually, all Class 1 weight sets are serviced and calibrated on-site against NIST-certified standards by an independent calibration company. The certificate of calibration is maintained in the QA Department. The weights are kept in the manufacturer package that indicates the certification expiration date for the weight set. A sticker is put on the outside of the box to indicate the date of certification and the company performing the certification.

9.4.2 Pressure Gauges

Pressure gauges are used to verify sample receipt pressures and for gaseous standard preparation. The measurement of pressure on the gauges used to pressurize canisters is relative. The readings are used to assess the initial canister receipt vacuum/pressure and then pressurize the canister to a known pressure. The receiving personnel compare the final vacuum/pressure recorded on the Chain-of-Custody Record and/or sample tags by the field personnel with the receipt vacuum/pressure. If there is a discrepancy of more than 7"Hg/7psi a Sample Discrepancy Report is initiated and the client is notified.

In addition, the pressure gauges installed on the pressurization manifolds are re-calibrated and NIST certified on-site by an idependent calibration company annually or as-needed. The certificates are kept on file in the QA Department.

9.4.3 Fume Hood Testing Device

Quarterly, the Velocicheck Portable Air Velocity Meter is used by a member of the Safety Committee to check fume hood velocities. Velocities are checked in various quadrants of the hood at both full open and half-open sash levels. Results of this check must be within specified limits and are recorded in the Fume Hood Evaluation Logbook. If results are outside of these limits, the fume hood must be taken out of service until the problem is corrected.

Annually, the Velocicheck Portable Air Velocity Meter is calibrated on-site by an

independent calibration company against NIST-traceable standards. The Certificates of Calibration are maintained in the QA Department.

9.4.4 Thermometers

9.4.4.1 Reference Thermometers

ATL has NIST-traceable digital thermometers, which are used by the QA Department as reference devices. The thermometers are re-calibrated and certified annually by an independent calibration company. A label indicating the date of calibration, the due date for the next calibration, and the name of the company performing the certification is placed on the back of the thermometer itself. The reference thermometers are kept, along with certificates of calibration, in the QA Department.

9.4.4.2 Working Liquid-Filled (Ref/Freezer and Receiving) Thermometers

Thermometers used to record the temperature of refrigerator/freezers as well as of Temperature Blanks (received with samples shipped on ice), are re-certified every year by the QA Department using the NIST-traceable digital thermometer as reference. The certification test is performed by comparison to the NIST-traceable digital thermometer. Both thermometers (working and reference) are placed in a Dual Well Dry Block Calibrator (Model 9009 Hart Scientific). This instrument allows accuracy checks at both low and high temperatures. Alternatively, the certification test may be performed by placing the thermometers in a medium to large-sized beaker filled with water (or Methanol for freezer thermometers). The beakers are placed into a refrigerator (or freezer) for approximately one hour. The beakers are then removed from the refrigerator/freezer and the thermometer readings are compared to the NIST-traceable digital thermometer which is also submersed in the liquid.

The temperature range tested must correspond to the temperature range that the thermometer is used to measure (i.e. approximately $4 \pm 2°C$ for Refrigerator and Receiving thermometers and $\leq -10°$ C $\pm$ 5°C for Freezer thermometers). The results of this test are recorded in the Thermometer Calibration Verification logbook. The difference between the temperatures of the working thermometers and the reference thermometer should be within the specified accuracy limits. Any thermometer that fails this certification test is discarded and new replacements are purchased as needed.

The manufacturer provides the newly purchased thermometers with a calibration certificate. The QA Department checks the new thermometers for defects (i.e., air bubbles present in red liquid column) before placing the new thermometers into use. A table containing the exact location, serial numbers, calibration and re-calibration due dates of each thermometer is kept in the Thermometer Calibration Verification Logbook.

9.4.4.3 Oven and IS Station Thermometers

Temperature controllers used in the Canister Cleaning and Tube Preparation areas are verified on a yearly basis by the QA Department to ensure that the proper temperature range is being achieved. The test is performed using the NIST-traceable digital thermometer as a reference. The test consists of comparing the temperatures displayed by the ovens temperature controllers versus the temperature measured by the reference thermometer.

The temperature range tested must correspond to the temperature range the thermometer is used to measure (i.e. approximately 65 - 125 °C for Can Cleaning ovens). The temperature readings are recorded in the Thermometer Calibration Verification logbook, which is kept in the QA Department. The accuracy

limits used to compare the two readings are ± 5°C.

If the readings are outside of acceptance limits, a correction factor may be applied to the temperature readings and maintenance or replacement of the controller may be necessary.

Temperature control used for desorption at the Internal Standard (IS) Loading Station in the main lab (used for VOST and TO-17 analysis) is verified for accuracy on prior to analysis using a NIST-traceable digital thermometer as a reference.

The temperature range tested must correspond to the temperature range the thermometer is used to measure (i.e. approximately 180 °C for the IS station). The temperature readings are recorded in the instrument logbook. The acceptance limits are ± 10°C.

If the readings are outside of acceptance limits, a correction factor may be applied to the temperature readings and maintenance or replacement of the thermometer may be necessary.

9.4.4.4 Non-Contact Thermometers

Non-contact thermometers are used to verify the temperature of the Desorption plate used in the analysis of VOST and TO-17 samples as well as to take the temperature of chilled samples which arrive without a Temperature Blank. These thermometers are certified against NIST-traceable standards on-site by an independent calibration company on a yearly basis. Certificates of calibration are maintained in the QA Department.

9.4.5 Temperature/Humidity Recorders

A Temperature/Humidity Recorder is used to verify that conditions required for PM10/TSP analyses of filters have been met in the Desicator unit. The required conditions are a temperature of 59 to 86°F + 5 °F and humidity at 20 to 45 %RH ± 5% RH (≤ 50% RH ± 5% RH for TSP) over a 24 hour period. These conditions are graphed, and every 7 days a replacement graph card is placed into the recorder by designated personnel. The date range recorded, along with the analyst's initials, is noted on the back of the graph and filed in a folder next to the instrument. The recorder is re-calibrated and certified annually by an independent calibration company. The Certificates of calibration are kept on file in the QA Department.

The Refrigerator used for the storage of VOST samples (Refrigerator #4) uses a Temperature Recorder in order to verify required temperature has been maintained over holidays when the regular temperature checks are not performed (see ATL SOP #19 Refrigerator/Freezer Temperature Monitoring and Documentation). The temperature is graphed, and every 7 days a replacement graph card is placed into the recorder by designated personnel. The date range recorded, along with the analyst's initials, is noted on the back of the graph and filed in a folder next to the instrument. The recorder is re-calibrated and certified annually by an independent calibration company. The Certificates of calibration are kept on file in the QA Department.

9.4.6 Flow Meters

Flow meters are used in the Laboratory to check the flow rates for VOST/TO-17 and other analyses, and in connection with sorbent tube preparation. Canister Cleaning also uses flow meters to calibrate flow controllers. These instruments are re-certified annually on-site by an independent calibration company against NIST-traceable standards. The certificates of calibration are kept in the QA Department.

9.4.7 Mass Flow Controllers

The Mass Flow Controllers on the sampling interfaces are used as part of the Initial Calibration. Therefore, measurements made using them are relative in nature. The samples are introduced through the very same process, therefore any potential bias is self-correcting. In addition, the accuracy of the Mass Flow Controllers is verified in four ways:

1) Each time the daily CCV is analyzed, the recoveries document the accuracy of the Mass Flow Controller with respect to the most recent instrument Calibration.

2) The linearity of the Calibration Curve demonstrates the accuracy of the Mass Flow Controller because the curve is developed using a mixture of syringe and Flow Controller standard loadings.

3) The accuracy of the Mass Flow Controller is verified through comparison of the new Calibration Curve with the previous Curve

4) In addition, the Mass Flow Controllers on the sampling interfaces are calibrated in house using a NIST certified flow meter before each Initial Calibration. They are calibrated by trained Analysts and/or Scientists. This action is documented in the instrument logbook the day of the calibration which includes flow controller serial number, NIST flow meter expiration date, nominal value, actual value, verified/set by initials and date. The Laboratory staff oversees the Mass Flow Controller certification program. The certificate of calibration for the NIST flow meter is kept in the QA Department.

9.4.8 Mechanical Volumetric Devices

Mechanical volumetric devices such as solvent dispensers are verified for accuracy against a known volume approximately once per month and never less than four times per year.

9.4.9 Oven Vacuum Gauges

Each oven used by the Support Services Department to clean stainless steel canisters is equipped with a CONVECTRON vacuum gauge and controller. The accuracy of these gauges is checked approximately every 6 months or as needed.

A NIST certified CONVECTRON gauge and controller is mounted onto an empty port on the evacuation manifold by a member of the Support Services Department. The controller readings are compared to the oven vacuum gauges and recorded into to the comment line of the oven logbook. The NIST gauge and the oven gauge should match within ± 6 % (± 1.2 mTorr for a 20 mTorr reading) based on the manufacturer's accuracy limits. If the 2 gauges do not match, then the oven vacuum gauge controller is adjusted until the readings are the same, or the oven gauge is replaced/repaired.

Documentation of changes or repair is noted in the Canister Cleaning Maintenance Logbook. The NIST gauge is re-certificied annually on-site by an independent calibration company.

10.0 PROFICIENCY TESTING PROGRAM

10.1 NELAP PT SAMPLE PROGRAM

Proficiency testing (PT) samples are used to measure analytical accuracy, precision, and report completeness. To be accredited under NELAP, the laboratory contracts with an outside approved PT sample provider in each field of testing. Testing is limited by availability of samples that meet NELAP criteria (noted below). The provider must be a NIST accredited PT provider. It may be necessary to participate in more than one proficiency testing program to be evaluated for multiple interdependent analyte groups. Performance samples are processed through the laboratory in the same manner as project samples. In each calendar year, the certified lab will complete at least two separate proficiency testing samples for each analyte or interdependent analyte group. The following policies apply to laboratory PT sample analysis and reporting:

- The samples shall be analyzed and reported to the PT provider within 45 calendar days of receipt or the specific deadline specified by the PT provider.
- The laboratory must follow the PT provider's instructions for preparing the PT sample.
- The laboratory management and bench chemist ensure that the PT samples are analyzed and reported in the same fashion as field samples using the same staff, equipment, and methods.
- The PT sample cannot undergo duplicate or replicate analyses that would not ordinarily be performed on field samples. The PT sample result cannot be derived from averaging the results of multiple analyses unless specifically called for in the reference method.
- The PT sample can only be analyzed on equipment leased or owned by the company and handled only by bona fide employees of the company.
- The analysis of PT samples by temporary or contract employees is explicitly forbidden.
- The laboratory shall not subcontract any PT sample or portion.
- The laboratory shall not knowingly receive any PT sample or portion from another lab.
- The laboratory shall not communicate in any fashion with another laboratory concerning the PT sample or results.
- The laboratory shall not attempt to obtain the PT sample result prior to reporting.
- The PT sample reporting forms provided by the sample provider will be maintained in the laboratory's record system.
- The laboratory shall maintain copies of all written, printed and electronic records relating the analysis or reporting of the PT sample for a period of 5 years.
- A CAR form will be generated any time an analyte result fails the proficiency testing assessment. A copy of the PT results is sent to the NELAP accrediting agency and associated corrective action summary will be sent upon request.
- The lab authorizes provider to release any PT assessment information to the accrediting agency.
- The QA Manager must sign the PT results form and by so doing, attests that the sample was analyzed and reported in the same fashion as a field sample and

followed the PT provider instructions for preparation.

- The lab must notify its primary accrediting agency and any other agencies under reciprocity that it has enrolled with a particular PT provider.

- The lab must notify its primary accrediting agency and any other agencies under reciprocity in the event it wishes to change PT providers.

- For each analyte or interdependent analyte group for which proficiency is not available, the certified lab will establish, maintain and document the accuracy and reliability of its procedures through a system of internal quality management.

10.2 EXTERNAL (NON-NELAP) PT SAMPLES

Occasionally proficiency testing samples are submitted along with field samples by private clients. The lab processes and reports the samples in the same fashion as field samples. When the client notifies the laboratory that one or more analytes appear to have failed, the report is processed through the normal Client Inquiry Corrective Action Process. The QA Manager will carry out an assessment and investigation into the circumstances surrounding the proficiency results including aspects relating to how the client prepared the sample for submission. The outcome of the assessment will be documented as per (Section 3.3.2) and maintained on file for a period of 5 years.

11.0 MANAGEMENT OF COMPUTER AND SOFTWARE SYSTEMS

Data are electronically captured from virtually all analytical instruments used by Air Toxics Limited. A network of computers and servers is used for the acquisition, processing, manipulation, recording, storage, and retrieval of test data. The laboratory uses a variety of both commercial as well as proprietary software applications to acquire, process, and report sample results. This network of computers is also used to receive and process customer information regarding field activities, sample disposition, and quality assurance objectives. Quality systems relating to the management of the computers and software are designed to incorporate the standards established in the *EPA Document "2185-Good Automated Laboratory Practices (1995)"* wherever possible given the size and resources available in the laboratory and IT groups.

11.1 SECURITY

The systems of Air Toxics Ltd. are protected from unauthorized access through the use of both physical and programmatic security measures. All of the laboratory servers are housed in a locked office, which maintains favorable environmental conditions to allow for optimal server performance. Access to the laboratory's networks is granted by the Systems Administrator or IT Manager. Network access is tightly controlled for the entire company. Users maintain individual network accounts and are allowed to access specific areas of the network based on the privileges assigned to them. A user is granted access to only those areas needed to fulfill his/her job function. All software used to reduce sample data or generate sample reports is password protected; users are granted rights to these systems based on a read/write/none privilege system.

11.2 BACK UP AND STORAGE OF DATA

All data systems are backed up on a daily, weekly, and monthly basis using a modified grandfather-father-son (GFS) rotation protocol. Specifically, these back ups are conducted on the servers responsible for all laboratory production data files and databases (i.e., Client Services files, analytical data, audit trails, quality assurance documents, etc.). A daily incremental back up is scheduled to run each night Monday through Saturday. The daily incremental back up is limited to files modified the same day. On Sunday, a weekly full back up of all files on each server is completed. At the end of each month, a full back up of each data system is conducted. This monthly back up tape is then placed in permanent storage. The permanent historical back-up tapes are stored in a fireproof safe in the secured server office. Data is not removed from the server until at least three permanent monthly back-up tapes have been created. This ensures that no archived data will be lost due to corruption of the magnetic tape. A more comprehensive description of the electronic data archiving system can be found in ATL SOP #55, *Electronic Archival of GC/MS Analytical Instrument Data.*

11.3 SOFTWARE AND ELECTRONIC DATA VALIDATION

The IT department is responsible for the testing and verification of all internally developed software applications. This includes testing during the software development, testing of the first pre-release version (alpha testing), and testing the release version in a closely monitored production environment. Findings discovered during the alpha and beta tests are documented and software fixes are applied as warranted. All custom software applications are tested prior to their release to the production laboratory.

There are three stages of testing and implementation of custom software modules by the IT department.

11.3.1 Stage I – Alpha Testing

Stage I testing is conducted for all ATLAS modules developed at Air Toxics Ltd. The Stage I testing is performed by two members of the ATLAS development team, typically the lead programmer and a representative end-user. The lead programmer is responsible for preliminary testing of the application and fixing errors, "bugs," within the program. The other evaluator acts as the user, testing the functions and features of the ATLAS module. The alpha test performed by the representative end user is conducted at a production workstation, which maintains the typical ATL configuration and connects with the ATLAS database through the laboratory network. This Stage I testing is conducted off-line, as the module is not used to perform any real-time production work. During the testing, the alpha tester identifies errors within the program and reports them to the lead programmer via the ATLAS Bug Report form. Examples include: finding areas where the module does not perform the task as per the specifications or an error message is displayed on the screen when working with the module.

The lead programmer evaluates the errors that are reported on the Bug Report form and fixes all identified problems within the ATLAS module, documenting the status of the repair on the Bug Report form (Exhibit 11.1).

Once all main functions have been tested and the alpha tester can no longer identify significant bugs within the program, the alpha testing is concluded. The alpha test results are documented in the completed ATLAS Bug Report forms, which are maintained as a permanent record in the IT Manager's office.

11.3.2 Stage II – Beta Testing

The Stage II testing is conducted after completion of the alpha test. This testing is performed by select on-line end-users. End-user participants in the beta test are chosen by their department manager, in an effort to have an accurate representation of the end-users that will be using the ATLAS module. The beta test participants perform their job duties using the ATLAS module. Both the lead programmer and the IT manager are available during the beta test.

The beta testers are trained how to use the ATLAS module on-line. The lead programmer, IT Manager, and the department supervisors all participate in the training of the beta testers. The beta testers perform their production duties on the ATLAS module and check all output from the module for accuracy. A summary of the beta test may be documented (Exhibit 11.2).

The beta testers identify any errors or deficiencies within the application and notify the lead programmer immediately upon finding a bug. In addition, the beta testers submit an ATLAS Bug Report form to the programmer.

The lead programmer evaluates the errors that are reported on the Bug Report form and fixes all identified problems within the ATLAS module, documenting the status of the repair on the Bug Report form.

The new version of the ATLAS module is uploaded onto the computer for the beta tester. The testing is resumed at the beginning of the task from which errors were identified in the software application. The tester verifies the fixes for reported bugs and documents this verification on the Bug Report form.

After the occurrence of bugs has been mitigated, the beta testing is concluded. The beta test results are documented in the completed ATLAS Bug Report forms, which are maintained as a permanent record in the IT Manager's office.

11.3.3 Stage III - Implementation

Stage III implementation is initiated after completion of the beta test. All end-users are

given access to on-line module. Training for end-users is conducted by the members of the ATLAS development team and the department supervisors. Users are trained individually by the department supervisors and/or a member of the ATLAS development team.

If any bug occurs on-line, a member of the IT team is contacted and the problem assessed to determine if it is a bug or a training issue. A confirmed bug is documented on an ATLAS Bug Report form. Any problem that affects data integrity is documented separately. This type of problem is typically documented by the IT Manager, however other members of the development team can assume this responsibility. This documentation is kept as a permanent record in the ATLAS project documentation binder in the IT Manager's office.

The lead programmer evaluates any error reported on the Bug Report form and fixes the program within the ATLAS module, documenting the status of the repair on the Bug Report form. The new version of the ATLAS module is uploaded to all PCs running the application. In most cases, an automatic update program loads the new version of the application for all users when they re-enter the program. Production work continues with the new version of the module.

11.3.4 Commercial Software Data Validation

Any commercial software application used for data reduction is verified for adequate performance before release to the production laboratory. Reports created by the laboratory's LIMS are reviewed for accuracy by the analyst responsible for creating the deliverables and a team scientist. Hand entered results are checked for accuracy by the analyst responsible for this data entry. Peer review is also conducted on these reports. Deliverables created using the LIMS are spot-checked for accuracy. Documentation of these reviews is maintained as a permanent record in the Work Order folder. The various testing stages and process for implementation of internally developed software are described in ATL SOP # 47, *Implementation and Testing of Atlas Modules,* and ATL SOP #41, *Preparation Of Hardcopy Analytical Reports Using Automated Data Transfer.*

Exhibit 11.1. ATLAS Bug Report

Module:
- ☐ Accounting
- ☐ Quote Methods
- ☐ Quotes
- ☐ Project Profiles
- ☐ Contacts
- ☐ Other: _____
- ☐ Shipments
- ☐ System Administration
- ☐ Work Order Editor (ATLAS98)
- ☐ Method Editor (ATLAS98)
- ☐ Compound Editor (ATLAS98)
- ☐ SuperCATS
- ☐ Accounts

Description of Problem:

_____
_____
_____
_____
_____
_____
_____
_____

Reported By:_____ Date:_____

Status: ☐ Fixed ☐ Pending ☐ Could not duplicate
☐ Other:

_____
_____
_____
_____
_____
_____

Verified as Fixed ☐ By:_____ Date:_____

Exhibit 11.2. ATLAS Beta Testing Summary Form

Name of Tester:_____ Date:_____

Module Tested:_____

Summary of Beta Test (include brief description of criteria used, etc.):

_____
_____
_____
_____
_____
_____
_____
_____
_____

Did the module pass all tests conducted? ☐ Yes ☐ No

If no, please provide comments below:

_____
_____
_____
_____

Signature of Tester: _____

Module approved for release to production group? ☐ Yes ☐ No

Signature of IT Manager: _____ Date: _____

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12.0 CONTROL OF PURCHASED ITEMS AND EXTERNAL SERVICES

The primary materials procured by the laboratory are computer hardware, analytical software, standard office software, analytical instrumentation, certified standards, carrier gases and cryogens, miscellaneous laboratory supplies, NIST-traceable re-certifications, disposable sampling media (e.g., Tedlar bags), and service contracts.

Control of the purchase of these items and services is maintained using a standard purchase order system that includes the following:

- A purchase request that is approved by a director or manager.
- An assigned purchase order (PO) number that is logged along with the date, vendor, and requester.
- A requirement that upon receipt or delivery of services, the product is inspected by the purchasing agent, and compared to the packing slip and/or request for services.
- Each PO is matched with invoices prior to payment to insure that purchased items or services were delivered as expected.

Critical vendors (those for whom a failure or lack of supply would cause irreparable damage to the laboratory operations) are selected on the basis of either being the sole supplier of an item or as a result of reliable service over a several year period. A table of current critical suppliers is presented in Exhibit 12.1.

When reagents are purchased in bulk volume for laboratory use, each lot is certified for cleanliness prior to use. A laboratory blank is prepared using the analytical reference method. The concentration of target species present must be less than the laboratory reporting limit for the lot to be certified clean and approved for use. Once a lot is approved, the vendor will set aside stock sufficient for several months for ATL use. The certificates of analysis are kept on file in the main analytical laboratory and each incoming shipment is monitored by the extractions area staff to verify that only certified lot numbers are used in the processes.

Solvent	Certification Method
Methylene Chloride	SW8270C
Hexane	TO-4A
Water	SW8260B/SW8270C

Each reagent is labeled with the date of receipt, date opened, and date of expiration. In the case of Methylene Chloride and Hexane, a 100 mL aliquot of the solvent is evaporated to 1 mL and analyzed via method SW8270C or TO-4A. In the case of reagent water, a reagent blank is prepared and analyzed via methods SW8260B (5 mL) and SW8270C (1 L). Only reagent grade water is used in the laboratory and is purchased in bulk lots as HPLC grade.

Cylinder gasses used as diluent gas for sample analyses are also certified for cleanliness. Each tank of UHP Helium or Nitrogen is tested by filling a clean lab blank canister followed by analysis via EPA method TO-14A. All target species must be present at less than the reporting limit in order for the cylinder to be certified clean. Results of the analysis are posted on each cylinder and stored in designated logbooks.

NIST traceable standards are re-certified upon receipt. The standard is analyzed under the appropriate method and compared to the existing inventory of standards. If the response of any target species is not within acceptance limits for a second source standard, the standard is considered to have failed. The vendor is then contacted to discuss the discrepancy and arrangements made to replace the standard.

Exhibit 12.1 Critical Suppliers

VENDOR	JUSTIFICATION
Scott Specialty Gases	Sole supplier/Reliable service over several years
Airgas	Reliable service over several years
Spectra Gases Inc.	Reliable service
SKC West Inc.	Sole supplier
Chromatography Research Supplies, Inc.	Sole supplier
Scientific Instrument Services	Reliable service over several years
Hamilton	Reliable service over several years
Quantum Analytics, Inc.	Reliable service over several years
R & D Glassware	Reliable service over several years
Aldrich Chemical Company	NIST Certified
Supelco	Reliable service over several years
Valco	Sole Supplier
VWR	Reliable service over several years
Control Company	Reliable service
Agilent Technologies	Reliable service
Millipore/Mykrolis	Reliable service over several years
Leco Corporation	Sole Supplier
Oakland Valve & Fitting CO.	Sole Supplier/Reliable Service

13.0 PROJECT MANAGEMENT SYSTEM

Any quality system, no matter how elaborate, and no matter how well documented, will fail unless the customer expectation is effectively communicated. The ATL Project Management System describes the critical pathways necessary to adequately ensure that the customer expectation is reviewed, committed to by top management, documented and communicated to the laboratory prior to sample delivery. System elements include:

- Review of project specific documents
- Negotiations and variance requests
- Documentation of project requirements
- Documenting client discussions
- Project briefings
- Scheduling sampling media
- Tracking sample analysis and reporting
- Project follow-up

The Project Management System is defined in the ATL SOP #1. Following are brief descriptions of the elements comprising project management systems.

13.1 REVIEW OF PROJECT SPECIFIC DOCUMENTS

Clients document project requirements in requests for proposals, work plans, SOWs, or QAPPs. No matter how the details are documented, the project requirements must be reviewed to ensure that the laboratory has sufficient staff, equipment, and capacity to meet project needs. Any document received from a client containing either contractual language, description of work, QA/QC criteria, and/or deliverable requirements different from our Standard Terms and Conditions will be processed as a proposal. When a proposal is received, an electronic Proposal File is started and routed through the Proposal Tracking System. The Account Managers are provided with technical support by the designated project chemist who reviews all relevant sections of the proposals. Each department's team leader is consulted for further information when needed.

Items to be reviewed include:

- Requested methods
- Adequate and documented training of appropriate personnel including Demonstration of Capability
- Adequate instrumentation
- Target compound lists and reporting limits
- Quantity of samples
- Requested media and degree of preparation
- Media preservation requirements
- Holding time requirements
- Project specific QC
- Deliverable requirements
- TAT requirements
- Insurance requirements
- Special billing and payment terms
- Data storage requirements
- Client financial status

The following flow chart (Exhibit 13.1) depicts how the proposal is distributed through the review process. Project requirements are received and logged into a database. Each proposal is given a unique identifier at that time. The Project Chemist reviews the document to determine whether or not the proposal contains methods, target compounds, or production demands requiring additional review. The Project Chemist reviews the document for special project requirements in the areas of:

- Quality assurance criteria
- Reporting criteria

- Electronic deliverable criteria
- Unusual TATs
- Unusual volume of samples
- Unusual compounds

If the Project Chemist has any questions, which may affect production, then the Account Manager is notified and the proposal is sent to the Operations Director to determine the implications to the laboratory production throughput. With Operations approval, the proposal may be sent to the Technical Director or designee for review and comment. If the proposal does not require method development, and has unusual deliverables then it is sent to the IT Director or designee to verify ATL is able to meet client deliverable demands. The reviewer may suggest pricing adjustments according to the client specific format difficulties. If the proposal does not require review by the IT Manager, it is returned to the Project Chemist. A variance table to be included with the proposal may be created by the Project Chemist. The variance table may undergo revision as per the result of discussion with the client.

The Contract specifications are reviewed by the Contract Administrator to evaluate the terms and conditions of the proposal, including the following areas:

- Retention;
- Penalties;
- Sales and Use Tax Requirements;
- Insurance Requirements;
- Data Storage Requirements; and
- Payments Terms.

The Contract Administrator then reviews the proposal to determine the amount of credit to be established for the client. The amount will be based upon credit status (Dunn & Bradstreet) report, the amount of the contract and past payment history with ATL.

Each of these steps is documented on the Bid/Proposal/Contract Review sheet (Exhibit 13.2). The review and comment activity is documented by signature and date on the Bid/Proposal/Contract Review sheet.

Following review and comments, the proposal is returned to the Account Manager for final review and pricing. The Client Service Representative is consulted and the proposal is generated. Then the proposal is entered into the ATLAS Quotes module for reference. If the bidding process is successful, the proposal documents continue on through the Client Services Representative to be set up as an active project. Before samples are received and the analyses are performed, a signed copy of the variance table must be scanned to the network. The Project Chemist is brought back as an active team member at this time if negotiations are necessary. The Client Services Representative will complete the project profile, while the Project Chemist creates a project requirement table that includes the approved variance table in the laboratory sample tracking database. An example of project profile appears in Section 3, Exhibit 3.1.

Before the final report is released a contract must be signed and filed. Once a contract is received, it is documented in the contract log. The contract is then reviewed to compare the pricing and language to the proposal. If there are exceptions made to the contract, these are noted and negotiated with the client. Once pricing and terms have been agreed upon, the contract is then executed and copies sent back to the client.

Exhibit 13.1 Proposal Review Flow Chart

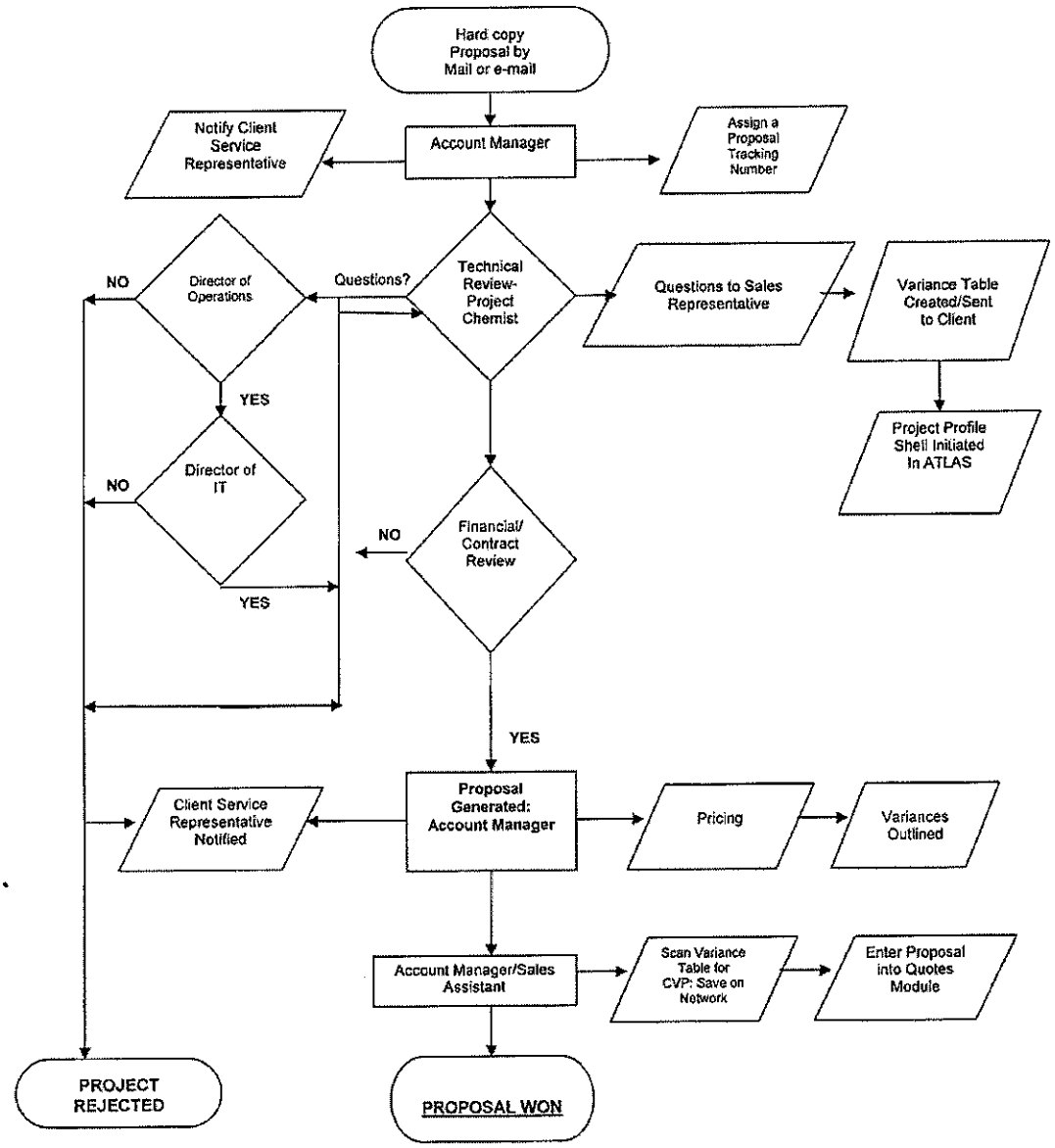

Exhibit 13.1 Proposal Review Flow Chart (*Continued*)

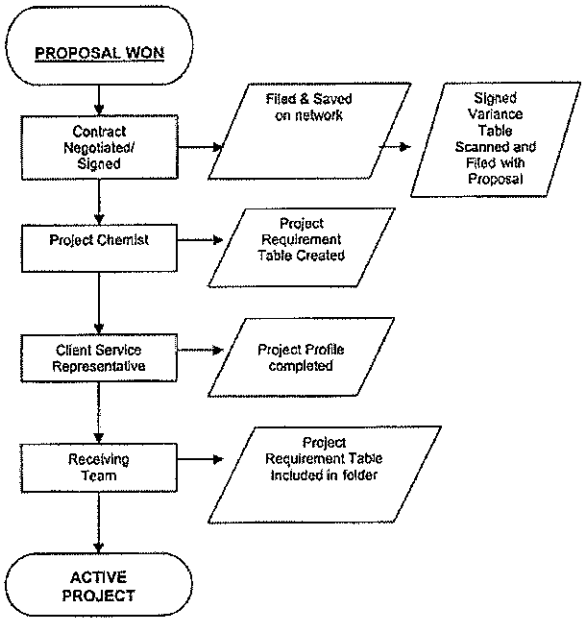

Exhibit 13.2 BID/Proposal/Contract Review Form

CLIENT_____ DUE DATE: _____

PROFILE# _____ DATE RECD:_____

PROPOSAL TRACKING#:_____ AM: _____

☐ BID ☐ PROPOSAL ☐ CONTRACT
(REVIEW)

PROJECT NAME:_____ RFP#:_____

1. ACCOUNT MANAGER REVIEW – FEASIBILITY DATE DUE: _____

QAPP? ☐ Yes ☐ No
SOW? ☐ Yes ☐ No
All documents referenced above provided? ☐ Yes ☐ No
Potential Sample Volume:_____
Methods Required:_____
Comments:

Reviewed by: _____ Date: _____

2. TECHNICAL REVIEW DATE DUE: _____

A. REVIEWER #1

Variance Table? ☐ Yes ☐ No
Notes Page? ☐ Yes ☐ No
Special Compounds? ☐ Yes ☐ No *(If yes, a special compound request form is required)*
Sample Storage Terms Exceptions?: ☐ Yes ☐ No
Comments:

Reviewed by: _____ Date: _____

Exhibit 13.2 BID/Proposal/Contract Review Form *(Continued)*

B. REVIEWER #2

Variance Table? ☐ Yes ☐ No
Notes Page? ☐ Yes ☐ No
Special Compounds? ☐ Yes ☐ No *(If yes, a special compound request form is required)*
Comments:

Reviewed by: _____ Date: _____

C. LAB MANAGER (Optional)

Special Technical Requirements ☐ Yes ☐ No
Comments:

Reviewed by: _____ Date: _____

Exhibit 13.2 BID/Proposal/Contract Review Form *(Continued)*

3. **DELIVERABLES – IT MANAGER /TEAM E** **DATE DUE:**_____

Client Specific Format: ☐ Yes ☐ No Format?_____
eCVP ☐ Yes ☐ No
Comments:

Reviewed by: _____ Date: _____

4. **FINANCIAL REVIEW** **DATE DUE:** _____

A. CONTRACT REVIEW – FINANCE

Contract Provided?	☐ Yes	☐ No
Exceptions Taken?	☐ Yes	☐ No
Retention Exceptions?	☐ Yes	☐ No
Penalty Exceptions?	☐ Yes	☐ No
Insurance Exceptions?	☐ Yes	☐ No
Data Storage Exceptions:	☐ Yes	☐ No
Payment Terms Exceptions:	☐ Yes	☐ No

Comments:

Reviewed by: _____ Date: _____

Exhibit 13.2 BID/Proposal/Contract Review Form *(Continued)*

B. FINANCIAL BACKING REVIEW

Credit information on file? ☐ Yes ☐ No
Terms & Conditions on file? ☐ Yes ☐ No
Dunn & Bradstreet #: _____ Rating: _____
Comments:

Reviewed by: _____ Date: _____

5. CSR REVIEW **DATE DUE:** _____

Variance Table Required? ☐ Yes ☐ No *(If yes, ensure a project profile has been started)*
Comments:

Reviewed by: _____ Date: _____

6. RETURN TO AM TO FINALIZE PROPOSAL **DATE DUE:** _____

Reviewed by: _____ Date: _____

7. SIGNATURE **DATE DUE:** _____

Reviewed by: _____ Date: _____

8. RETURN TO AM TO FILE **DATE COMPLETED:** _____

Variance Table Signed? ☐ Yes ☐ No
Proposal saved to Network? ☐ Yes ☐ No
Additional Information:

13.2 NEGOTIATIONS AND VARIANCE REQUESTS

When the Project Chemist notes differences between the project request and laboratory standard protocol, the laboratory may request a variance from the requirements. Ideally, variance requests occur during the proposal stage, but sufficient details regarding project requirements are sometimes not known until sampling is about to begin. With the assistance of the QA team the Project Chemist notes all discrepancies in a variance table that is submitted to the Account Manager. The assigned Account Manager communicates the discrepancies to the client by faxing the variance table. Variance requests are most often handled directly between these parties. On occasion, a conference call may be held with agency representative or additional project and laboratory staff present. It is the responsibility of the Account Manager to coordinate the meeting.

Once an agreement has been reached, the Project Chemist and the QA team will finalize the understandings concerning the discrepancies in a final variance table, which is used for sample login and analysis. The variance table is given a unique identifier that ties it to the unique identifier assigned to the proposal. The table is stored on a network-shared drive in read-only format until sample log in occurs.

13.3 DOCUMENTATION OF PROJECT REQUIREMENTS

The Client Services Representative becomes the primary client contact following the project award. The Client Services representative will verify at that time that the client has been provided most recent version of the project plans. Any outstanding issues are discussed by phone and documented in the customer contact database. At this time the project profile is updated to include:

- Shipping information
- Report To and Bill To information
- Pricing
- Reference method
- Requested media and degree of preparation
- Target compound list
- Special QA requirements
- Calibration criteria (if different from SOP)
- Deliverable requirements
- Variance table by reference
- Any special instructions
- Subcontracting (when relevant)

The project profiles are secured with read only privileges for all staff except the Client Services Representatives, Account Managers, the Project Chemist and members of the QA team.

13.4 DOCUMENTING CLIENT DISCUSSIONS

Once a project has been awarded, the majorities of contacts occur via phone and are documented in the Client Services software. The software can track contacts by client name, project name, or date. Client Services team members may sort the database for summaries of calls made on the basis of specific clients or sub-contracting entities.

13.5 PROJECT BRIEFINGS

Client Services Representatives hold frequent briefings to discuss the recent client calls. The entire team is kept informed of the status of in-house projects. Potential scheduling problems or other matters affecting sample analysis and reporting are discussed.

13.6 SCHEDULING SAMPLING MEDIA

The ATL Client Services Representatives work closely with clients to ensure that media is delivered according to project schedule. Shipments for on-going projects are scheduled well in advance. The Client Services

Representatives are responsible for processing shipping requests through the Client Services database. This is the same database used to log phone contacts. Each shipping request is given a unique identifier. Both laboratory staff and shipping staff monitor the database throughout the day for posted shipping requests.

Some media types (e.g., DNPH solutions, PUF/XAD cartridges, etc.) take time to prepare. Careful planning and scheduling on the part of both the project managers and the clients is necessary. Clients are encouraged to provide as much lead-time as possible.

13.7 TRACKING SAMPLE ANALYSIS AND REPORTING

Client Services Representatives monitor the progress of samples from the time they arrive at the laboratory until the final report has been delivered. The sample tracking database is reviewed daily and provides the Client Services Representatives with up-to-date information on sample status. Daily contact with the laboratory team and task leaders is necessary when the rate of the production is less than desirable in any area. It is the responsibility of the Client Services Representative to inform the client in the event that delays in analysis and reporting are anticipated.

13.8 PROJECT FOLLOW-UP

All contact with the client following reporting is handled by the Client Services Representatives. This includes requests for re-issues, perceived problems with data, or further clarification. All discussions are documented in the Client Services database. When a client desires a modification to a completed report, the Client Services Representative reviews the request. Commonly the laboratory team or task leader responsible for the work or the QA Manager may be consulted. If the request is considered to be legitimate, the Client Services Representative initiates a request for report re-issue (per ATL SOP #68) in the Sample Tracking database. The database tracks the re-issue status to make sure that the report is fixed and sent to the client. The reason for the re-issue is documented on the report cover along with report re-issue date. It is the responsibility of the Client Services Representative to ensure that the correct reason and supporting documentation is provided in the report folder.

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14.0 DATA INTEGRITY PROCEDURES

14.1 TRAINING

Data integrity is the cornerstone of Air Toxics Limited. Our Mission Statement and Value Statement define the goals and values which produce data of known and defensible quality. Everything from data reporting programs, employee retention programs to customer service programs evolve around maintaining our core values above all else.

ATL Mission Statement

- To deliver high quality cost effective environmental analytical services
- That are profitable, on time and meet/exceed the expectations of our customers

How we go about accomplishing this mission is governed by our standards of conduct; the ability to discern right from wrong and proper from improper and the commitment to always do what is right, good and proper.

"We seek success in what we do, but not at the expense of integrity. Integrity is essential to establishing and maintaining the trust that allows us to work as a team and to foster confidence in our customers and co-workers. Without integrity there can be no trust."

Without integrity, our customers would not trust us to get the job done and would not hire us. Employees would not trust management to set realistic goals and provide adequate resources. Without integrity, management would not trust employees with the ultimate form of empowerment.... direct responsibility for customer satisfaction.

All new employees are provided with introductory training which consists of:

Ethics Training I
The ATL Value Statement
The ATL Mission Statement
Definition of Standards of Conduct and Ethics
ATL Strategic Goals
Importance of Trust
Definition of Integrity
Four basic enemies of integrity with workplace examples
Criminal ramifications for misconduct
Benefits of Integrity Training
Role of the Employee (reporting systems)
Role of Management (promote core values)
Where to find ATL Codes of Conduct
- Employee Handbook (employment standards)
- Quality Manual (quality standards)
- SOP's (technical standards)
- Chemical Hygiene Plan (safety standards)

A yearly refresher course is provided which reviews the basic information of Ethics Training I but then goes on to define the critical steps in making ethical decisions:

Ethics Training II
1. Review relevant values and standards, devise a plan
2. Question the plan, your motives and any consequences
3. Resolve to address any ethical dilemmas by making touch choices.

Case studies are used in Ethics Training II to encourage work group participation in actual decision making scenarios. Following each training session, the employee is provided with a certificate for training and asked to sign the certificate indicating they have been informed of their obligations in the ATL integrity program and understand that legal ramifications may be imposed upon them for failure to comply.

14.2 PERIODIC MONITORING

There are three parts to the ongoing periodic monitoring for inappropriate data manipulations following initial training. First, the IT Department has removed access to adjustment of data acquisition and reporting computer clocks. Second, each new employee undergoes a training period in which all of their data is reviewed by a Scientist or Team Leader until such time as basic knowledge and comprehension of method as well as data integrity procedures is demonstrated. A development plan is provided to each new employee by their Department Manager or Team Leader, which outlines goals, timelines and demonstration of understanding. The measurement of success may include proficiency with a task as well as a verbal or written test demonstrating concept comprehension.

When the Department Manager and/or Team Leader determine the new employee is ready to produce data of defensible quality, he/she is asked to provide several representative data packages to the Quality Assurance Manager for thorough review. If the QA Manager agrees that defensible data was produced, the employee is released from the 100% review program.

The third and final part of the periodic monitoring program involves the use of proprietary in-house data validation software to review every data point generated and to alert the reviewer when manual integrations occur. The software is also programmed to report when more than three attempts for a daily CCV or tune check standard to pass have been attempted. (Validation software currently reviews all method TO-14A/TO-15 results. Further software development is scheduled in 2007 to bring more methods on line).

14.3 MECHANISMS FOR REPORTING INFRACTIONS

During Ethics Training I, the new employee is informed how to go about communicating any real or perceived infractions of the data integrity system. Open dialogue is encouraged between the employee and any member of management or senior scientists they feel most comfortable with. It is management's responsibility to relay the information to the Technical Director(s) and follow-up with an inquiry or corrective action. The employee who desires to remain anonymous is encouraged to report to the teams senior scientist as ombudsman. The scientist will meet separately with management and the employee involved in order to ensure anonymity. An immediate inquiry by one of the Technical Directors will follow each and every reported incident. Documentation of the inquiry and subsequent disciplinary actions will be maintained by both the Technical Director and the Human Resource Manager.

Appendix A

DEFINITIONS AND TERMS

Accuracy: The degree of agreement between an observed value and an accepted reference value.

Analyte: The substance or thing for which a sample is analyzed to determine its presence or quantity.

Approved: The determination by any state for federal accrediting agency that a certified laboratory may analyze for an analyte under the specified method.

Assessment: The process of inspecting, testing and documenting findings for purposes of certification or to determine compliance.

Batch: A group of analytical samples ($\leq$ 20) of the same matrix processed together including extraction, concentration and analysis using the same process, staff and reagents.

Bag: Means an inert air-sampling container consisting of inert polymeric material.

Canister: A stainless steel spherical air-sampling device consisting of summa polished or glass lined internal walls and a leak tight on/off valve.

Contamination: The effect caused by the introduction of the target analyte from an outside source into the test system.

Continuing Calibration Verification (CCV): A CCV is analyzed to verify instrument linearity with respect to the Initial Calibration. The CCV concentration may be identical to any given point contained within the initial calibration. A CCV is analyzed at the beginning of every analytical sequence (all methods) and then once every ten or twenty samples depending on the method (GC and LC, GC/MS excluded). GC and LC methods also include a CCV in every analytical sequence as an End Check.

Control Charts: These are statistical tools for monitoring the performance of a particular task on a continuing basis. The control chart is prepared for each test parameter after 20 determinations have been performed. The mean is plotted with the warning limits being $\pm 2s$ and the control limits being $\pm 3s$. (s – standard deviation)

Corrective Action: An action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

Data Reduction: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Duplicate Samples: Samples collected for checking the preciseness of the sampling process. These samples are collected at the same time and from the same source as the study samples.

Equipment Blank: A sample that is known not to contain the target analyte that is used to check the cleanliness of sampling devices, collected in a sampling container from a clean sample collection device and retuned to the laboratory as a sample.

Appendix A

DEFINITIONS AND TERMS

Field Blank: A sample that is known not to contain the target analyte and is used to check for analytical artifacts or contamination introduced by sampling and analytical procedures, carried to the sampling site, exposed to sampling conditions and returned to the laboratory and treated as an environmental sample.

Field Duplicate: Samples collected at the same time from the same source, but submitted and analyzed as separate samples.

Holding Time: The maximum time that a sample may be held prior to preparation or analysis.

Impinger: The glass vessel used to contain collection solution through which a stream of air is bubbled for sampling purposes.

Initial Calibration: Demonstration of a linear response to different concentrations of calibration standards within a defined range.

Initial Demonstration of Analytical Capability: The procedure described in the method 40 CFR Appendix A, used to determine a laboratory's accuracy and precision in applying an analytical method.

Instrument Blank: A sample that is known not to contain the target analyte, processed through the instrumental steps of the measurement process used to determine the absence of instrument contamination prior to analysis of field samples.

Instrument Detection Limit (IDL): It is the concentration of the analyte that produces a signal greater than five times the signal-to-ratio of the instrument.

Interference: The effect on the final result caused by the sample matrix.

Internal Standards (ISs): These are the measured amounts of certain compounds added after preparation or extraction of a sample.

Key Personnel: The laboratory director, technical director, quality assurance manager, and team leader, all of whom meet the requirements of the NELAP rule.

Laboratory Control Sample: An independent second source reference standard which goes through he same pretreatment and preparation procedures as the samples. It validates the accuracy of the initial calibration.

Laboratory Duplicates: Aliquots of the same sample that are prepared and analyzed at the same time.

Limit of Detection (LOD): an estimate of the minimum amount of a substance that an analytical process can reliable detect. An LOD is analyte and matrix-specific and may be laboratory dependent. The LOD may be determined by a Method Detection Limit study.

Limits of Quantitation (LOQ): the minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. Generally, the LOQ is equal to the concentration of analyte(s) in the lowest point of a calibration (see Reporting Limit).

Appendix A

DEFINITIONS AND TERMS

Matrix: The component or substrate (e.g., surface water, drinking water, air, liquid waste) which contains the analyte of interest.

Matrix Spike: A sample prepared to determine the effect of the matrix on a method's recovery efficiency by adding a known amount of the target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available.

Matrix Spike Duplicate (MSD): Duplicates of the matrix spike sample.

Measurement Uncertainty: Measurement uncertainty is the estimation of potential errors in a measurement process and is expressed as ± 2X (*s*) of the historical mean of LCS recoveries.

Method Detection Limit: The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero as determined from analysis of a sample containing the analyte in a given matrix (40 CFR Part 136, Appendix B, July 1995).

Practical Quantitation Limit (PQL): A synonym for the standard of lowest concentration contained in the Initial Calibration. It is the smallest concentration of the analyte that can be reported with a specific degree of confidence.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance or arrange, in either absolute or relative terms.

Preservation: The temperature control or the addition of a substance to maintain the chemical or biological integrity of the target analyte.

Proficiency Testing (PT) Assessment: The event including receiving, analyzing, and reporting of results from a set of samples that a proficiency testing provider sends to a laboratory for the laboratory to demonstrate compliance with the proficiency testing requirements.

Proficiency Test (PT) Sample: A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Quality Assurance: An integrated system of activities involving planning, quality control, reporting, and quality assessment and improvement to ensure that the product meets defined standards of quality with a stated level of confidence.

Quality Assurance Project Plan (QAPP): An orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.

Reporting Limit: The smallest concentration of an analyte that can be measured with a stated probability of significance. All Initial Calibrations contain a standard at the Reporting Limit. The Reporting Limit is never less than the PQL.

Appendix A

DEFINITIONS AND TERMS

Reporting Limit Verification: A re-quantification of the lowest concentration data point of an initial calibration to test the percent recovery of each component. Analyte recovery should be between 50-150% to verify detection limit accuracy.

Selectivity: The capability of a method or instrument to respond to the target analyte in the presence of other substances or things.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels of a target analyte.

Standard Operating Procedures (SOP): A written document which details the steps of an operation, analysis or action whose techniques and procedures are thoroughly prescribed, and is accepted as the procedure for performing certain routine or repetitive tasks.

Surrogate: A substance which is unlikely to be found in the environment and which has properties that mimic the target analyte and that is added to a sample to check for analytical efficiency.

Target Analyte: The analyte that a test is designed to detect or quantify.

Technical Employee: A designated individual who performs the analytical method and associated techniques.

Trip Blank: A sample known not to contain the target analyte that is carried to the sampling site and transported to the laboratory for analysis without having been exposed to the sampling procedures.

Appendix B

STANDARD OPERATING PROCEDURES

#1	Customer Support System
#2	Analysis of Volatile Organic Compounds in VOST Cartridges and Condensates by Modified EPA SW-846 Method 5041A/8260B
#3	Analysis of Semi-Volatile Organic Compounds by Modified EPA SW-846 Method 8270C
#4	Preparation and Conditioning of VOST and CMS Tubes
#5	Analysis of Volatile Organic Compounds in Ambient Air Using Modified EPA Method TO-17 with Modified EPA SW-846
#6	Analysis of Volatile Organic Compounds in SUMMA™ Polished Canisters by Modified EPA Methods TO-14A/TO-15
#7	Preparation of Silonite™, Silcosteel™, and Summa™ Canisters for Sampling
#8	Analysis of Oxygen, Nitrogen, Methane, Ethane, Ethene, Carbon Monoxide, Carbon Dioxide, Hydrogen and NMOC by Modified ASTM Method D-1946
#10	Analysis of Semi-Volatile Organic Compounds Collected on PUF Cartridges by GC/MS Full Scan Modified EPA Method TO-13A
#11	Analysis of Aldehydes and Ketones by Modified EPA Methods TO-5 (Impingers), TO-11A (Sep-Pak Cartridges), Modified SW-846 Method 0011/8315A (Impingers) and Modified CARB 430 (Impingers)
#12	Extraction of Aldehydes and Ketones by Modified EPA Method TO-5 and Modified CARB 430
#13	Analysis of Sulfur Compounds by ASTM Method D-5504
#14	Preparation of PUF and PUF/XAD-2 Media for Ambient Air Sampling and XAD-2 Media for MM5 Sampling
#15	Extraction of Ambient Air & MM-5 Samples for Semivolatile Analysis and Pesticides/PCB Analysis by Modified EPA SW-846 Method 3542
#17	Safe Lifting Procedures
#19	Refrigerator/Freezer Temperature Monitoring and Documentation
#20	ATL GC Applications for Analysis of Organic Compounds in Air
#24	Storage and Disposal of Hazardous Wastes
#25	Extraction of Aldehydes by Modified Methods 0011 and 8315A
#26	Analysis of Pesticides and PCBs Collected on PUF Cartridges using Modified EPA Methods TO-4A/TO-10A
#27	Internal Audit Procedures
#30	Laboratory Security

Appendix B

STANDARD OPERATING PROCEDURES

#33	Standard Preparation, Validation, and Documentation
#34	Certification of Test Equipment
#36	Analysis of Non-Methane Organic Compounds (NMOC) Using Modified EPA Method TO-12
#38	Analysis of Volatile Organic Compounds in Summa™ Polished Canisters by GC/MS Selective Ion Monitoring Modified EPA Methods TO-14A/TO-15
#39	Procedures to Perform an MDL Study
#43	Analysis of Benzene, Toluene, Ethylbenzene, Xylene and Total Petroleum Hydrocarbons in Ambient Air Using Modified EPA Method TO-3
#44	Certification of SUMMA™ Polished or Glass-Lined Canisters used in the Analysis of Volatile Organic Compounds
#45	Preparation and Review of Laboratory Narratives
#46	Writing and Updating Standard Operating Procedures
#47	Implementation and Testing of Atlas Modules
#48	Preparation and Review of Control Charts
#50	Receipt and Tracking of Samples
#52	Manual Peak Integration for GC/MS Analyses
#53	Tune Check Spectrum Generation
#54	Analysis of Natural Gases by Modified ASTM Method D-1945
#55	Electronic Archival of Analytical Instrument Data
#57	Manual Peak Integration - Gas Chromatography
#58	Dissolved Gas Analysis in Water Samples Using GC Headspace Equilibration Technique Modified EPA SOP RSK-175
#59	Screening Samples Using GC/FID
#60	Canister Pressurization
#61	Corrective Action Procedure
#62	Preparation of 2,4-Dinitrophenylhydrazine (DNPH) Reagent for Use in Modified EPA Methods 0011, TO-5, TO-11A, and CARB 430 Sampling Media
#63	Sample Custody Cage Logbook Documentation
#65	Extraction of Aldehydes by Modified EPA Method TO-11A

Appendix B

STANDARD OPERATING PROCEDURES

#66	Determination of Suspended Particulate Matter in the Atmosphere as Total Suspended Particulates from Quartz Fiber Filters by 40 CFR Part 50 Appendix B; Determination of Particulate Matter as PM10 from Quartz Fiber Filters by 40 CFR Part 50 Appendix J
#67	NOAH Auto-Sampler and NOAH 3 Software
#68	Procedure to Reissue Finalized Data Reports
#69	Transfer of Sample Collected in a Tedlar Bag to a SummaTM Canister
#70	Preparation and Procedures for Flow Controller Assemblies
#71	Siloxanes in Air by GC/MS Direct Inject Analysis
#72	Analysis Of Cresol Isomers and Phenol By Modified NIOSH Method 2546
#74	Analysis Of Polycyclic Aromatic Hydrocarbons by GC/MS Selective Ion Monitoring (SIM) Modified EPA Method TO-13A
#78	Generation of Air Toxics Ltd. Data Deliverables, Electronic Conversion, and Archival
#79	Analysis of Volatile Organic Compounds in SMVOC Cartridges (Tenax®-GC and Anasorb® 747) and Condensates by Modified EPA SW-846 Method 5041A/8260B /0031
#82	Analysis of Volatile Organic Compounds in Air By Modified TO-14A GC/FID
#83	Analysis Of Volatile Organic Compounds In SummaTM Polished Canisters by GC/MS Low Level Modified EPA Methods TO-14A/TO-15
#84	Analysis Of Volatile Hydrocarbons and Ozone Precursors In Summa™ Polished Canisters
#85	Analysis Of Volatile Organic Compounds In Summa™ Polished Canisters by GC/MS Modified EPA Method TO-15 To Comply With NJDEP
#86	Analysis of Ozone Precursors in Ambient Air by EPA 600-R-98/161 using Dual GC/FID
#87	Demonstration of Capability Procedure
#88	NCASI Method IM/CAN/WP-99.02
#89	Media Management
#90	Subcontract Analysis
#91	Analysis Of Volatile Organic Compounds In Summa™ Polished Canisters by GC/MS Modified EPA Methods TO-14A/TO-15 (5 & 20 ppbv)
#92	Analysis Of Volatile Organic Compounds In Soil Gas Collected in Passivated Canisters by EPA SW-846 Modified Method 8260B

REFERENCES

- Annual Book of ASTM Standards, American Society for Testing & Materials, 1991.
- EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (First and Second Editions)
- EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air, Winberry *et al.*, Atmospheric Research and Exposure Assessment Laboratory, September 1989.
- Environmental Sampling and Analyses Lab Manual, Maria Csuros, Lewis Publishers, 1997.
- Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Final Update III, Revision 1, December, 1996.
- Statement of Work for the Organic Superfund Contract Laboratory Program, OLM04.2 May, 1999.
- CLP Draft - Analytical Method for the Determination of VOCs in Air Collected in Summa Canisters and Analyzed by GC/MS, December 1991.
- Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act 40 CFR (136) 1984.
- NIOSH Manual of Analytical Methods, Center for Disease Control, Fourth Edition, August, 1994.
- OSHA Analytical Methods Manual, U.S. Department of Labor, January, 1990.
- California Air Resources Board Stationary Source Test Manual, Monitoring and Laboratory Division, September, 1990.

ARCADIS

Appendix C

Health and Safety Plan

Curtiss-Wright Flow Control Corporation, Target Rock Division

Appendix C

Health and Safety Plan

Client Name: Curtiss-Wright Flow Control Corporation, Target Rock Division

Project Name: Target Rock

Date: December 30, 2008

ARCADIS
Infrastructure, environment, buildings

ARCADIS

Christopher D. Keen
Designated H&S Plan Writer

for
Carlo San Giovanni
Designated H&S Plan Reviewer

for
Michael F. Wolfert
Project Manager/Hydrogeologist

Appendix C
Health and Safety Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale,
New York
NYSDEC Site # 1-52-119

Prepared for:
Curtiss-Wright Flow Control Corporation,
Target Rock Division

Prepared by:
ARCADIS
Two Huntington Quadrangle
Suite 1S10
Melville
New York 11747
Tel 631 249 7600
Fax 631 249 7610

Our Ref.:
NY001490.0001.00001

Date:
December 30, 2008

Attachments

1. Introduction

All work on this project will be carried out in compliance with ARCADIS' Health and Safety Manual and the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response regulation 29 CFR 1910.120. Specific safety information for the project is contained in this Health and Safety Plan (HASP). All personnel working on hazardous operations or in the area of hazardous operations shall read and be familiar with this HASP before doing any work. All project personnel shall sign the certification page acknowledging that they have read and understand this HASP.

Changes in the scope of the project or introduction of new hazards to the project shall require revision of the HASP by the HASP writer and reviewer, and approval by the Project Manager. The HASP Addendum Form is included as Appendix A. Addendums are to be added to every copy of the HASP, and logged in the following table to verify that all copies of the HASP are current:

Addendum Number	Date of Addendum	Reason for Addendum	Person Completing Addendum
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

2. Project Description

2.1 Project Dates

Projected Start Date: 1/1/2009
Projected End Date: 12/31/2009

2.2 Site Background

This HASP has been prepared by ARCADIS on behalf of Curtiss-Wright Flow Control Corporation, Target Rock Division (Target Rock) as a component of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Target Rock Site (Site) in East Farmingdale, New York (NYSDEC Site Number 1-52-119).

This HASP has been prepared as a component of the Sampling and Analysis Plan (SAP), which is the umbrella document that consists of Appendices A through D of the RI/FS Work Plan. The SAP includes the following required elements:

- The Field Sampling Plan (FSP) (Appendix A) defines sampling and data gathering methods consistent with NYSDEC Draft DER-10 (NYSDEC, 2002) and the "Field Methods Compendium," OER 9285.2-11 (draft July 1993).

- The Quality Assurance Project Plan (QAPP) (Appendix B) describes the quality assurance/quality control (QA/QC) protocols necessary to achieve the project data quality objectives.

- This HASP (Appendix C) details procedures for protecting persons at and near the Site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The Citizen Participation Plan (CPP) (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC, 1998).

The Site is located at 1966E Broadhollow Road, East Farmingdale, Town of Babylon, Suffolk County, New York and is identified by Tax Map Number: District 0100, Section 031, Block 1, Lots 2.2 through 2.4. Target Rock manufactures valves used

primarily for nuclear power applications. Manufacturing processes include machining and testing of valves. One of the elements of the manufacturing process is the non-destructive testing of the valves for minor cracks. Target Rock began manufacturing operations at the Site in 1982 and operations have been ongoing to the present.

A series of investigations were completed at the Site between 1988 and 2004. These completed investigations and findings are described in Section 2.4.1 of the RI/FS Work Plan. In summary, the following findings were reported:

- VOCs (primarily 1,1,1-TCA; tetrachloroethene [PCE]; trichloroethene [TCE]; 1,1-dichloroethane [1,1-DCA]) were detected above applicable NYSDEC Recommended Soil Cleanup Objectives (RSCOs) and Suffolk County Department of Health Services (SCDHS) Action Levels in some soil samples collected at the Site.

- VOCs (primarily 1,1,1-TCA; PCE; TCE; 1,2-dichloroethene [1,2-DCE]; 1,1-DCA) were detected above applicable NYSDEC standards in some groundwater samples collected at the Site.

2.3 List of Project Tasks and Scope of Work

Task 1 – Drilling of Soil Borings, Temporary Monitoring Wells, Temporary Soil Vapor Points, and Temporary Sub-Slab Soil Vapor Points

Task 1 will involve the following activities: advancing soil borings and collection of soil cores for the purpose of lithologic characterization and laboratory analysis; advancing temporary monitoring wells (TMWs) to characterize the nature and extent of groundwater contamination; advancing temporary soil vapor points (SVPs) to assess soil vapor quality; advancing temporary sub-slab soil vapor points (SSVPs) to assess sub-slab soil vapor quality beneath the east and west buildings; and, management of investigation-derived waste (IDW). The soil borings, TMWs, and SVPs will be drilled using direct push (i.e., Geoprobe®) drilling techniques. The SSVPs will be drilled using a core drill or rotary hammer drill and a manual slide hammer. It is planned that IDW (purge water and decontamination water) will be containerized in DOT-rated 55-gallon drums.

Task 2 – Monitoring Well Sampling and Hydraulic Monitoring

Task 2 will involve the sampling of monitoring wells for the purpose of laboratory analysis and characterization and the collection of water-level measurements. The monitoring wells will be sampled using low-flow (minimal drawdown) groundwater sampling techniques. The water-level measurements will be collected using an electronic water-level indicator. Monitoring well purge water will be containerized in DOT-rated 55-gallon drums.

2.4 Site Description

Site Type: (Check as many as applicable)

X	Active	X	Secure	X	Industrial		Landfill		Service station
	Inactive		Unsecured		Commercial		Well field		Water work
			Uncontrolled		Residential		Railroad		Undeveloped
					Other specify:				

Surrounding Population:

X	Residential	X	Industrial	X	Commercial		Rural		Other:

The approximately 11-acre Site contains two manufacturing buildings (east building and west building), each situated on 5-acre lots, and a 1-acre right-of-way. The west building is used for manufacturing and contains office space; the east building is used for shipping and receiving, valve testing, and contains additional manufacturing and office space. The areas of the Site not occupied by buildings are largely paved and used for parking. The Site is secured by a perimeter fence and automatic gate. The Site is situated on relatively flat topography on the western edge of an industrial area. Residential areas are located to the west and south of the Site. A commercial building is located to the north of the Site.

3. Hazard Analysis

3.1 Project Hazard Checklist

Physical Hazards Present: ☐ None	☒ Heat ☒ Cold ☒ Noise ☒ Walking/working surfaces (includes slip/trip/fall & floor/wall openings) ☒ Visible Dust (floor slab drilling) ☐ LASER ☐ Other:	☐ Holes/Pits ☐ Ionizing radiation ☐ Non-ionizing radiation ☒ Electricity ☒ Severe Weather ☐ Poor lighting ☒ Overhead Hazards ☐ Other:
Environmental/Equipment Hazards Present: ☐ None	☐ Heavy machinery ☐ Trenching/excavation ☐ Docks – marine operations ☐ Docks – loading ☐ Diving operations ☒ Drilling ☐ Forklifts ☐ Water operations work ☐ Elevated heights (includes fall protection) ☒ Overhead/Underground utilities ☐ Confined spaces ☒ Power Tools/Hand Tools	☐ Cranes/Hoists/Rigging ☐ Ladders ☐ Scaffolding ☐ Man lifts ☐ Welding ☒ Gas cylinders ☐ Roadway work ☐ Railroad work ☐ Energized equipment (LO/TO) ☐ Pressurized equipment (LO/TO) ☒ Drums and containers ☒ Other: Generators
Biological Hazards Present: ☒ None	☐ Animal/human fluids or blood ☐ Animal/human tissue(s) ☐ Poisonous/irritating plants ☐ Other:	☐ Contaminated needles ☐ Live bacterial cultures ☐ Insects/rodents/snakes ☐ Other:
Ergonomic Hazards Present: ☐ None	☒ Repetitive motion (Slide Hammer) ☐ Awkward position ☒ Heavy lifting ☐ Frequent lifting ☐ Other:	☐ Limited movement ☒ Forceful exertions (Slide Hammer) ☒ Vibration (Slide Hammer; Core/Hammer Drilling) ☐ Other: ☐ Other:
Personal Safety/Security: ☒ None	☐ Personal safety ☐ Security issue ☐ Project site in isolated area ☐ Employees working alone ☐ Other:	☐ Employees working early/late ☐ Potentially dangerous wildlife ☐ Guard or stray dogs in area ☐ No/limited cell phone service ☐ Other:
Driving Safety ☒ None	☐ Driving early/late ☐ Driving long trip ☐ Driving off-road	☐ City driving ☐ Pulling trailer ☐ Other:
Chemical Hazards: ☐ None	☒ Flammable/Combustible ☒ Compressed gas (calibration gas cylinders) ☐ Explosive ☐ Organic peroxide ☐ Oxidizer ☐ Water reactive ☐ Unstable reactivity ☐ Dust/Fumes/ Particulates	☒ Corrosive (i.e., sample preservative chemicals) ☒ Toxic ☐ Highly toxic ☒ Irritant ☐ Sensitizer ☒ Carcinogen ☐ Mutagen ☐ Other:

3.2 Chemical Hazards

Chemical	Hazards	TLV/PEL* 8-hr TWA	Ionization Potential	Estimate of quantity to be used or stored on site	Symptoms of Overexposure	Special Precautions
1,1,1-Trichloroethane (1,1,1-TCA)	Toxic	350 ppm	11.00 eV		Irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	**Personal Protection & Sanitation** Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation
Tetrachloroethene (PCE)	Toxic	25 ppm	9.32 eV		Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	**Personal Protection & Sanitation** Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench Animal carcinogen; Chlorinated solvent
Trichloroethene (TCE)	Toxic	50 ppm	9.45 eV		Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	**Personal Protection & Sanitation** Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench Animal carcinogen; Chlorinated solvent
1,2-Dichloroethene (1,2-DCE)	Toxic	200 ppm	9.65 eV		Irritation eyes, respiratory system; central nervous system depression	**Personal Protection & Sanitation** Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation Incompatible with strong oxidizers like Hydrogen Peroxide

Chemical	Hazards	TLV/PEL* 8-hr TWA	Ionization Potential	Estimate of quantity to be used or stored on site	Symptoms of Overexposure	Special Precautions
1,1-Dichloroethane (1,1-DCA)	Toxic	100 ppm	11.06 eV		Irritation skin; central nervous system depression; liver, kidney, lung damage	**Personal Protection & Sanitation** Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation
Gasoline	Toxic, Flammable/ Combustible	300 ppm	NA	Less than 5 gallons – Gasoline will primarily be used to run the generator	Irritation eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid); possible liver, kidney damage; [potential occupational carcinogen]	**Personal Protection & Sanitation** Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation Provide: Eyewash, Quick drench
Hydrochloric Acid	Corrosive, Irritant, Toxic	2 ppm	12.74 eV	Trace volume present in sample containers	Irritation nose, throat, larynx; cough, choking; dermatitis; solution: eye, skin burns; liquid: frostbite; in animals: laryngeal spasm; pulmonary edema	**Personal Protection & Sanitation** Skin: Prevent skin contact (solution)/Frostbite Eyes: Prevent eye contact/Frostbite Wash skin: When contaminated (solution) Remove: When wet or contaminated (solution) Change: No recommendation Provide: Eyewash (solution), Quick drench (solution), Frostbite wash

*The TLV (Threshold Limit Value) from the American Conference of Governmental Industrial Hygienists is listed unless the PEL (Permissible Exposure Limit), designated by OSHA, is lower.

3.3 Hazard Communication (HazCom)

All project required chemicals will be handled in accordance with OSHA 29 CFR 1910.1200 and ARCADIS-required procedures. The SSO will act as the HazCom Program Coordinator for the Site and will maintain the Master Inventory List (MIL) of hazardous chemicals kept on the job Site. The SSO will maintain MSDS on Site for all chemicals. Material Safety Data Sheets (MSDS) for the chemicals that will be brought to the job Site are available in Appendix B of this HASP. The SSO will communicate the location of the MSDS and the hazards associated with these chemicals to all project Site ARCADIS employees and subcontractors during the safety orientation. This information will be reviewed during tailgate briefings, especially if new chemicals or materials are introduced on Site.

The SSO will ensure that all containers of chemicals (including drums, bags, pails, tanks, vessels, etc.) are labeled appropriately: The contents of the container, the proper name of the chemical, associated hazards and appropriate hazard warnings, and the name and address of the manufacturer/importer. Chemicals will not be accepted or allowed on Site that are not properly labeled. If transferred to a secondary container, the new container will be labeled as described.

The SSO will ensure that the PPE necessary for work around the particular chemical is available and that project Site employees have been trained in its use.

The Project Manager will ensure that all project personnel have received Hazard Communication training as required in OSHA 29 CFR 1910.1200 (h).

3.4 Task Hazard Analysis

Each hazard is evaluated and rated for the level of risk based on the task of the project. A thorough task hazard analysis is completed for each respective task using the following Relative Hazard Rating Scale:

Hazard is/has...	Minimal health effects	Moderate health effects	Severe health effects
Rarely present	LOW	LOW	MED
Sometimes present	LOW	MED	HIGH
Constantly present	MED	HIGH	HIGH

Administrative and engineering controls for each hazard are evaluated for hazard abatement. Personal protective equipment (PPE) required to protect employees from the hazard are indicated, and a summary checklist is provided in Appendix C of this HASP. Prior to initiating field work, a tailgate safety briefing must be conducted with all field staff to review the hazards with the project team. Tailgate safety briefings should be conducted daily, or as tasks/hazards change. The tailgate safety briefing form is included in Appendix D of this HASP.

This section also specifies the monitoring equipment to be used on Site for each task. If air monitoring levels reach and/or approach the action levels, work should be suspended and the project manager contacted to determine if the HASP should be amended to upgrade PPE requirements. All monitoring equipment will be maintained and calibrated in accordance with manufacturer recommendations. All pertinent monitoring data will be logged on the Real Time Air Monitoring Data Form (Appendix E of this HASP) and maintained on Site for the duration of project activities. Calibration of all monitoring equipment will be conducted **daily** and logged on the same form.

3.4.1 Task 1 – Drilling of Soil Borings, Temporary Monitoring Wells, Temporary Soil Vapor Points, and Temporary Sub-Slab Soil Vapor Points

HAZARD	Volatile Organic Compounds in Air	Level of Risk:	MED
Source of Hazard	Volatile organic vapors during drilling and sampling activities		
Admin. & Eng. Controls	Open Air Environment; Seal sub-slab boring as soon as practical following soil vapor sampling; Review attached module and JSA	PPE:	Level D
HAZARD	Dermal Contact with Soil	Level of Risk:	MED
Source of Hazard	Soil cores; Soil sampling		
Admin. & Eng. Controls	Cautiousness, Use of appropriate PPE (coveralls, nitrile gloves); Review attached module and JSA	PPE:	Level D
HAZARD	Dermal Contact with Liquids	Level of Risk:	MED
Source of Hazard	Groundwater; Sample Preservatives		
Admin. & Eng. Controls	Cautiousness, Use of appropriate PPE (coveralls, nitrile gloves); Review attached module and JSA	PPE:	Level D
HAZARD	Dust in Air	Level of Risk:	MED
Source of Hazard	Dust during sub-slab soil vapor point advancement generated by drilling through floor slab		
Admin. & Eng. Controls	Employ dust suppression using hand held sprayer, as necessary; Use water with core drill; Review attached module and JSA	PPE:	Level D
HAZARD	Being Struck by Equipment	Level of Risk:	MED
Source of Hazard	Drilling rig; Core/Hammer Drill		
Admin. & Eng. Controls	Cautiousness, Communication, Injury Prevention Training, Establish and maintain clearance around equipment, Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Walking/Working Surfaces	Level of Risk:	MED

Source of Hazard	Uneven Terrain/Floors		
Admin. & Eng. Controls	Cautiousness, Adequate lighting, Injury Prevention Training, Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Noise	Level of Risk:	MED
Source of Hazard	Drilling rig; Core/Hammer Drill		
Admin. & Eng. Controls	Use Insulation/Baffles/Sound Barricades on Equipment, As Needed; Maintain practical distance from noise generating components of equipment; Orient Equipment Exhaust away from Personnel; Review attached module and JSA	PPE:	Level D with Hearing Protection
HAZARD	Lifting/Vibration/Repetitive Motion	Level of Risk:	MED
Source of Hazard	Moving equipment (i.e., Core/Hammer Drill/Slide Hammer)/Operating Core/Hammer Drill/Slide Hammer		
Admin. & Eng. Controls	Lift with your legs with knees bent, move slowly, don't twist at waist; Use Buddy to Assist or Arrange Equipment to Avoid Lifting; Take breaks as necessary; Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Electricity/Energized Equipment	Level of Risk:	LOW
Source of Hazard	Core/Hammer Drill; Electrical Extension Cord		
Admin. & Eng. Controls	Cautiousness, Training; Review attached module and JSA	PPE:	Level D
HAZARD	Overhead/Underground Utilities	Level of Risk:	MED
Source of Hazard	Utility Service Lines		
Admin. & Eng. Controls	Conduct Mark Outs and GPR Survey, Maintain Recommended Utility Clearance, Cautiousness, Training; Review and implement ARCADIS Utility Location Policy; Utilize ARCADIS Utility Checklist Form (attached); Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Drums and containers	Level of Risk:	MED

Source of Hazard	Drums will be used to containerize waste during drilling/sampling activities		
Admin. & Eng. Controls	Properly label and stage containers, Properly handle containers, HazCom training; Review attached module and JSA	PPE:	Level D
HAZARD	Calibration Gas Cylinders	Level of Risk:	LOW
Source of Hazard	Calibration gases for PID		
Admin. & Eng. Controls	Properly store gas cylinders, Properly handle and use gas cylinders; Review attached module	PPE:	Level D
HAZARD	Heat/Cold Stress	Level of Risk:	MED
Source of Hazard	Hot weather and little shade in work area, long work days, strenuous work to setup and breakdown sampling apparatus, cold weather in winter		
Admin. & Eng. Controls	Frequent breaks during hot weather, maintain supply of fluids, clothing for winter work; Review attached modules	PPE:	Level D, Proper Seasonal Clothing

Is air monitoring required for this task? ☒ YES ☐ NO If yes, complete the following:

Monitoring Equipment	Monitoring Frequency	Action Level
PID (with 11.7 eV lamp)	Periodic (15 minute intervals)	25 ppm
Particulate Monitor (During Floor Slab Drilling)	Periodic (5 minute intervals)	150 ug/m^3

3.4.2 Task 2 – Monitoring Well Sampling and Hydraulic Monitoring

HAZARD	Volatile Organic Compounds in Air	Level of Risk:	MED
Source of Hazard	Volatile organic vapors during sampling activities		
Admin. & Eng. Controls	Open Air Environment, Let well vent until PID reading is below action level; Review attached module and JSA	PPE:	Level D
HAZARD	Dermal Contact with Liquids	Level of Risk:	MED
Source of Hazard	Groundwater; Sample Preservatives		
Admin. & Eng. Controls	Cautiousness, Use of appropriate PPE (coveralls, nitrile gloves); Review attached module and JSA	PPE:	Level D
HAZARD	Walking/Working Surfaces	Level of Risk:	MED
Source of Hazard	Uneven Terrain		
Admin. & Eng. Controls	Cautiousness, Adequate lighting, Injury Prevention Training, Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Electricity/Energized Equipment	Level of Risk:	LOW
Source of Hazard	Generator		
Admin. & Eng. Controls	Cautiousness, Training; Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Heavy Lifting	Level of Risk:	MED
Source of Hazard	Moving sampling equipment (i.e., generator and pump)		
Admin. & Eng. Controls	Lift with your legs with knees bent, move slowly, don't twist at waist; Use Buddy to Assist or Arrange Equipment to Avoid Lifting; Take breaks as necessary; Use TRACK; Review attached module and JSA	PPE:	Level D
HAZARD	Drums and containers	Level of Risk:	MED

Source of Hazard	Drums will be used to containerize waste during sampling activities		
Admin. & Eng. Controls	Properly label and stage containers, Properly handle containers, HazCom training; Review attached module and JSA	PPE:	Level D
HAZARD	Calibration Gas Cylinders	Level of Risk:	LOW
Source of Hazard	Calibration gases for PID		
Admin. & Eng. Controls	Properly store gas cylinders, Properly handle and use gas cylinders; Review attached module	PPE:	Level D
HAZARD	Heat/Cold Stress	Level of Risk:	MED
Source of Hazard	Hot weather and little shade in work area, long work days, strenuous work to setup and breakdown sampling apparatus, cold weather in winter		
Admin. & Eng. Controls	Frequent breaks during hot weather, maintain supply of fluids, clothing for winter work; Review attached modules	PPE:	Level D, Proper Seasonal Clothing
HAZARD	Noise	Level of Risk:	MED
Source of Hazard	Generator		
Admin. & Eng. Controls	Place generator away from monitoring well area; Orient Equipment Exhaust away from Personnel; Review attached module and JSA	PPE:	Level D with Hearing Protection

Is air monitoring required for this task? ☒ YES ☐ NO If yes, complete the following:

Monitoring Equipment	Monitoring Frequency	Action Level
PID (with 11.7 eV lamp)	Periodic (15 minute intervals)	25 ppm

3.5 Client-Specific Health and Safety Requirements

Target Rock has evaluated operations at their facility, and has identified hazards associated with these operations. In evaluation of these hazards, Target Rock has determined that the following safety measures must be taken to protect on-site personnel:

- All personnel working at the Site are required to attend a Target Rock H&S meeting prior to beginning work.
- A Target Rock Facilities & Safety representative will attend all Tailgate Safety Briefings.
- All personnel working at the Site are required to sign-in at the front desk prior to beginning work.
- Any personnel that require entry into the buildings must be a U.S. citizen.

Project workers will comply with the client's safety requirements at all times. The Project Manager is to be notified immediately if subcontractors or visitors are not following client-specific safety guidelines.

4. Decontamination Procedures

Level D decontamination protocol will be used with the following decontamination stations:

Level C Decontamination Steps		Level D Decontamination Steps	
1	Equipment Drop	1	Equipment Drop
2	Outer Garment, Boots, and Glove Wash and Rinse	2	Glove and Boot Wash and Rinse
3	Disposable Garment, Boots, and Glove Removal	3	Disposable Garment, Outer Boot, and Glove Removal
4	Cartridge Change (if necessary)	4	Field Wash
5	Remove Respiratory Protection		
6	Field Wash		

Place an X by all decontamination equipment that is required at the Site.

Decontamination Equipment Checklist			
X	Scrub Brushes	X	Garbage Bags
X	Waste Containers	X	Paper Towels
X	Soap		Isopropyl Alcohol
X	Plastic Tubs	X	Pump Spray Bottles
X	Plastic Drop Cloths	X	Pump Spray Bottles (water)

5. Emergency Procedures

In the event that an injury, over-exposure or spill has occurred, emergency response procedures will be implemented. The Site Safety Officer (SSO) will coordinate the entry and exit of response personnel during an emergency and make emergency contacts as necessary from the following list. After immediate notifications are made, the SSO will contact the Project Manager.

5.1 Emergency Contact Information

Emergency Contact	Telephone Number
Local Police (Suffolk County Police Department)	911 and/or (631) 854-8100
Local Ambulance (East Farmingdale Fire Department)	911 and/or (631) 249-0047
Local Fire Department (East Farmingdale Fire Department)	911 and/or (631) 249-0047
Local Hospital (Plainview Hospital)	(516) 719-3000
National Response Center (all spills in reportable quantities)	800.424.8802
U.S. Coast Guard (spills to water)	804.441.3516
Project Manager – Michael Wolfert	631.391.5238
Client Contact – John Pluta (Facilities and Safety Manager)	631.396.4414
WORK CARE	800.455.6155

5.2 WORK CARE

WorkCare is a 24-hour service that provides professional medical assistance over the telephone for non-emergency injuries or illness. The WorkCare nurse or doctor may assess the injury or symptoms, advise the employee as to appropriate care, and assist in identifying a medical facility if necessary.

Note: First aid should be administered and, when needed, emergency medical treatment should be sought prior to contacting WorkCare.

The Project Manager will make the following notifications:

Name	Phone Numbers
Corporate Health & Safety Director – Mike Thomas	720.344.3835 (O) 720.308.2147 (C)
Corporate Health & Safety Manager – Pat Vollertsen	720.344.3779 (O)
Regional Health & Safety Manager – Kurt Merkle	267.685.1800 (O)
Area Health & Safety Representative – Carlo San Giovanni	631.391.5259 (O) 516.903.6591 (C)

If emergency attention is not needed but professional medical attention is necessary, the employee will be taken to:

Medical Facility: Plainview Hospital
Address: 888 Old Country Road
Plainview, New York 11803
Phone Number: (516) 719-3000

A map to the medical facility is included in Appendix F.

5.3 Emergency Equipment

	Emergency shower	X	First-aid kit
X	Emergency eyewash	X	Cell phone/radio
X	Fire extinguisher		Chemical spill kit
	Other:		Other:

All employees working on this project will be shown the location and proper use of all emergency equipment prior to beginning work on the project.

6. Department of Transportation (DOT) Dangerous Good Shipping Requirements

Hazardous materials and dangerous goods (re: Canadian regulatory term) are those materials that have one or more of the following characteristics: explosives, compressed and liquefied gases, flammable liquids and solids, oxidizing materials, and other substances that are poisonous, infectious, radioactive or corrosive. It is the handling, loading, packing or placing of hazardous materials (dangerous goods) in or from a container or vehicle at any facility for the purpose of transportation (including storing) in the course of transportation. This also includes the packing and transporting for air and ground shipment of laboratory analysis samples.

Regulations governing hazardous materials and dangerous goods exist to protect people, the environment, or property when these goods are being transported by road, rail, sea, or air. Given the increased emphasis of federal (i.e., Federal Aviation Administration and US Department of Transportation, and the Transportation of Dangerous Goods Act) attention to the transport of hazard material-containing goods, it is imperative that all shipments are packaged and transported such that they adhere to all federal requirements. ARCADIS has strict policies in place, whether shipping via ground or air, designed to meet the associated federal requirements. As such, only ARCADIS staff that have been trained in the proper methods to prepare and ship hazardous materials are authorized to do so. If you have not received training on the appropriate preparation and shipping protocols, you are to contact your supervisor or health and safety representative prior to packaging and/or shipping any material that is, or suspected to be, hazardous.

7. Project Team and Training

7.1 Personnel List

The project manager is responsible for safety at the project site and for ensuring that all site workers have reviewed the HASP and understand the hazards. The project manager must also ensure that the necessary PPE is procured and provided to site workers. The task manager assists the project manager in implementing safety measures at the site, and conveys any safety concerns to the project manager.

The SSO officer is responsible for implementing the HASP at the project site. If any site personnel or visitors do not comply with the HASP, the SSO will cease all work

until personnel/visitors comply. The SSO will contact the PM/TM to inform them of any personnel not complying with the HASP.

Project Manager:	Michael Wolfert
Task Manager:	Christopher Keen
Site Safety Officer:	On-Site Scientist, Engineer, or Technician
Site Workers:	On-Site Scientist, Engineer, or Technician

7.2 Training Requirements

All personnel working at the site must have the necessary training based on the hazards present. The following training is required for all site workers:

Training Required: ☐ None	☒ 40-hour HAZWOPER ☐ 24-hour HAZWOPER ☒ HAZWOPER site supervisor ☐ OSHA 30-hour Construction ☐ OSHA 10-hour Construction ☐ PPE ☐ Respiratory protection ☐ Chemical hygiene ☒ Hazard communication ☐ Hazardous waste ☒ First-aid/CPR/Bloodborne pathogens ☒ DOT/IATA hazmat transportation ☐ Diving ☐ Boating safety	☐ Confined space ☐ Lockout/tagout ☐ Electricity ☐ Fire extinguishers ☐ Fall protection ☐ Noise exposure ☐ Forklifts ☐ Asbestos ☐ Lead ☐ Cadmium ☐ Radiation safety ☐ Client specific ☐ Other:
Medical Screening	☒ Medical Surveillance Exam (HAZWOPER) ☐ Client required drug and/or alcohol testing	☐ Blood and/or urine screening for other hazardous substances

All 40-hour HAZWOPER trained personnel who are working at HAZWOPER project sites are required to participate in the ARCADIS medical surveillance program as outlined in the Corporate Health and Safety Manual.

7.3 Subcontractors

A copy of this HASP is to be provided to all subcontractors prior to the start of work so that the subcontractor is informed of the hazards at the site. While the ARCADIS HASP will be the minimum H&S requirements for the work completed by ARCADIS

and its subcontractors, each subcontractor, in coordination with ARCADIS H&S personnel, is expected to perform its operations in accordance with its own HASP, policies and procedures unique to the subcontractor's work to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to ARCADIS for review prior to the start of on-site activities.

In the event that the subcontractor's procedures/requirements conflict with requirements specified in this HASP, the more stringent guidance will be adopted after discussion and agreement between the subcontractor and ARCADIS project H&S personnel. Hazards not listed in this HASP, but known to the subcontractor or known to be associated with the subcontractor's services, must be identified and addressed to the ARCADIS Project or Task Manager and SSO prior to beginning work operations.

If the subcontractor prefers to adopt this HASP, the **"Subcontractor Acknowledgement Memo" (provided on the ARCADIS Intranet) must be signed and dated by the subcontractor's management and placed in the project file.** Once the signed memo is received by the project manager, an electronic version of our HASP can be submitted to the subcontractor to use as their own. Subcontractors working at the site will need to have this plan with them, and will also need to sign the Subcontractors HASP receipt signature page of the ARCADIS HASP (Section 8.2). Subcontractors are responsible for the H&S of their employees at all times, and have the authority to halt work if unsafe conditions arise.

The Project/Task Manager and SSO (or authorized representative) has the authority to halt the subcontractor's operations and to remove the subcontractor or subcontractor's employee(s) from the Site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

8. Project Personnel HASP Certification

8.1 ARCADIS Personnel Signature Page

I certify that I have read, understand, and will abide by the safety requirements outlined in this HASP.

Printed Name	Signature	Date

8.2 Subcontractor Acknowledgement: Receipt of HASP

ARCADIS claims no responsibility for the use of this HASP by others although subcontractors working at the Site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this Site. Strict adherence to the health and safety guidelines provided herein will reduce, but not eliminate, the potential for injury at this Site. To this end, health and safety becomes the inherent responsibility of personnel working at the Site.

Printed Name	Company	Signature	Date

8.3 Visitor Acknowledgement and Acceptance of HASP

By signing below, I waive, release and discharge the Owner of the Site and ARCADIS G&M, Inc. and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the Site and in any way arising from or related to any and all known and unknown conditions on the Site.

Name	Company	Reason for Visit	Date/Time On Site	Date/Time Off Site

ARCADIS

Attachment C-1

HASP Addendum Pages

ARCADIS

Addendum Page

This form should be used to document any changes required to this HASP. These changes may be a result of changes to the scope of services, changes in field conditions, new hazards identified on the Site, higher or lower hazards than anticipated, etc. Please complete this form prior to the next work day once the changes have been identified. Review the modifications with all Site staff, including subcontractors, during the daily tailgate briefing, and complete the tailgate briefing form as required. Attach a copy of the addendum to all copies of the HASP including the Site copy, and log in the Addendum Log in Section 1.0.

Addendum Number: _____ Project Number: _____
Date of Changed Conditions: _____ Date of Addendum: _____

Description of Change that Results in Modifications to HASP:

Hazard Analysis for Change in Work:

HAZARD		Level of Risk:	
Source of Hazard			
Admin. & Eng. Controls		PPE:	
HAZARD		Level of Risk:	
Source of Hazard			
Admin. & Eng. Controls		PPE:	

Signed: _____ Signed: _____
Project Manager Site Safety Officer

Signed: _____ Signed: _____
H&S Plan Writer H&S Plan Reviewer

Make additional copies of this form as necessary.

ARCADIS

Attachment C-2

Material Safety Data Sheets

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Hydrochloric Acid
HYD2200

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Hydrochloric Acid
CAS Number: 7647-01-0
Chemical Formula: ClH
Structural Chemical Formula: HCl
EINECS Number: 231-595-7
ACX Number: X1002202-3
Synonyms: 4-D BOWL SANITIZER; ACIDE CHLORHYDRIQUE; ACIDO CLORHIDRICO; ACIDO CLORIDRICO; ANHYDROUS HYDROCHLORIC ACID; ANHYDROUS HYDROGEN CHLORIDE; AQUEOUS HYDROGEN CHLORIDE; BOWL CLEANER; CHLOORWATERSTOF; CHLOROHYDRIC ACID; CHLOROWODOR; CHLORURE D'HYDROGENE; CHLORURE D'HYDROGENE ANHYDRE; CHLORURO DE HIDROGENO; CHLORWASSERSTOFF; CLORURO DE HIDROGENO ANHIDRO; EMULSION BOWL CLEANER; EPA PESTICIDE CHEMICAL CODE 045901; HYDROCHLORIC ACID; HYDROCHLORIC ACID GAS; HYDROCHLORIDE; HYDROGEN CHLORIDE; HYDROGEN CHLORIDE (HCL); HYGEIA CREME MAGIC BOWL CLEANER; MURIATIC ACID; MURIATIC ACID); NOW SOUTH SAFTI-SOL BRAND CONCENTRATED BOWL CLEANSE WITHMAGIC ACTIO; PERCLEEN BOWL AND URINAL CLEANER; SPIRITS OF SALT; VARLEY'S OCEAN BLUE SCENTED TOILET BOWL CLEANER; VARLEY POLY-PAK BOWL CREME; WHITE EMULSION BOWL CLEANER; WUEST BOWL CLEANER SUPER CONCENTRATED
General Use: Hydrogen chloride is used to produce pharmaceutical hydrochlorides; vinyl chloride from acetylene; alkyl chlorides from olefins and arsenious chloride from arsenious oxide; electronic grade for etching semiconductor crystals. Used in the chlorination of rubber; in organic reactions involving isomerization, polymerization and alkylation; as a catalyst and condensing agent; for making chlorine where economical; in the separation of cotton from wool and cotton de-linting; as flux in the babbitt type of metal alloy; etching semi-conductor crystals.
Hydrochloric acid is used for pickling and heavy duty cleaning of metal parts; rust and scale removal. The production of chlorides; neutralizing bases; a laboratory reagent. For hydrolyzing starch and proteins in preparations for food. As a catalyst and solvent in organic synthesis. As "spirits of salts" for cleaning of lime and masonry from new brickwork. As flux or flux component for soldering; manufacture of "killed spirits".

Section 2 - Composition / Information on Ingredients

Name	CAS	%
hydrogen chloride	7647-01-0	> 99.0

OSHA PEL
Ceiling: 5 ppm, 7 mg/m^3.

NIOSH REL
Ceiling: 5 ppm (7 mg/m^3).

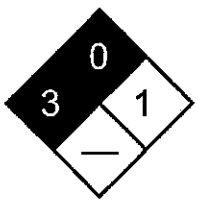
DFG (Germany) MAK
TWA: 5 ppm; PEAK: 5 ppm.

ACGIH TLV
Ceiling: 2 ppm.

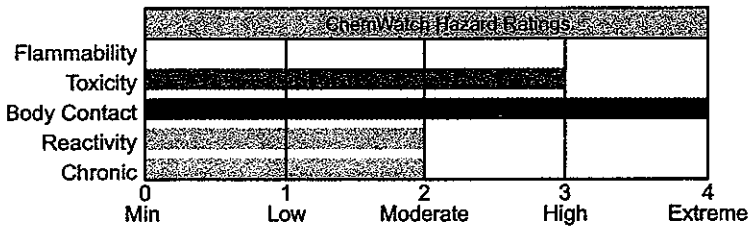
IDLH Level
50 ppm.

EU OEL
TWA: 5 ppm; STEL: 10 ppm.

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word
Danger!


Corrosive Compressed Gas

☆☆☆☆☆ **Emergency Overview** ☆☆☆☆☆
Colorless gas; characteristic suffocating, pungent odor. Corrosive. Stored as compressed gas which may cause frostbite. Chronic Effects: erosion of teeth.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, liver (in animals)
Primary Entry Routes: inhalation, skin contact, eye contact
Acute Effects

Inhalation: The vapor is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be harmful if inhaled.
Inhalation of quantities of liquid mist may be extremely hazardous, even lethal due to spasm, extreme irritation of larynx and bronchi, chemical pneumonitis and pulmonary edema.
A single severe exposure may cause coughing and choking; bleeding of nose, inflammation and occasionally ulceration of the nose, throat and larynx. Fluid on the lungs followed by generalized lung damage may follow.
Breathing of vapor may aggravate asthma and inflammatory or fibrotic pulmonary disease.
High concentrations cause necrosis of the tracheal and bronchial epithelium, pulmonary edema, atelectasis and emphysema and damage to the pulmonary blood vessels and liver.
Inhalation hazard is increased at higher temperatures.
The vapor from heated material is extremely discomforting to the upper respiratory tract and lungs if inhaled.
Continued severe exposure can result in pulmonary edema and corrosion of tissues in the nose and throat.

Eye: Hydrogen Chloride: The vapor is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Hydrochloric Acid: Eye contact is extremely painful and may cause rapid corneal damage. The liquid is extremely corrosive to the eyes and is capable of causing severe damage with loss of sight.
The vapor is highly discomforting and may be corrosive to the eyes. The vapor from heated material is extremely discomforting to the eyes.

Skin: The material is corrosive to the skin and may cause chemical burns.
Toxic effects may result from skin absorption. Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
The vapor is discomforting to the skin.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal if swallowed in quantity. Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic exposure may cause discoloration or erosion of the teeth, bleeding of the nose and gums; and ulceration of the nasal mucous membranes.
Repeated exposures of animals to concentrations of about 34 ppm produced no immediate toxic effects.
Workers exposed to hydrochloric acid suffered from gastritis and a number of cases of chronic bronchitis have also been reported.
Repeated or prolonged exposure to dilute solutions may cause dermatitis. Repeated exposure to low vapor concentrations can cause skin tenderness, bleeding of the nose and gums, chronic bronchitis, gastritis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

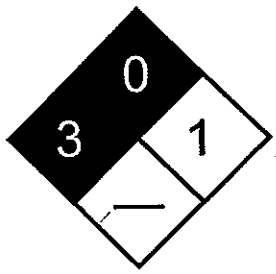
Ingestion: Contact a Poison Control Center. Rinse mouth out with plenty of water. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:
1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.

3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.
INGESTION:
1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.
SKIN:
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.
EYE:
1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam; Bromochlorodifluoromethane (BCF) (where regulations permit); Dry agent; Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Noncombustible liquid. Will not burn, but heat produces highly toxic fumes/vapors.
Heating may cause expansion or decomposition leading to violent rupture of containers. Decomposes on heating and produces toxic fumes of hydrogen chloride. Decomposition may produce toxic fumes of chlorine.
Reacts with metals producing flammable/explosive hydrogen gas. Contact with moisture or water may generate heat causing ignition. Reacts vigorously with alkalis. Moderate fire hazard when in contact with reducing agents.
Fire Incompatibility: Reacts with metals producing flammable/explosive hydrogen gas.
Avoid reactions with metals, metal oxides, hydroxides, amines, carbonates, alkaline materials, acetic anhydride, cyanides, sulphides, sulphites, phosphides, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde and potassium permanganate, unsaturated organics, metal acetylides, sulphuric acid.
Note: Compatibility with plastics should be confirmed prior to use.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation. Cool fire-exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire. Equipment should be thoroughly decontaminated after use. Water spray or fog may be used to disperse vapor. Do not approach cylinders suspected to be hot. If safe to do so, stop flow of gas.

Section 6 - Accidental Release Measures

Small Spills: DO NOT touch the spill material. Clean up all spills immediately. Wear fully protective PVC clothing and breathing apparatus. Contain and absorb spill with sand, earth, inert material or vermiculite. Use soda ash or slaked lime to neutralize. Collect residues and place in labeled plastic containers with vented lids. Clear area of personnel and move upwind. Avoid breathing vapors and contact with skin and eyes. Do not exert excessive pressure on valve; do not attempt to operate damaged valve. Water spray or fog may be used to disperse vapor.
Large Spills: Contact fire department and tell them location and nature of hazard. Clear area of personnel and move upwind. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation. Stop leak if safe to do so. Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve. Do not exert excessive pressure on valve; do not attempt to operate damaged valve. Shut off all possible sources of ignition and increase ventilation. Water spray or fog may be used to disperse vapor. Use soda ash or slaked lime to neutralize.
Collect and seal in labeled drums for disposal. Wash spill area with large quantities of water. If contamination of

drains or waterways occurs, advise emergency services. After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing. DO NOT touch the spill material. Contain and absorb spill with sand, earth, inert material or vermiculite.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist and vapor, breathing vapors and contact with skin and eyes.
Avoid physical damage to containers. Use in a well-ventilated area. Wear protective clothing and gloves when handling containers. Handle and open container with care.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material. When handling, DO NOT eat, drink or smoke. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Local exhaust ventilation may be required for safe working, i.e. to keep exposures below required standards; otherwise, PPE is required.
Keep dry. Reacts violently with water.
Transport containers on a trolley. Avoid sources of heat. DO NOT transfer gas from one cylinder to another.
Recommended Storage Methods: Packaging as recommended by manufacturer. Check that containers are clearly labeled.
Cylinder. Ensure the use of equipment rated for cylinder pressure. Ensure the use of compatible materials of construction. Valve protection cap to be in place until cylinder is secured, connected. Cylinder must be properly secured either in use or in storage. Cylinder valve must be closed when not in use or when empty. Segregate full from empty cylinders. WARNING: Suckback into cylinder may result in rupture. Use back-flow preventive device in piping.
Hydrochloric acid: Packs of 2.5 litres or less require a child-resistant closure. Glass container or Plastic carboy or Polylined drum.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: If risk of overexposure exists, wear air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas. Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
If risk of inhalation or overexposure exists, wear NIOSH-approved respirator or work in fume hood. Hydrogen chloride vapors will not be adequately absorbed by organic vapor respirators.
Personal Protective Clothing/Equipment:
Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Neoprene gloves; rubber gloves. Nitrile gloves.
Safety footwear. Rubber boots.
Hydrochloric acid: Barrier cream and Neoprene gloves or Elbow length PVC gloves. Nitrile gloves.
PVC boots or PVC safety gumboots.
Respiratory Protection:
Exposure Range >5 to <50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 50 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: white
Other: Ensure there is ready access to a safety shower; Eyewash unit.
Acid-resistant overalls. Full protective suit. Operators should be trained in procedures for safe use of this material.
Glove Selection Index:

BUTYL	Best selection
BUTYL/NEOPRENE	Best selection
HYPALON	Best selection
NEOPRENE	Best selection
NEOPRENE/NATURAL	Best selection
NITRILE+PVC	Best selection
PE/EVAL/PE	Best selection
SARANEX-23	Best selection
VITON/NEOPRENE	Best selection
PVC	Best selection

NITRILE ..... Best selection
NATURAL RUBBER..... Satisfactory; may degrade after 4 hours continuous immersion
NATURAL+NEOPRENE..... Satisfactory; may degrade after 4 hours continuous immersion
NAT+NEOPR+NITRILE ..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Hydrogen chloride: Colorless, corrosive gas. Pungent suffocating odor. White fumes in moist air. Soluble in methanol, ethanol, ether and benzene.
Hydrochloric acid: Clear to light yellow (orange tint for inhibited grades) fuming corrosive liquid with sharp, suffocating odor.
Physical State: Hydrogen chloride: Compressed gas; Hydrochloric acid: Liquid
Odor Threshold: 0.26 to 0.3 ppm
Vapor Pressure (kPa): < 24.8 at 25 °C
Vapor Density (Air=1): 1.268 at 20 °C
Formula Weight: 36.461
Specific Gravity (H_2O=1, at 4 °C): < 1.19 at 20 °C
Evaporation Rate: Slow
pH: Hydrochloric acid: < 1
Boiling Point: -85 °C (-121 °F)
Freezing/Melting Point: -114.44 °C (-173.992 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not applicable
Water Solubility: 56.1 g/100 cc hot water at 60 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Decomposes in the presence of moisture to produce corrosive acid. May generate sufficient heat to ignite combustible materials. Presence of heat source and direct sunlight (ultra-violet radiation). Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Hydrogen chloride: Segregate from most common metals and their alloys, alkalis, unsaturated organics, fluorine, metal carbides, metal acetylides, potassium permanganate and sulfuric acid. Compatibility with plastics should be confirmed prior to use.
Hydrochloric acid: Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates. Avoid storage with metals, metal oxides, hydroxides, amines, carbonates, alkaline materials, acetic anhydride, cyanides, sulphides, sulphites, phosphides, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde and potassium permanganate. Reacts with zinc, brass, galvanized iron, aluminum, copper and copper alloys.

Section 11 - Toxicological Information

Toxicity
Inhalation (human) LC_{Lo}: 1300 ppm/30 m
Inhalation (human) LC_{Lo}: 3000 ppm/5 m
Inhalation (rat) LC_{50}: 3124 ppm/60 m
Inhalation (rat) LC_{50}: 4701 ppm/30 m
Oral (rat) LD_{50}: 900 mg/kg

Irritation
Eye (rabbit): 5 mg/30 s - mild

See *RTECS* MW 4025000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TL_m Gambusia affinis (mosquito fish) 282 ppm/96 hr (fresh water) /Conditions of bioassay not specified; Lethal Lepomis macrochirus (bluegill sunfish) 3.6 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Cockle 330 to 1,000 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Carassius auratus (goldfish) 178 mg/l (1 to 2 hr survival time) /Conditions of bioassay not specified; LC_{50} Shore crab 240 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Shrimp 100 to 330 ppm/48 hr (salt water) /Conditions of bioassay not specified; LC_{100} Trout 10 mg/l 24 hr /Conditions of bioassay not specified
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Treat and neutralize at an effluent treatment plant. Bury residue in an authorized landfill. Decontaminate empty containers with a lime slurry. Return empty containers to supplier or bury empty containers at an authorized landfill.
Return empty cylinders to supplier.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Hydrogen chloride, anhydrous
ID: UN1050
Hazard Class: 2.3 - Poisonous gas
Packing Group:
Symbols:
Label Codes: 2.3 - Poison Gas, 8 - Corrosive
Special Provisions: 3
Packaging: **Exceptions:** None **Non-bulk:** 304 **Bulk:** None
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:** 40

Shipping Name and Description: Hydrochloric acid
ID: UN1789
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: A3, A6, B3, B15, IB2, N41, T8, TP2, TP12
Packaging: **Exceptions:** 154 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** C **Other:**

Shipping Name and Description: Hydrochloric acid
ID: UN1789
Hazard Class: 8 - Corrosive material
Packing Group: III - Minor Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: IB3, T4, TP1, TP12
Packaging: **Exceptions:** 154 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** C **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed
RQ: 5000 lb
TPQ: 500 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Nitric Acid
CAS Number: 7697-37-2
Chemical Formula: HNO_3
Structural Chemical Formula: HNO_3
EINECS Number: 231-714-2
ACX Number: X1002177-5
Synonyms: ACIDE NITRIQUE; ACIDO NITRICO; AQUA FORTIS; AZOTIC ACID; AZOTOWY KWAS; ENGRAVER'S ACID; ENGRAVERS ACID; HYDROGEN NITRATE; KYSELINA DUSICNE; NITAL; NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH >70% NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH NOT >70% NITRICACID; NITROUS FUMES; NITRYL HYDROXIDE; RED FUMING NITRIC ACID (RFNA); SALPETERSAURE; SALPETERZUUROPLOSSINGEN; WHITE FUMING NITRIC ACID (WFNA)
General Use: Manufacture of organic and inorganic nitrates and nitro compounds for fertilizers, dye intermediates and many organic chemicals.
Used for etching and cleaning metals.
Operators should be trained in procedures for safe use of this material.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nitric acid	7697-37-2	>95

OSHA PEL
TWA: 2 ppm; 5 mg/m^3.

NIOSH REL
TWA: 2 ppm (5 mg/m^3); STEL: 4 ppm (10 mg/m^3).

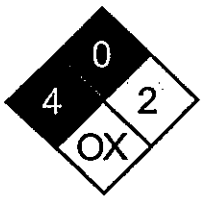
DFG (Germany) MAK
TWA: 2 ppm; PEAK: 2 ppm.

ACGIH TLV
TWA: 2 ppm; STEL: 4 ppm.

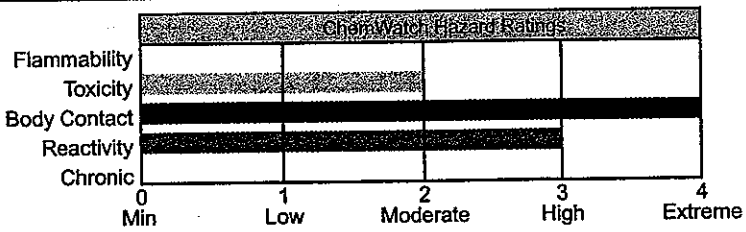
IDLH Level
25 ppm.

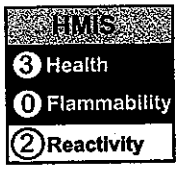
EU OEL
STEL: 2.6 mg/m^3 (1 ppm).

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive. Other Acute Effects: lung damage. Chronic Effects: tooth erosion, bronchitis. Strong oxidizer.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, teeth
Primary Entry Routes: inhalation, ingestion, skin contact, eye contact
Acute Effects
Inhalation: The vapor is extremely discomforting and corrosive to the upper respiratory tract and lungs and the material presents a hazard from a single acute exposure or from repeated exposures over long periods.
Inhalation hazard is increased at higher temperatures.
Reactions may occur following a single acute exposure or may only appear after repeated exposures.

Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.
The material may produce respiratory tract irritation which produces an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Unlike most organs the lung can respond to a chemical insult or agent by first trying to remove or neutralize the irritant and then repairing the damage. The repair process, which initially developed to protect mammalian lungs from foreign matter and antigens, may however, cause further damage the lungs when activated by hazardous chemicals. The result is often the impairment of gas exchange, the primary function of the lungs.
Inhalation of nitric acid mist or fumes at 2 to 25 ppm over an 8 hour period may cause pulmonary irritation and symptoms of lung damage.
Only several minutes of exposure to concentrated atmosphere i.e. 200 ppm may cause severe pulmonary damage and even fatality. Death may be delayed for several days.
Exposure to nitric acid fumes (with concurrent inhalation of nitrogen dioxide and nitric oxide) may elicit prompt irritation of the upper respiratory tract leading to coughing, gagging, chest pain, dyspnea, cyanosis if concentrations are sufficiently high and duration of exposure sufficiently long, pulmonary edema.

Eye: The liquid is extremely corrosive to the eyes and contact may cause rapid tissue destruction and is capable of causing severe damage with loss of sight.
The vapor is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The material may produce moderate eye irritation leading to inflammation.
Repeated or prolonged exposure to irritants may produce conjunctivitis.
Eye contact with concentrated acid may give no pain, whilst diluted solution causes intense pain and both can cause permanent eye damage or blindness. Burns may result in shrinkage of the eyeball, symblepharon (adhesions between tarsal and bulbar conjunctivae), permanent corneal opacification, and visual impairment leading to blindness.

Skin: The liquid is extremely corrosive to the skin and contact may cause tissue destruction with severe burns.
Bare unprotected skin should not be exposed to this material.
The vapor is highly discomforting to the skin.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Skin contact causes yellow discoloration of the skin, blisters and scars that may not heal. The skin may be stained bright-yellow or yellowish brown due to the formation of xanthoproteic acid. Dilute solutions may harden the epithelium without producing overt corrosion.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The material is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal.
Even a small amount causes severe corrosion of the stomach, burning pain, vomiting and shock, possibly causing non-healing scarring of the gastrointestinal tract and stomach. Death may be delayed 12 hours to 14 days or to several months. Such late fatalities are attributed to a chemical lobular pneumonitis secondary to aspiration. Survivors show stricture of the gastric mucosa and subsequent pernicious anemia.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged or repeated overexposure to low concentrations of vapor may cause chronic bronchitis, corrosion of teeth, even chemical pneumonitis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Immediately transport to hospital or doctor. DO NOT delay.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor. DO NOT delay.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Immediately transport to hospital or doctor. DO NOT delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:

1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.

INGESTION:

1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

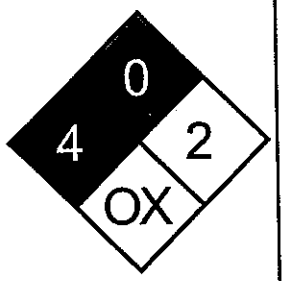
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Will not burn but increases intensity of fire.
Heating may cause expansion or decomposition leading to violent rupture of containers.
Heat affected containers remain hazardous.
Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
May emit irritating, poisonous or corrosive fumes.
Decomposes on heating and produces toxic fumes of nitrogen oxides (NO_x) and nitric acid.

Fire Incompatibility: Oxidizing agents as a class are not necessarily combustible themselves, but can increase the risk and intensity of fire in many other substances.
Reacts vigorously with water and alkali.
Avoid reaction with organic materials/compounds, powdered metals, reducing agents and hydrogen sulfide (H_2S) as ignition may result.
Reacts with metals producing flammable/explosive hydrogen gas.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
Extinguishers should be used only by trained personnel.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
If fire gets out of control withdraw personnel and warn against entry.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Dangerous levels of nitrogen oxides may form during spills of nitric acid.
Wear fully protective PVC clothing and breathing apparatus.
Clean up all spills immediately. No smoking, bare lights, ignition sources.
Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials, as ignition may result.
Avoid breathing dust or vapors and all contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with dry sand, earth, inert material or vermiculite. DO NOT use sawdust as fire may result.
Scoop up solid residues and seal in labeled drums for disposal.
Neutralize/decontaminate area.
Use soda ash or slaked lime to neutralize.

Large Spills: DO NOT touch the spill material. Restrict access to area.
Clear area of personnel and move upwind. Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, flames or ignition sources. Increase ventilation.
Contain spill with sand, earth or other clean, inert materials.
NEVER use organic absorbents such as sawdust, paper, cloth; as fire may result. Avoid any contamination by organic matter.
Use spark-free and explosion-proof equipment.
Collect any recoverable product into labeled containers for possible recycling. DO NOT mix fresh with recovered material.
Collect residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains. Decontaminate equipment and launder all protective clothing before storage and reuse.
If contamination of drains or waterways occurs advise emergency services.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Do not allow clothing wet with material to stay in contact with skin.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Stainless steel drum. Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Bare unprotected skin should not be exposed to this material. Impervious, gauntlet length gloves i.e., butyl rubber gloves or Neoprene rubber gloves or wear chemical protective gloves, e.g. PVC.

Wear safety footwear or safety gumboots, e.g. Rubber.

Respiratory Protection:

Exposure Range >2 to <25 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask

Exposure Range 25 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Other: Operators should be trained in procedures for safe use of this material.

Acid-resistant overalls or Rubber apron or PVC apron.

Ensure there is ready access to an emergency shower.

Ensure that there is ready access to eye wash unit.

Ensure that there is ready access to breathing apparatus.

Glove Selection Index:

BUTYL ..... Best selection
HYPALON ..... Best selection
NEOPRENE..... Best selection
NEOPRENE/NATURAL..... Best selection
PE/EVAL/PE ..... Best selection
SARANEX-23 ..... Best selection
NATURAL RUBBER..... Satisfactory; may degrade after 4 hours continuous immersion
NATURAL+NEOPRENE..... Satisfactory; may degrade after 4 hours continuous immersion
PVC..... Poor to dangerous choice for other than short-term immersion
NITRILE+PVC..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to slightly yellow liquid. Sharp strong odor.
CAUTION: exothermic dilution hazard.
HIGHLY CORROSIVE. Corrosive to most metals. Powerful oxidizing agent.
Darkens to brownish color on aging and exposure to light.

Physical State: Liquid
Odor Threshold: 0.75 to 2.50 mg/m^3
Vapor Pressure (kPa): 8.26
Vapor Density (Air=1): 1.5
Formula Weight: 63.02
Specific Gravity (H_2O=1, at 4 °C): 1.3-1.42
pH: < 1

pH (1% Solution): 1
Boiling Point: 83 °C (181 °F) at 760 mm Hg
Freezing/Melting Point: -42 °C (-43.6 °F)
Volatile Component (% Vol): 100 (nominal)
Decomposition Temperature (°C): Not applicable
Water Solubility: Soluble in all proportions

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and direct sunlight. Storage in unsealed containers. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from reducing agents, finely divided combustible materials, combustible materials, sawdust, metals and powdered metals.

Avoid contamination of water, foodstuffs, feed or seed.

Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 430 mg/kg
Inhalation (rat) LC_{50}: 2500 ppm/1 hr
Unreported (man) LD_{Lo}: 110 mg/kg

Irritation

Nil reported

See *RTECS* QU 5775000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: LC_{50} Starfish 100-300 mg/l/48 hr /Aerated water conditions; LC_{50} Shore crab 180 mg/l/48 hr /Static, aerated water conditions; LC_{50} Cockle 330-1000 mg/l/48 hr /Aerated water conditions

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Special hazards may exist - specialist advice may be required.
Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize at an approved treatment plant.
Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
Puncture containers to prevent reuse and bury at an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Nitric acid *other than red fuming, with more than 70 percent nitric acid*

ID: UN2031
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols:
Label Codes: 8 - Corrosive, 5.1 - Oxidizer
Special Provisions: B47, B53, T10, TP2, TP12, TP13
Packaging: **Exceptions:** None **Non-bulk:** 158 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 2.5 L
Vessel Stowage: **Location:** D **Other:** 44, 66, 89, 90, 110, 111

Shipping Name and Description: Nitric acid *other than red fuming, with not more than 70 percent nitric acid*

ID: UN2031
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: B2, B47, B53, IB2, T8, TP2, TP12
Packaging: **Exceptions:** None **Non-bulk:** 158 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** D **Other:**

Shipping Name and Description: Nitric acid, red fuming

ID: UN2032
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols: + - Override definitions
Label Codes: 8 - Corrosive, 5.1 - Oxidizer, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: 2, B9, B32, B74, T20, TP2, TP12, TP13, TP38, TP45
Packaging: **Exceptions:** None **Non-bulk:** 227 **Bulk:** 244
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed
RQ: 1000 lb
TPQ: 1000 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Unleaded Petrol
AUT5000

Section 1 - Chemical Product and Company Identification 61

Material Name: Unleaded Petrol
CAS Number: 8006-61-9
Chemical Formula: Mixture of hydrocarbons
EINECS Number: 232-349-1
ACX Number: X1003056-5
Synonyms: AUTOMOTIVE GASOLINE, LEAD-FREE; GASOLINE; MOTOR FUEL; MOTOR SPIRITS; NATURAL GASOLINE; PETROL; UNLEADED PETROL
General Use: Lead free motor fuel for internal combustion engines, 2-stroke and 4-stroke.

Section 2 - Composition / Information on Ingredients

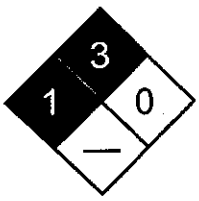
Name	CAS	%
gasoline	8006-61-9	>90
benzene	71-43-2	5 max.

OSHA PEL

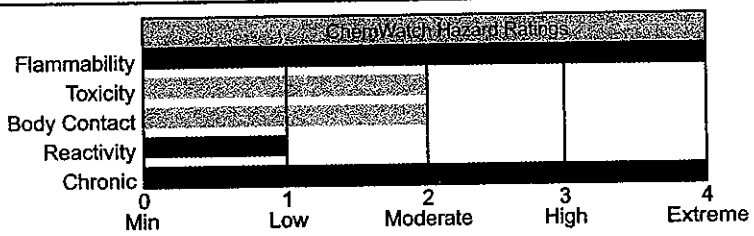
NIOSH REL

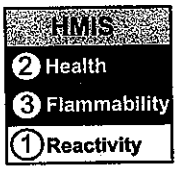
ACGIH TLV
TWA: 300 ppm, 890 mg/m^3;
STEL: 500 ppm, 1480 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear liquid; distinctive odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, drunkenness, unconsciousness. Chronic Effects: dermatitis. Possible cancer hazard. Flammable.

Potential Health Effects

Target Organs: skin, eye, respiratory system, central nervous system (CNS)
Primary Entry Routes: inhalation, ingestion, skin contact

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract and may be harmful if exposure is prolonged. Inhalation hazard is increased at higher temperatures. Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. WARNING: Intentional misuse by concentrating/inhaling contents may be lethal. High inhaled concentrations of mixed hydrocarbons may produce narcosis characterized by nausea, vomiting and lightheadedness. Inhalation of aerosols may produce severe pulmonary edema, pneumonitis and pulmonary hemorrhage. Inhalation of petroleum hydrocarbons consisting substantially of low molecular weight species may produce irritation of mucous membranes, incoordination, giddiness, nausea, vertigo, confusion, headache, appetite loss, drowziness, tremors and anesthetic stupor. Massive exposures may produce central nervous system depression with sudden collapse and deep coma; fatalities have been recorded. Irritation of the brain and/or apneic anoxia may produce convulsions. Although recovery following overexposure is generally complete, cerebral micro- hemorrhage of focal post-inflammatory scarring may produce eleptiform seizures some months after the exposure. Pulmonary episodes may include chemical pneumonitis with edema and hemorrhage. The lighter hydrocarbons may produce kidney and neurotoxic effects. Liquid paraffins may produce anesthesia and depressant actions leading to weakness, dizziness, slow and shallow respiration, unconsciousness, convulsions and death. C_{5-7} paraffins may also produce polyneuropathy. Aromatic hydrocarbons accumulate in lipid-rich tissues (typically the brain, spinal cord and peripheral nerves) and may produce functional impairment manifested by nonspecific symptoms such as nausea, weakness, fatigue, vertigo; severe exposures may produce inebriation or unconsciousness. Many of the petroleum hydrocarbons are cardiac sensitizers and may cause ventricular fibrillations.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration. The vapor is discomforting to the eyes. Petroleum hydrocarbons may produce pain after direct contact with the eyes. Slight, but transient, disturbances of the corneal epithelium may also result. The aromatic fraction may produce irritation and lachrymation. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The material is moderately discomforting to the skin if exposure is prolonged. The material contains a component that may be absorbed through the skin and may cause drying of the skin, which may lead to dermatitis from repeated exposures over long periods. Toxic effects may result from skin absorption. Open cuts, abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing dermatitis condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis. Ingestion of petroleum hydrocarbons may produce irritation of the pharynx, esophagus, stomach and small intestine with edema and mucosal ulceration. Resulting symptoms include a burning sensation in the mouth and throat. Large amounts may produce narcosis with nausea and vomiting, weakness or dizziness, slow and shallow respiration, swelling of the abdomen, unconsciousness and convulsions. Myocardial injury may produce arrhythmias, ventricular fibrillation and electrocardiographic changes. Central nervous system depression may also occur. Light aromatic hydrocarbons produce a warm, sharp, tingling sensation on contact with taste buds and may anesthetize the tongue. Aspiration into the lungs may produce coughing, gagging, and a chemical pneumonitis with pulmonary edema and hemorrhage.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes. Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following. Chronic poisoning may occur from vapor inhalation or skin absorption. The most significant toxic effect is insidious and irreversible injury to the blood-forming tissue by benzene. Leukemia may develop. Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes. Gasoline "sniffing" has caused severe nerve damage. Repeated or prolonged exposure to mixed hydrocarbons may produce narcosis with dizziness, weakness, irritability, concentration and/or memory loss, tremor in the fingers and tongue, vertigo, olfactory disorders, constriction of visual field, paresthesias of the extremities, weight loss and anemia and degenerative changes in the liver and kidney. Chronic exposure by petroleum workers to the lighter hydrocarbons has been associated with visual disturbances, damage to the central nervous system, peripheral neuropathies (including numbness and paresthesias), psychological and neurophysiological deficits, bone marrow toxicities (including hypoplasia, possibly due to benzene) and hepatic and renal involvement. Chronic dermal exposure to petroleum hydrocarbons may result in defatting which produces localized dermatoses. Surface cracking and erosion may also increase susceptibility to infection by microorganisms.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital, or doctor.

Eye Contact: Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water). Wash affected areas thoroughly with water (and soap if available). Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

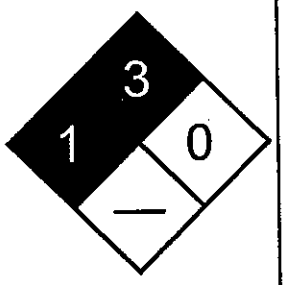
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: -43 °C
Autoignition Temperature: 280 °C
LEL: 1.4% v/v
UEL: 7.6% v/v



Fire Diamond

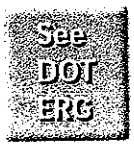
Extinguishing Media: Foam. Dry chemical powder.
Bromochlorodifluoromethane (BCF) (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable. Severe fire hazard when exposed to heat, flame and/or oxidizers. Vapor forms an explosive mixture with air. Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition. Heating may cause expansion/decomposition with violent rupture of containers. On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents, i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc., as ignition may result.

Fire-Fighting Instructions: Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. If safe, switch off electrical equipment until vapour fire hazard removed. Use water delivered as a fine spray to control fire and cool adjacent area. Avoid spraying water onto liquid pools. Do not approach containers suspected to be hot. Cool fire exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures



Small Spills: Remove all ignition sources. Clean up all spills immediately. Avoid breathing vapors and contact with skin and eyes. Control personal contact by using protective equipment. Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind. Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. No smoking, naked lights or ignition sources. Increase ventilation. Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite. Use only

spark-free shovels and explosion proof equipment. Collect recoverable product into labeled containers for recycling. Absorb remaining product with sand, earth or vermiculite. Collect solid residues and seal in labelled drums for disposal. Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs. Use in a well-ventilated area. Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked. Avoid smoking, bare lights, heat or ignition sources. When handling, DO NOT eat, drink or smoke. Vapor may ignite on pumping or pouring due to static electricity. DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling. Avoid contact with incompatible materials. Keep containers securely sealed. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can, metal drum. Packing as recommended by manufacturer. Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area. If inhalation risk of overexposure exists, wear a NIOSH approved organic-vapor respirator. Correct respirator fit is essential to obtain adequate protection. In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves or PVC gloves. Safety footwear. Do NOT use this product to clean the skin.
Respiratory Protection:
Exposure Range >300 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to 15,000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >15,000 to 300,000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >300,000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Ensure that there is ready access to eye wash unit. Ensure there is ready access to an emergency shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Purple, highly flammable, volatile liquid with characteristic sharp odor. Floats on water. Consists of a complex mixture of hydrocarbons with small amounts of residual benzene from the refining operations.

Physical State: Liquid
Odor Threshold: 0.005 ppm
Vapor Pressure (kPa): 53.33 at 20 °C
Vapor Density (Air=1): > 2
Formula Weight: Not applicable.
Specific Gravity (H_2O=1, at 4 °C): 0.72-0.735 at 15 °C
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 38.89 °C (102 °F)
Freezing/Melting Point: Not available
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not available.
Water Solubility: Insoluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of incompatible materials. Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 18800 mg/kg

Irritation
Skin (rabbit): 500 mg/24h mild

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
Biochemical Oxygen Demand (BOD): 8%, 5 days

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible. Follow all applicable federal, state, and local laws. Incinerate residue at an approved site. Recycle containers where possible, or dispose of in an authorized landfil.
BEWARE: Empty solvent, paint, lacquer and flammable liquid drums present a severe explosion hazard if cut by flame torch or welded. Even when thoroughly cleaned or reconditioned, the drum seams may retain sufficient solvent to generate an explosive atmosphere in the drum.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Gasoline
ID: UN1203
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: 139, B33, B101, T8
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** E **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Scott Specialty Gases

AIR LIQUIDE

Material Safety Data Sheets
MSDS No: M-704
Date: 04/15/2008

SUPPLIER ADDRESS: 6141 Easton Road, Bldg. 1
PO Box 310
Plumsteadville, PA 18949-0310

EMERGENCY PHONE NUMBER: (215) 766-8861

1. CHEMICAL PRODUCT

PRODUCT NAME: ISOBUTYLENE IN AIR SYNONYMS: None

2. COMPOSITION, INFORMATION ON INGREDIENTS

				Exposure Limits (PPM)			
Ingredient Name	Formula	CAS #	Concentration	ACGIH TLV	OSHA PEL	MAC	Other STEL
ISOBUTYLENE	C4H8	115-11-7	1-1500 PPM	NE	NE	NE	NE
AIR	O2	132259-10-0	BALANCE	NE	NE	NE	NE

Note: NE = NONE ESTABLISHED S/A = SIMPLE ASPHYXIANT

3. HAZARD INDENTIFICATION

* * * EMERGENCY OVERVIEW * * *
High pressure gas.
May accelerate combustion.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation

ACUTE EFFECTS: None

CHRONIC EFFECTS: None known

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known

OTHER EFFECTS OF OVEREXPORSURE: None

CARCINOGENICITY (US ONLY):

NTP - No
IARC MONOGRAPHS - No
OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air.If breathing has stopped, give artificial respiration.If breathing is difficult, give oxygen.

EYE CONTACT: None

SKIN CONTACT: None

INGESTION: None

IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN

NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: Nonflammable

AUTOIGNITION TEMPERATURE: N/Ap

FLAMMABLE LIMITS: Nonflammable

LOWER:
UPPER:

EXTINGUISHING MEDIA: Use what is appropriate for surrounding fire.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing.Keep fire exposed cylinders cool with water spray.If possible, stop the product flow.

HAZARDOUS COMBUSTION PRODUCTS: None

UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions.Compressed air at high pressure will accelerate the combustion of flammable materials.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area.Remove leaking cylinder to exhaust hood or safe outdoor area.Shut off source if possible and remove source of heat.

SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling.Use suitable hand truck to move cylinders.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store in well ventilated areas.Keep valve protection cap on cylinders when not in use.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation.

EYE / FACE PROTECTION: Safety glasses

SKIN PROTECTION: None

RESPIRATORY PROTECTION: In case of leakage, use self-contained breathing apparatus.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless

ODOR: Odorless

PHYSICAL PRESSURE: Gas

VAPOR PRESSURE: N/Ap

VAPOR DENSITY (AIR=1): 0.991

BOILING POINT (C): N/Ap

SOLUBILITY IN WATER: @20deg.celsius: 18.68cm3/l

SPECIFIC GRAVITY (H2O=1): Gas

EVAPORATION RATE: Gas

ODOR THRESHOLD: N/Ap

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.

CONDITIONS TO AVOID: Storage in poorly ventilated areas.Storage near a heat source.

MATERIALS TO AVOID: Oxidizing agents.

HAZARDOUS POLYMERIZATION: Will not occur.

HAZARDOUS DECOMPOSITION: None

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): NONE ESTABLISHED

LETHAL DOSE 50 (LD50): N/Ap

TERATOGENICITY: N/Ap

REPRODUCTIVE EFFECTS: N/Ap

MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place.

14. TRANSPORT INFORMATION

CONCENTRATION: 1-1500 ppm

DOT DESCRIPTION (US ONLY):

PROPER SHIPPING NAME: Compressed gases, n.o.s.
HAZARD CLASS: 2.2 (nonflammable)
INDENTIFICATION NUMBER: UN1956
REPORTABLE QUANTITIES: None
LABELING: NONFLAMMABLE GAS

ADR / RID (EU Only): Class 2, 1A

SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Minor component is not listed in appendix A of 29 CFR 1910.119 as a highly hazardous chemical.

TSCA: Mixture is not listed in TSCA inventory.

SARA: The threshold planning quantity for this mixture is 10,000 lbs.

EU NUMBER: N/Ap

NUMBER IN ANNEX 1 OF DIR 67/548: Mixture is not listed in annex 1.

EU CLASSIFICATION: N/Ap

R: 20

S: 9

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

ABBREVIATIONS: N/Ap - Not Applicable N/Av - Not Available SA - Simple Asphyxiant NE - None Established

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Attachment C-3

PPE Checklist

Description (Specify Material or Type in Box)	Level Of Protection R = Required O = Optional	
	D	C
Body		
Coveralls	O	NA
Chemical Protective Suit	NA	R
Splash Apron	O	NA
Rain Suit	O	NA
Traffic Safety Vest (reflective)	R (as required)	R (as required)
Head		
Hard Hat (if does not create other hazard)	R	R
Head Warmer (depends on temperature and weather	O	O
Eyes & Face		
Safety Glasses (incorporate sun protection as necessary)	R	NA
Goggles (based on hazard)	O	NA
Splash Guard (based on hazard)	O	NA
Ears		
Ear Plugs	R (as required)	R (as required)
Ear Muffs	O	O
Hands and Arms		
Outer Chemical Resistant Gloves	R (Nitrile)	R (Nitrile)
Inner Chemical Resistant Gloves (i.e. Nitrile)	NA	R (Nitrile)
Insulated Gloves	O	O
Work Gloves	O	O
Foot		
Safety Boots (steel toe and shank)	R	R
Rubber, Chemical Resistant Boots	NA	R
Rubber Boots	O	O
Disposable Boot Covers	O	O
Respiratory Protection (indicate cartridge type where applicable)		
Dust Protection	O	NA
1/2 Mask APR	NA	NA
Full Face APR	NA	R
Full Face Canister APR	NA	NA
Powered APR	NA	NA
Other Supplies		
First Aid Kit	R	R
Fire Extinguisher	R	R
Mobile Phone	R	R
Traffic Cones (as required)	R	R
Walkie Talkies	O	O
Water or Other Fluid Replenishment	R	R
Eye Wash Station	O	O
Eye Wash Bottle	R	R
Wash and Dry Towelettes	O	O
Sunscreen (SPF 15 or higher)	O	NA
Insect Repellant	O	NA

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Attachment C-4

Tailgate Briefing Sign-in Log

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Site Activities Tailgate Safety Briefing Sign-in Log

Project Number:		**Project Name:**	
Date:		**Time:**	
Briefing Conducted by:	**Signature:**	**Company:**	

This sign-in log documents the tailgate briefing conducted in accordance with the HASP. Personnel who perform work operations on Site are required to attend each briefing and to acknowledge receipt of each briefing, daily.

TOPICS COVERED (check all those covered):

☐ General PPE Usage	☐ Confined Space	☐ Excavation Safety
☐ Hearing Conservation	☐ Slips, Trips, Falls	☐ Confined Space
☐ Respiratory Protection	☐ Heat Stress	☐ Traffic Safety
☐ Personal Hygiene	☐ Thermal Stresses	☐ Changes to the HASP
☐ Exposure Guidelines	☐ Site Control	☐ Initial Review of Hazard Evaluation
☐ Decon Procedures	☐ Work Zones	☐ Other (specify):
☐ Emergency Procedures (include route to hospital)	☐ Lockout/Tagout	☐ Other (specify):

Personnel Sign-in List

Printed Name	Signature	Company Name

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Attachment C-5

Real Time Air Monitoring Log

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Real Time Air Monitoring Data Collection Form

Document all air monitoring conducted on the Site below based on Section E of the HASP. Keep this form with the project files.

Site Name: _____ Date: _____

Instrument: _____ Model: _____ Serial #: _____

Calibration Method: (material used, settings, etc.)	
Calibration Results:	
Calibrated By:	

Activity Being Monitored	Compounds Monitored	Time	Reading	Action Required? Y/N

Describe Any Actions Taken as a Result of this Air Monitoring and Why:

_____

_____

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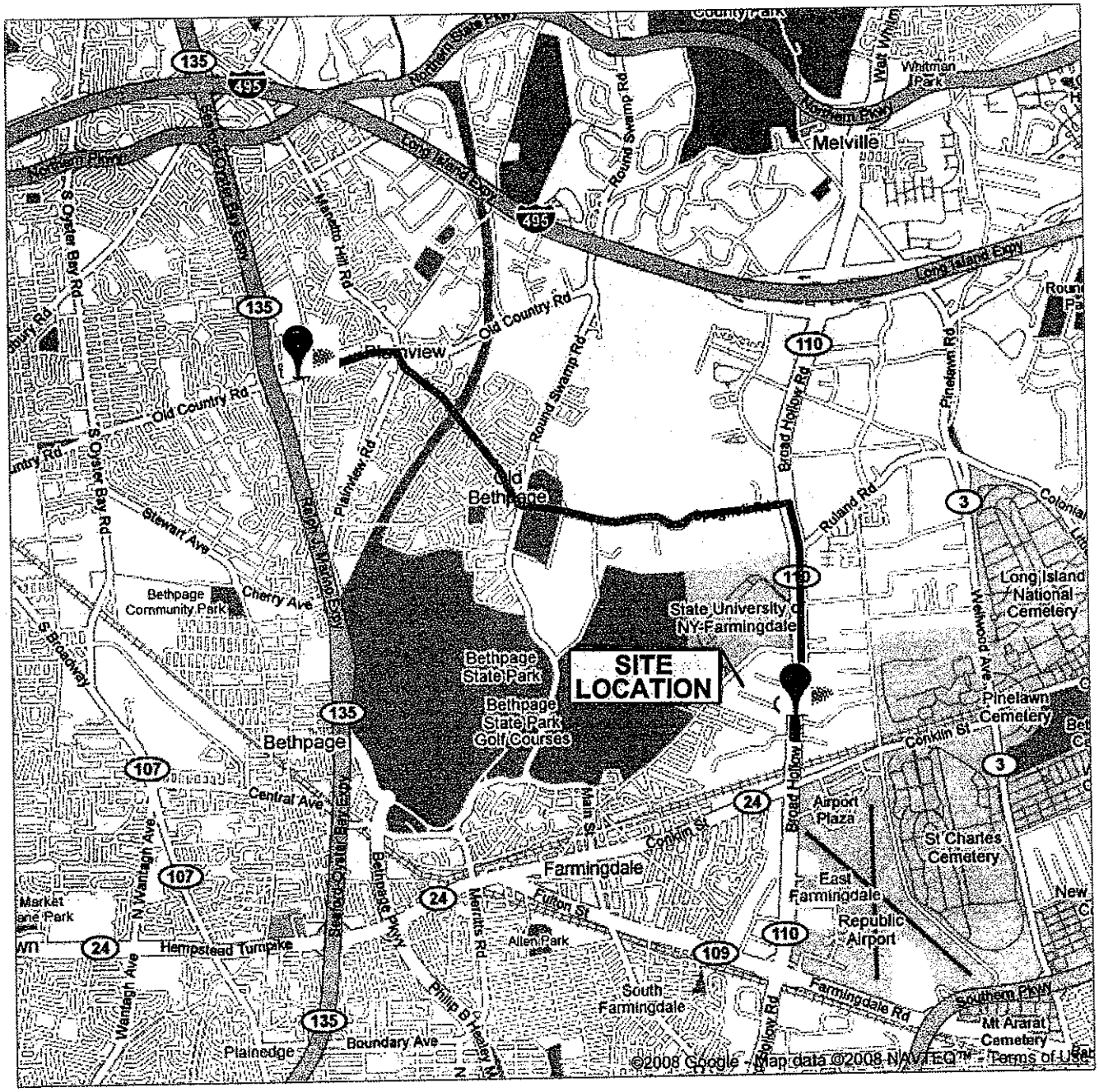
Attachment C-6

Map to the Hospital

Google Maps

Start **1966 Broadhollow Rd**
Farmingdale, NY 11735
End **888 Old Country Rd**
Plainview, NY 11803
Travel **5.0 mi – about 13 mins**



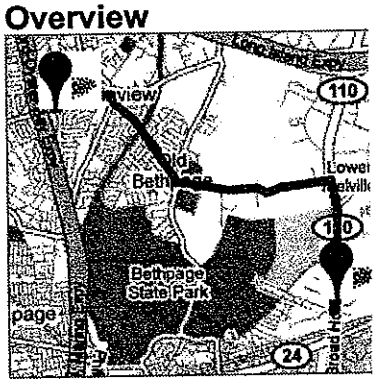
1966 Broadhollow Rd
Farmingdale, NY 11735
Drive: 5.0 mi – about 13 mins

1.	Head **south** on **Broad Hollow Rd/RT-110 S** toward **Price Pkwy**	0.1 mi
2.	Make a **U-turn** at **Price Pkwy**	1.4 mi 4 mins
3.	Turn **left** at **Spagnoli Rd**	1.6 mi 5 mins
4.	Continue on **Old Bethpage Rd**	1.1 mi 3 mins
5.	Slight **right** at **Plainview Rd**	0.1 mi
6.	Turn **left** at **Old Country Rd**	0.6 mi 2 mins

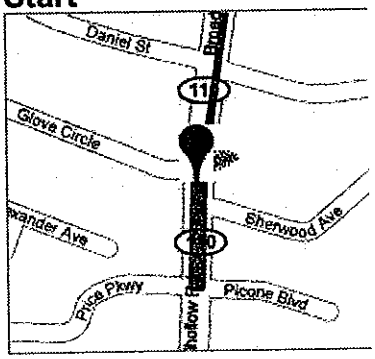
888 Old Country Rd
Plainview, NY 11803

These directions are for planning purposes only. You may find that construction projects, traffic, or other events may cause road conditions to differ from the map results.

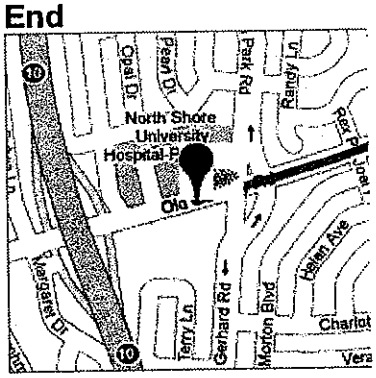
Overview



Start



End



ARCADIS

Attachment C-7

Safety Modules

CHEMICALS AND OTHER HAZARDOUS SUBSTANCES

Cis-1,2-Dichloroethylene (DCE):

Breathing high levels of 1,2-dichloroethene can make you feel nauseous, drowsy, and tired; breathing very high levels can result in death. Animals that ingested extremely high doses of *cis*- or *trans*-1,2-dichloroethene died. Lower doses of *cis*-1,2-dichloroethene caused effects on the blood, such as decreased numbers of red blood cells, and also effects on the liver.

The long-term (365 days or longer) human health effects after exposure to low concentrations of 1,2-dichloroethene aren't known. One animal study suggested that an exposed fetus may not grow as quickly as one that hasn't been exposed.

Exposure to 1,2-dichloroethene hasn't been shown to affect fertility in people or animals.

1,2-Dichloroethene, also called 1,2-dichloroethylene, is a highly flammable, colorless liquid with a sharp, harsh odor. It is used to produce solvents and in chemical mixtures. You can smell very small amounts of 1,2-dichloroethene in air (about 17 parts of 1,2-dichloroethene per million parts of air [17 ppm]).

In the environment:

- 1,2-Dichloroethene evaporates rapidly into air.
- In the air, it takes about 5-12 days for half of it to break down.
- Most 1,2-dichloroethene in the soil surface or bodies of water will evaporate into air.
- 1,2-Dichloroethene can travel through soil or dissolve in water in the soil. It is possible that it can contaminate groundwater.
- In groundwater, it takes about 13-48 weeks to break down.
- There is a slight chance that 1,2-dichloroethene will break down into vinyl chloride, a different chemical which is believed to be more toxic than 1,2-dichloroethene.

Chemical Name	Physical Description	Health Effects	TLV 8-hr TWA	Physical Properties	Special Precautions
Cis-1,2-DCE	Colorless liquid with a slightly acrid, chloroform – like odor	Irritant to eyes, skin, and lungs; Effects nervous system	200 ppm	Flammable liquid LEL 5.6% Flashpoint – 36F	Incompatible with strong oxidizers like Hydrogen Peroxide

Gasoline

Gasoline is a complex mixture of hydrocarbons and additives used primarily as a motor fuel. Vapor pressure of gasoline is moderate to high. The lower explosive limit for gasoline is 1.1 percent concentration in air. Fire and explosion hazards can be significant in enclosed spaces where airborne concentrations may accumulate.
Exposures to a high concentration of gasoline vapor may cause unconsciousness, coma, and possibly death from respiratory failure. Exposure to low concentrations of gasoline vapor may produce flushing of the face, slurred speech, and mental confusion. Gasoline is irritating to the skin. Prolonged skin contact may cause drying and dermatitis.
Gasoline components and additives can present significant hazards. The aromatic compounds benzene, toluene, ethylbenzene, and total xylenes (BTEX) are the greatest concern on this project. Some additives used to control octane (e.g., methyl tertiary butyl ether [MTBE]), oxygenation (e.g., alcohols and

MTBE), and water scavenging (e.g., ethylene glycol methyl ether [EGME]) can also present significant hazards as a result of prolonged inhalation or skin exposure. In the past, tetra-ethyl and tetra-methyl lead, both of which have been identified as carcinogens that present moderate skin contact hazards, were added to gasoline for anti-knock control.

Perchloroethylene (PCE):

High concentrations of perchloroethylene (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death.

Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used perchloroethylene to get a "high."

In industry, most workers are exposed to levels lower than those causing obvious nervous system effects. The health effects of breathing in air or drinking water with low levels of perchloroethylene are not known.

Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that perchloroethylene can cause liver and kidney damage. Exposure to very high levels of perchloroethylene can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

Perchloroethylene is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is also used to make other chemicals and is used in some consumer products.

Other names for perchloroehtylene include tetrarchloroethylene, PCE, and tetrachloroethene. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell perchloroethylene when it is present in the air at a level of 1 part perchloroethylene per million parts of air (1 ppm) or more, although some can smell it at even lower levels.

- Much of the perchloroethylene that gets into water or soil evaporates into the air.
- Microorganisms can break down some of the perchloroethylene in soil or underground water.

In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain.

Chemical Name	Physical Description	Health Effects	TLV 8-hr TWA	Physical Properties	Special Precautions
PCE	Colorless liquid with a chloroform-like odor	Irritant to eyes, skin, and lungs; Effects nervous system	25 ppm	Noncombustible liquid	Animal carcinogen Chlorinated solvent

Petroleum Products

Some components of petroleum products are known carcinogens. Petroleum products are also flammable and combustible. Hazards posed by these materials include skin exposure, fire, and explosion. All on-site personnel will wear protective clothing and show caution when in areas where potential flammable and combustible liquids may be encounter. No smoking will be allowed in the vicinity

of these materials. Petroleum products also may contain volatile organic compounds and semi volatile organic compounds.

Trichloroethylene (TCE):

Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Skin contact with TCE for short periods may cause skin rashes.

TCE is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

TCE is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

- TCE dissolves a little in water, but it can remain in ground water for a long time.
- TCE quickly evaporates from surface water, so it is commonly found as a vapor in the air.
- TCE evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time.
- TCE may stick to particles in water, which will cause it to eventually settle to the bottom sediment.

TCE does not build up significantly in plants and animals.

Chemical Name	Physical Description	Health Effects	TLV 8-hr TWA	Physical Properties	Special Precautions
TCE	Colorless liquid with a chloroform-like odor	Irritant to eyes, skin, and lungs; Effects nervous system	50 ppm	Combustible liquid LEL 8%	Animal carcinogen Chlorinated solvent

Cold Stress

The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds (wind chill), dampness or cold water. One, all or a combination of these factors can cause cold-related hazards. Cold stress, including frostbite and hypothermia, can result in severe health effects. Exposed skin is highly susceptible to wind chill and low temperatures.

Engineering controls should be utilized whenever possible to protect workers from cold related hazards. For example, on-site heat sources, heated shelter, work areas shielded from drafty or windy conditions, and the use of thermal insulating material on equipment handles.

Effects arising from cold exposure will be minimized by the following control measures:

- Personnel will be trained to recognize cold stress symptoms.
- Field activities will be curtailed or halted if the equivalent chill temperature is below 20° F.
  - As much as possible, work that exposes personnel to the cold will be done during the warmest hours of the day.
  - Inactivity in cold conditions will be kept to a minimum.
- Frequent short breaks in warm, dry shelters will be taken.
- Vehicles will be equipped with supplies in case the vehicle becomes inoperable (e.g., blanket, dry clothing, water, food, a shovel, etc.).

The following PPE will be provided during work in cold environments

- Workers will be provided with insulated dry clothing when the equivalent chill temperature is less the 30° F.
- Feet, hands, the face, and the head should be protected (40% of the body's heat can be lost when the head is exposed).
  - Foot and hand wear may also need to be waterproof.
- Clothing should be layered so that adjustments can be made to changing environmental temperatures and conditions. For example, an outer layer to break the wind, a middle layer that will absorb sweat and retain insulation when wet, and an inner layer that allows ventilation.

Cold-Related Illnesses

Hypothermia: Hypothermia occurs when the body temperature falls to a level where normal muscular and cerebral functions are impaired. Although it usually occurs in freezing air and water temperatures, it can occur in any climate if a person's temperature falls below normal. Symptoms should not be ignored and a supervisor, or whomever is available, should be notified as soon as hypothermia is suspected.

Initially, symptoms may include shivering, an inability to do complex motor functions, sluggishness and mild confusion as the body temperature drops to around 95° F. As the body temperature falls, speech may become slurred and behavior may be irrational, simple motor functions may be difficult to do and a state of "dazed consciousness" may exist. In severe states (below 90° F), heart rate, blood flow and breathing will slow. Unconsciousness and full heart failure can occur.

First Aid:

On land:

- Call for emergency help and move the victim (unless other injuries prohibit their being moved) to a warm, dry area and replace wet clothing with warm, dry clothing or a blanket. Move the person carefully because movement can increase the irritability of the heart.

- If the person is conscious and lucid, warm liquids can be provided but **not** alcohol or caffeinated drinks. If possible, have them to move their arms and legs to create muscle heat.
- If the person is unconscious or unable to assist, place warm bottles/packs in the person's arm pits, groin, neck and head areas.
- **Do not** rub the person's body or place them in warm water.

In water (the body loses heat up to 25 times faster than on land):

- Call for emergency help and get the victim out of the water. Move the person carefully because movement can increase the irritability of the heart.
- **Do not** remove clothing- button, buckle, zip and tighten collars, cuffs, shoes and hoods as the water trapped next to the body provides a layer of insulation that may slow the loss of heat.
- If it is you in the water, **do not** swim unless a floating object or person can be reached quickly as swimming uses the body's heat and reduces survival time by about 50%.
  - If you are in the water and is not possible to get out, conserve body heat by folding arms across the chest, keeping thighs together, bending knees and crossing ankles. If another person is in the water with you, huddle together.

Frostbite: Frostbite occurs when the skin actually freezes, and deep frostbite can affect deeper tissues such as tendons and muscles. Frostbite usually occurs when temperatures drop below 30° F, but wind chill effects can cause frostbite at above-freezing temperatures. The ears, fingers, toes, cheeks and nose are the most commonly affected body parts.

Initially, symptoms include an uncomfortable sensation of coldness. Tingling, stinging or an aching feeling of the exposed area is followed by numbness. Frostbitten areas appear white and cold to the touch and with deeper frostbite, the area becomes numb, painless and hard and can turn black.

First Aid:

- Seek medical attention as soon as possible and treat any existing hypothermia first.
- Warm liquid can be provided, but **not** alcohol or caffeinated drinks such as tea and coffee.
- **Do not** rub the affected areas, but cover them with dry, sterile gauze or soft, clean bandages.
- **Do not try rewarming the affected area if you have not been specifically trained to do so** and/or if there is a chance the affected area will get cold again.

Trench Foot: Trench Foot is caused by a continuous exposure to a wet, cold environment. Symptoms include tingling and/or itching sensation, burning pain and swelling and, in more extreme cases, blisters.

First Aid:

- Seek medical attention as soon as possible and move the victim to a warm, dry area.
- Affected tissue can be treated with careful washing and drying, slight elevation. **Do not try rewarming the affected area if you have not been specifically trained to do so.**

Cold Stress Monitoring

Monitoring for cold stress is difficult and will be completed by the SSO by monitoring for symptoms and the weather conditions on a daily basis. The following table may be used as a guideline for establishing a work/rest regimen.

TABLE THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT

Air Temperature-Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	Normal	1	Normal	1	75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	Normal	1	75 min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to –29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

Compressed Gas Cylinders

- Valve protection caps should be in place when compressed gas cylinders are transported, moved, or stored. Never move a compressed gas cylinder with just a regulator in place.
- Cylinder valves should be closed when work is finished, when cylinders are empty, or when they are moved.
- Compressed gas cylinders should be secured in an upright position at all times.
- Compressed gas cylinders should be shielded from or secured a safe distance away from any welding operation.
- Compressed gas cylinders should be placed where they cannot become part of an electrical outlet.
- Regulators should be in a proper working order while in use.
- While in storage, oxygen and acetylene (or other fuel gas) cylinders should be separated from each other by a distance of 20 feet or by a barrier that is at least five feet tall and has a one-hour fire rating.
- Compressed gas cylinders should not be taken into confined spaces.
- Compressed gas cylinders should be moved by using a hand truck, forklift, or cylinder pallet.
- Steel-toed safety shoes must be worn when moving or handling compressed gas cylinders.

Use of Drums and Containers

OSHA defines "anything that holds hazardous chemicals except pipes and piping systems" as a container (48 FR 228 p. 53335). OSHA does not concern itself with non-hazardous materials; however, that does not mean that drums or containers containing non-hazardous materials cannot cause injury to workers. Examples of non-hazardous materials stored in drums and containers would include a drum of molasses rolling or falling and striking a worker.

Training

Prior to any movement of drums or containers containing hazardous materials or otherwise posing a threat to the safety of employees, all employees are required to be informed of the potential hazards associated the contents of the drums or containers.

As applicable, additional activities requiring appropriate training of employees include:

- Sampling procedures
- Communication methods
- Methods for relieving pressure from drums and containers or for shielding when pressure cannot be relieved from a remote location
- Emergency response to accidents on site.
- Characterization of wastes to be bulked, and
- Use of monitoring equipment.

Labeling of Drums and Containers

Drums and containers shall be identified and classified prior to packaging for shipment.

Procedures for Handling Drums and Containers

A. Handling Drums and Containers

Where containers of capacity greater than 5 gallons are used for containerizing chemical products or waste materials, handling of the containers will be accomplished in accordance with the following:

- When not in use, drums/containers will be covered with tight fitting lids.
- At the conclusion of each work shift all drums/containers will be placed in a designated storage area. This area will be properly marked and secured.
- Mechanical or powered drum handling equipment will be used to move "filled" drums/containers. Manual handling of the drums leads to musculo-skeletal injuries and will be avoided to the maximum extent possible.

B. Opening Drums and Containers

Only a couple of pounds of "built up" pressure to cause a loosened fitting to fly into the air like a rocket. This projectile can cause injury to site workers, and can puncture adjacent containers or drums, causing rupture and leakage. If the drum or container is filled to or near the level of the opening, material can spew from the opening causing injury to site personnel, formation of hazardous/flammable atmospheres at the work site and/or environmental damage. The procedure for opening of drums and containers needs to incorporate the minimum safeguards listed below:

- Employees not actually involved in the opening of the drum or container must be kept a safe distance from the drum or container during the process of opening it.

- Where there is the reasonable probability of a flammable atmosphere being present or developing on site, all equipment and tools must be of a type to prevent sources of ignition (non-sparking, explosion proof, intrinsically safe) and grounding/bonding of containers needs to be considered.

- If the pressure within a drum or container cannot be relieved from a remote location, the employee opening the drum or container needs to be protected by an appropriate shield to reduce the risk of injury.

- Drums and containers are not stepladders. Employees are not allowed to stand on or work off of drums or containers.

- Material handling equipment used to move drums and containers needs to selected, positioned and operated in a manner that minimizes the potential for the equipment to act as a source of ignition in the event that a drum or container should rupture.

- When a drum or container exhibits signs of over-pressurization such as swelling or bulging, the drum or container is not to be moved until the cause of the over-pressurization has been determined and proper containment procedures have been implemented.

- It is necessary to limit the number of areas where drums and containers are staged in order to identify and classify them.

- Areas where drums and containers are staged need to be provided with adequate routes for access and egress from the staging area.

Use of Approved Drums or Containers

Drums and containers are required to meet the appropriate DOT, OSHA and EPA regulations for the materials that they contain. Large containers or drums shall carry either a DOT approval or a nationally recognized testing laboratory approval or both. The use of approved drums and containers provides some assurance that the drum or container will not fail due to incompatibility with the stored material and that the drum or container is structurally suitable for designated duty.

Drum Condition

The following apply to the assessment of drum condition:

- When practical, drums and containers must be inspected and their integrity assured prior to being moved. Drums and containers that cannot be inspected prior to being moved due to storage conditions (i.e. buried, in a pile, stacked several tiers high, etc.) must be moved to an accessible location and inspected prior to further handling.

- Drums and containers that cannot be moved without risk of rupture, leakage or spillage must be emptied into a sound container using a device classified (i.e. intrinsically safe or explosion proof for the class of flammable material) for use around the material being transferred.

- Drums and containers are to be opened in a manner that safely relieves excess internal pressure.

- If crystalline material is noted on any container, the contents of the container are to be handled as a shock-sensitive waste until positive identification of the contents determines otherwise.

Other Considerations

Unlabeled drums and containers must be considered to contain hazardous substances and are to be handled accordingly until positive identification of the contents has been made.

Polyethylene drums and containers are not equipped with a means for electrical grounding. When transferring flammable materials, the polyethylene container (or any other container for that matter) needs to

be equipped with a mechanism that allows for grounding. A grounded suction pump (approved only) or a grounded metallic self-closing faucet can be used to accomplish safe transfer of flammable materials from these containers.

Where leaking drums or containers may be present, or ruptures or spills may occur, U.S. DOT specified salvage drums or containers must be available on site along with suitable quantities of an appropriate absorbent material.

Electrical Hazards

Electrical safety practices to prevent electrical injuries to employees and to protect the property will be utilized at all times.

Only licensed electricians will adapt, modify, install or add to electrical systems, or work on electrical systems over 120V. If an explosive environment is present or there is potential for an explosive environment, the licensed electrician must have experience in Class I, Division I environments.

Maintenance of electrical systems or replacement of parts on existing electrical systems of 120 V or less, may be done by ARCADIS personnel who have been appropriately trained in electrical safety and Lockout/Tagout. ARCADIS personnel **will not** adapt, modify, install or add to electrical systems or work on electrical systems greater than 120V.

Hazards

- Electrocution
- Electric Shock
- Burns
- Fire

Definitions

- Arc/Flash: An electrical discharge through the air from a high voltage source to a ground.
- Barrier: A physical obstruction intended to prevent contact with energized lines or equipment.
- Bond: An electrical connection from one conductive element to another to minimize potential (voltage) differences, provide a pathway for fault current, or mitigate leakage current.
- Circuit Breaker: A device designed to open and close a circuit manually, and to open the circuit automatically at a preset overcurrent without damaging itself, when properly sized for its current rating.
- Conductor: A material suitable for carrying an electric current, usually in the form of a wire, cable or bus bar.
- Dead: Free from any electrical connection to a voltage source and at the same electrical potential as a ground.
- Explosion-proof: Enclosed in a casing that will withstand the explosion of a specified gas or vapor, and will not ignite a surrounding flammable atmosphere.
- Fuse: An overcurrent protection device with a circuit-opening part fusible part.
- Ground: A conductive body (usually earth) to which an electrical potential is referenced, or the conductive connection from a circuit or electrical equipment to a ground.
- Ground Fault Circuit Interrupter (GFCI): A device that interrupts the electrical current flow to a load when the fault current to ground exceeds the set overcurrent in the interrupter.
- High Voltage: Voltage in excess of 15,000 volts. Note: This definition varies widely between countries; for example, Australia defines high voltage as greater than 650 volts.
- Insulated: Separated form other conducting surfaces by a dielectric substance (including air space) that provides high resistance to current flow.
- Jumper: A reliable conductor used to maintain conductivity between metal parts that must remain electrically connected.
- Live: Connected to a source of electrical energy
- Low Voltage: Electrical potential between 0 and 600 volts.
- Medium Voltage: Electrical potential between 600 and 15,000 volts.

- Qualified Person: A person who through experience and/or training is familiar with the particular operation to be performed and the hazards involved. A qualified electrician must be trained and licensed where applicable to perform electrical installation and repair work.

Responsibilities

Facility Manager

- Identify tasks to be completed only by qualified electricians, and ensure that they perform the work.
- Identify areas that present electrical hazards and provide signage and security to prevent unauthorized entry.
- Ensure that the work permits required for a particular task are properly completed.
- Ensure that employees are trained in basic electrical safety as part of their orientation.
- Ensure that specialized electrical safety equipment is available as needed.
- Ensure that electrical facilities are installed properly and in a timely manner.
- Conduct a job briefing for any work performed in an electrical substation.

Safety Representative

- Arrange and document employee training in basic electrical safety during orientation.
- Ensure that qualified electricians perform all electrical installation and repair.
- Ensure that Qualified Electricians receive the required training and document certifications and licenses.
- Ensure that employees are trained in pole-top rescue procedures if they work with overhead power lines.

Qualified Electricians

- Install all electrical equipment including motors, generators, wiring and controls so that exposed live parts are properly guarded or insulated to provide adequate protection to operating personnel.
- Install all equipment with sufficient room (three feet minimum) for safe inspection, repair and replacement.
- Ensure the safety of themselves and employees using the following precautions:
    a) Install Ground Fault Circuit Interrupters (GFCI) at all outdoor locations and wet areas.
    b) Test utility extension cords and tools quarterly for continuity and grounding.
    c) Repair, remove, lock open or tag defective electrical equipment to prevent its use.
    d) Follow all steps of the Lockout/Tagout procedure.
    e) Return enclosure doors, covers, and guards to safe operating positions when electrical repairs have been completed.
    f) Regularly inspect and properly store all specialized electrical tools and personal protective equipment.

Employees

- Follow facility electrical safety and Lockout/ Tagout procedures.
- Inspect all tools and extension cords prior to use. Do not use defective equipment.
- Treat all circuits as live until their condition has been verified.
- Obey all warning and caution signs.
- Do not defeat electrical safety interlock switches on equipment or tools.
- Do not enter any transformer or electrical yard area without a Qualified Electrician, and then only when specifically authorized to do so.

- Be aware of overhead lines when handling gin poles or other masts.
- Avoid contact with hot surfaces on motors or other electrical equipment.

Procedures

BASIC SAFETY CONSIDERATIONS

- Treat all electrical circuits as live until their condition has been verified. Treat even low voltages as dangerous.
- Do not work on any live circuit without a written plan approved by a Qualified Electrician.
- Do not work on electrical equipment with wet hands or standing in wet areas.
- Work on low voltage systems must be performed by at least two people, one of whom must be a Qualified Electrician.
- Do not install fuses or circuit breakers larger than the circuit rating.
- Conduct a tool count before beginning work and after work is completed.
- Use Lockout/Tagout procedures whenever working on electrical equipment.
- Use only approved and properly rated lighting devices and tools in vessels, boilers and confined spaces.
- Do not remove the globes of explosion-proof lighting except when cleaning and replacing bulbs. Disconnect the circuit before changing light bulbs. Do not use oversized lamps in these fixtures.
- If a rescue from electrical equipment is required, use the following precautions:
    a) Disconnect the circuit if possible before attempting the rescue.
    b) Make sure you are standing on a dry surface.
    c) Use a dry belt, rope, coat or other non-conductive material to loop over the victim and drag them away from the contact.
    d) Assess the condition of the victim and apply first aid and/or CPR if qualified, or get help if not qualified.
    e) Use the following precautions when using electrical cords:
    f) Visually inspect electrical cords before each use for fraying, cuts or other damage.
    g) Do not use extension cords for permanent installations.
    h) Keep extension cords properly covered or raised overhead to prevent tripping hazards and damage from traffic.
    i) Extension cords or cables shall not be secured with staples, hung from nails, or suspended by bare wire
    j) Use properly grounded, approved outlets and connections. If an outlet is needed, notify the First Line Supervisor.
    k) Only use electrical cords that are equipped with a grounding pole on the plug. Never remove a grounding pole from a cord.
    l) If a cord that is not equipped with a grounding pole must be used, the electrical equipment must be double insulated.
    m) Test all cords for continuity and grounding every quarter.
- Install all electrical equipment including motors, generators, wiring and controls so that exposed live parts are properly guarded or insulated to provide adequate protection to operating personnel.
- Portable electrically driven tools must be grounded with a three-wire circuit or double insulated. Explosion-proof tools are required in hazardous areas.
- Drum racks for flammable and combustible liquids must be grounded, and drums on the racks must be bonded to the racks or directly to the ground.
- Inspect all permanent grounds annually and document the inspection results.
- In wet locations:
    a) Plugs and receptacles shall be kept out of water unless of an approved submersible type.

b) Where a receptacle is used in a wet location it shall be contained in a weatherproof enclosure, the integrity of which is not affected when an attachment plug is inserted.
c) All temporary lighting strings in outdoor or wet locations (such as tunnels, culverts, valve pits, floating plant, etc.) shall consist of lamp sockets and connection plugs permanently molded to the hard service cord insulation.

SUBSTATION-SPECIFIC RULES

In addition to the basic electrical safety guidelines described above, the following guidelines are required for working on or near electrical substations.

- The First Line Supervisor will conduct a job briefing that covers the hazards associated with electrical work on any substation, special procedures or precautions to be taken, required PPE and methods to control energy sources.
- Routine or repetitive tasks may require only a short discussion. If unusual conditions are anticipated or develop, or the work is particularly hazardous, a more detailed safety briefing should be conducted.
- Erect safety barricades at proper distances from the work to keep unauthorized workers away from the work area.
- Visitors may only enter a substation when escorted by a Qualified Electrician, cleared by the First Line Supervisor, and after a briefing on the hazards and minimum distances involved in the work to be done. Visitors must sign the substation log book and wear head protection while in the substation.
- Before grounding equipment, visually verify that all de-energized equipment has been opened and properly cleared, danger tags and lockouts have been installed, and personnel protective grounds are installed.
- Verify by a one-line circuit diagram that all electrical feedback sources are disabled and are included in the tagout procedure.
- For direct buried distribution cables, verify the proper clearance distance from all network voltage sources. Make sure line potential and station transformers are included.
- Verify the circuit tester operation by testing an energized circuit before and after testing the circuit to be grounded. Test each phase with a test device such as a "hot horn" at the rated voltage immediately before applying grounds.
- The minimum working clearance from energized parts is ten feet. Equipment may be moved to within but not less than 10 feet of energized parts if the move is observed by a Qualified Electrician. Equipment may be operated within 10 feet of energized parts only under the supervision of a Qualified Electrician, with proper barricades and warning signs erected and personal grounding devices installed. Only personnel required to complete the work may contact the mechanized equipment.

- Contracted equipment and operators must stay outside the minimum clearance distances as follows for the operating voltages shown:

Nominal Voltage between Phases	***Minimum Clearance Distance***
Up to 50 kV	10 feet
57 kV	10 feet 3 inches
69 kV	10 feet 8 inches
115 kV	12 feet 2 inches
230 kV	16 feet
500 kV	25 feet

- All energized sources in the area must be de-energized and tagged by a qualified safety watch, and protective grounds must be installed. A full-time safety watch must be present during all work to enforce the minimum clearance distance.
- Install and remove protective grounding connections as follows:
    a) At least two people, one of which is a Qualified Electrician, must install and remove grounds.
    b) Portable protective grounds for personnel are required for any person to come within the minimum working distance of a substation circuit. The grounds must be visible from the work site and should be installed as close as practical to the work. They must be installed on all electrical phases.
    c) Inspect personal ground systems before using them. Do not use grounding components that have broken or frayed wires or damaged clamps. Tag the grounding equipment as defective and replace or repair it.
    d) Ground systems must be tested for continuity using a micro - ohm tester annually. The inspection date must be entered on the equipment tag.
    e) Treat all electrical circuits as live and energized until they are properly grounded.
    f) The protective grounding cables should be tied together so that all phases are bonded into a single connected ground at one point. This should protect workers from all electrical sources.
    g) Do not use a disconnect switch, circuit breaker, transformer or fuse as part of a protective grounding circuit.
    h) Connect the ground end of the protective ground first, making sure to maintain electrical and mechanical integrity of the connection. Apply ground cables to the nearest connector or bus, and work outward from the ground end until all phases are grounded. Disconnect the ground in the reverse order.
    i) When working in an energized substation, ground manlifts, metal scaffolds, cranes and oil processing equipment to the substation grounding system or to a secure ground rod.
    j) Capacitor installations must be grounded on both the line and neutral sides to discharge any stored current. Portable protective grounds must also be installed. Ground each terminal on the capacitor for at least five seconds before handling. Short circuit capacitors with an approved hotstick before storing or transporting.

- When grounding rod and pipe electrodes:
    a) Electrodes of rod or pipe shall be free from non-conducting coatings and, if practicable, shall be embedded below permanent moisture levels.
    b) Grounding rod and pipe electrodes shall be in unbroken 2.4 m (8 ft) lengths and driven to full depth: where rock bottom is encountered, the electrode shall be driven at an angle not to exceed 45o from the vertical or shall be buried in a trench that is at least 0.75 m (2.5 ft) deep.
    c) A single electrode which does not have a resistance to ground of 25 ohms or less, shall be augmented by one additional electrode spaced no closer than 1.8 m (6 ft) to the first electrode.
    d) Electrodes of rods of iron or steel shall be at least 1.6 cm (5/8 in) diameter; nonferrous rods, or their equivalent, shall be listed by a nationally recognized testing laboratory and shall be at least 1.3 cm (0.5 in) diameter.
    e) Electrodes of pipe or conduit shall be at least 1.9 cm (3/4 in) trade size; pipes and conduit of iron or steel shall have the outer surface galvanized or otherwise metal-coated for corrosion control.

- Conductors used for bonding or grounding stationary and movable equipment shall be of ample size to carry the anticipated current.
    a) When attaching bonding and grounding clamps or clips, a secure and positive metal-to-metal contact shall be made.
    b) The ground end shall be attached first; the equipment end shall be attached and removed by insulated tools or other suitable devices.
    c) When removing grounds, the grounding device shall be removed from the line or equipment first, using insulated tools or other suitable devices.
    d) Bonding and grounding attachments shall be made before systems are activated and shall not be broken until after systems are deactivated.

- When operating or working around storage batteries, use the following precautions:
    a) Wear acid-resistant gloves, aprons, a face shield and safety goggles.
    b) Use insulated tools when installing or maintaining batteries.
    c) Ventilate the battery room to prevent a buildup of hydrogen or oxygen vapor. Be sure the ventilation system is working before entering a battery storage room.
    d) Do not connect or disconnect battery cables while the battery system is under load.
    e) Do not smoke or permit any ignition source near storage batteries.
    f) An eyewash station must be located near storage batteries for employee use.
    g) Do not clean battery connections with brushes or other devices that may short out or damage the cell.

WORK AROUND ENERGIZED EQUIPMENT

The following guidelines must be followed when working on or around energized equipment:

- Remove all metal watches, keys, rings, or other jewelry when working within reach of energized equipment.
- Wear clothing made from natural fabrics such as cotton. Do not wear clothing made of acetate, nylon, rayon, or polyester as these materials may worsen injuries from electric arcs.
- Before cutting the ground or neutral wire of any circuit, use appropriately sized jumpers to connect the ground leg of the section to be opened.
- Opened pad-mounted transformers must be guarded at all times by a qualified person.
- Capacitor installations must be grounded on both the line and neutral sides to discharge any stored current. Ground each terminal on the capacitor for at least five seconds before handling. Short circuit capacitors with an approved hotstick before storing or transporting. Leave the short in place until the capacitor is returned to service.

- When connecting de-energized circuits to energized circuits, connect the de-energized part first. Remove the source end first when disconnecting de-energized circuits from energized circuits.
- Stay as far away as possible from a fuse when opening or closing it. Wear safety glasses, hearing protection and head protection.
- Wear personal protective equipment such as insulating gloves, hoods, grounding devices and special tools that are designed and rated for the task at hand. Maintain protective equipment in good condition; test suspect equipment and remove it from service if defective. Use rubber protective devices for voltages of 5,000 volts or less. They may only be used up to 15,000 volts for situations where no other satisfactory protective device has been developed.
- Mobile equipment and vehicles are considered energized, and contact with energized circuits must be avoided. Ground or barricade all mobile equipment such as lift trucks, boom trucks and cranes. If aerial work is performed in an energized area, a safety watch must monitor the work continuously.
- Safe working clearances must be maintained for all energized circuits. The clearances for live line work are as follows:

AC Live-Line Work
Safe Working Clearances

Nominal Voltage	Phase to Ground Exposure		Phase to Phase Exposure	
1.1 to 15.0 kV	2 ft/1 in.	0.64m	2 ft/2 in.	0.66m
15.1 to 36.0 kV	2 ft/4 in.	0.72m	2 ft/7 in.	0.77m
36.1 to 46.0 kV	2 ft/7 in	0.77m	2 ft/10 in	0.85m
46.1 to 72.5 kV	3 ft/0 in	0.90m	3 ft/6 in	1.05m
72.6 to 121 kV	3 ft/2 in	0.95m	4 ft/3 in	1.29m
138 to 145 kV	3 ft/7 in	1.09m	4 ft/11 in	1.50m
161 to 169 kV	4 ft/0 in	1.22m	5 ft/8 in	1.71m
230 to 242 kV	5 ft/3 in	1.59m	7 ft/6 in	2.27m
345 to 362 kV	8 ft/6 in	2.59m	12 ft/6 in	3.80m
500 to 550 kV	11 ft/3 in	3.42m	18 ft/1 in	5.50m
765 to 800 kV	14 ft/11 in	4.53m	26 ft/0 in	7.91m

Note: Some locations may have local regulations with slightly different requirements. Facilities should operate in accordance with the more conservative distance, either that required by local regulations or the distances noted above.

OVERHEAD LINES

When overhead power transmission lines are installed or maintained on poles, towers or other structures, additional qualifications and training are required for the employees that perform the construction and maintenance. Only qualified linemen should perform aerial work on these structures.

- Use the following precautions when setting or working on power poles:
  a) Wear appropriate rubber gloves when setting, removing or moving a pole near an exposed energized overhead line. Raise poles and fixtures in close proximity to high voltage power sources only under the supervision of a qualified person.
  b) Be aware of all circuits and related voltages on the pole before climbing it.
  c) Do not allow the pole to contact uninsulated body parts. Use pole and line guards if incidental contact with an energized conductor is possible.

d) The holes for poles must be guarded when open, and hole covers placed if the hole cannot be guarded or barricaded.
e) Review the MSDS for any pole treatment chemicals such as creosote before handling the pole. Wear safety glasses, work gloves, and long-sleeve shirts with the sleeves down. Avoid rubbing eyes or wiping perspiration from the face using hands, gloves or shirtsleeves exposed to pole treatment chemicals.
f) Inspect any pole before climbing it for signs of cracking or damage.
g) Use a safety strap with double locking on both belt snaps, and an approved hand line when climbing or working on a pole. Do not fasten both snaps of the safety strap to the same D-ring.
h) Do not place a safety strap around pins or cross braces, or across the top cross arm. Do not use pins, brackets, cross arms braces or other attachments for support while climbing, as these items may pull loose from the pole.
i) Climb on the high side of a leaning pole.
j) Do not throw tools or parts upward to linemen working on poles. Use a hand line to raise and lower items.

- When installing or working on towers, use the following precautions:
  a) Do not stand under a tower or structure while work is in progress. If this position is required to help linemen working above, the linemen must be aware of the presence of the helpers below.
  b) Do not detach load lines from a tower section until the load is safely secured in place.
  c) Use appropriate personal protective equipment for the physical hazards as well as electrical hazards.
  d) Use tag lines to control the movement of tower sections when placing members, unless they create a greater hazard.
  e) When placing tower sections using a helicopter, keep the employee exposure time spent under the load to a minimum. The supervisor must maintain visual and radio communication with the helicopter pilot. A safety watch is also required for all helicopter operations.
  f) Employees must wear head and eye protection, fluorescent vests and protective clothing when working around a helicopter.
  g) NEVER approach a helicopter from the rear.

- Use the following precautions when installing electrical wires on poles or towers:
  a) Use barriers, tension stringing equipment or similar measures to avoid contact with energized lines or equipment.
  b) Maintain wire-pulling equipment (including tensioning and pulling devices) in safe working condition.
  c) Maintain a continuous, reliable means of communication between the pulling rig operator and the reel tender during pulling and tensioning operations.

TRAINING

- Qualified Electricians must receive training in accordance with local regulations and must obtain licenses and certifications if required.
- All employees should receive basic electrical safety training during their orientation.
- All qualified linemen, line construction workers, and employees doing aerial work must be trained in pole-top rescue.
- Qualified linemen must receive and maintain the required training according to local requirements to perform line installation, maintenance and removal on power lines and structures.

Ergonomic Hazards

Hazards

- Low back pain
- Musculoskeletal disorders
- Repetitive strain injuries
- Tension neck syndrome
- Carpal tunnel syndrome
- White finger

Definitions

Carpal Tunnel Syndrome: The compression and entrapment of the median nerve where it passes through the wrist into the hand in the carpal tunnel. The median nerve is the main nerve that extends down the arm to the hand and provides the sense of touch to most of the hand.
Ergonomics: The science of fitting the jobs to the people who work in them, rather than the person to the job.
Occupational Overuse Injuries: A range of conditions such as discomfort, strains, and sprains, that affect mainly the back, neck and limbs, and which are related to the working environment or the task performed. Some of these conditions are referred to as RSI (Repetitive Strain Injuries).
Raynaud's Syndrome or white finger: Blood vessels of the hand may be damaged from repeated exposure to vibration over a long period of time. The skin and muscles do not get the necessary oxygen from the blood and eventually die.
Tendonitis: Tendon inflammation that occurs when a muscle or tendon is repeatedly stressed by overuse or unaccustomed use.
Work-related Musculoskeletal disorder (WMSD): An injury or illness that includes muscle strains and tears, ligaments sprains, joint and tendon inflammation, pinched nerves, and spinal disc degeneration and medical conditions such as rotator cuff syndrome, trigger finger, carpal tunnel syndrome, and hand-arm vibration syndrome (HAVS), that are associated with workplace risk factors.

Procedures

Recognition

Workplace risk factors include:

- Repetitive, forceful or prolonged motions.
- Frequent or heavy lifting.
- Pushing, pulling or carrying heavy objects.
- Fixed or awkward work postures.
- Contact stress.
- Localized or whole body vibration.
- Cold temperatures.
- Poor lighting.
- Noise.

These factors can be intensified by work characteristics such as:

- Inadequate work-rest cycles.
- Excessive work pace or duration.
- Lack of task variability.
- Machine-paced work.
- Improper tool design.

Control Practices

Workstations

- Make workstations adjustable, enabling both large and small persons to fit comfortably and reach materials readily.
- Locate all materials in front of the worker to reduce twisting motions. Provide enough workspace.
- Avoid static loads and fixed work postures.
- The work surface should be set above elbow height for tasks involving fine visual details, and below elbow height for tasks involving downward movement and heavy physical effort.
- Provide adjustable and properly designed chairs.
- Allow employees to alternate between sitting and standing.
- See suggested posture and workstation guidelines in Attachment 1.

Hand and Wrist Tasks

- Reduce the number of repetitive motions per shift.
- Maintain a neutral wrist position.
- Reduce the force or pressure on the wrists and hands.
- Avoid reaching above shoulder height, below waist level or behind the body to minimize shoulder stress.
- Avoid repetitive work that requires full arm extension.
- Isolate hands from heat, cold and vibration.

Hand Tool Use

- Maintain straight wrists through the work movement.
- Avoid static muscle loading.
- Reduce grip force requirements.
- Avoid sharp edges and pinch points.
- Avoid repetitive trigger-finger actions.
- Wear gloves that fit.

Lifting and Lowering

- Reduce manual lifting where possible.
- Eliminate the need to lift or lower manually by using appropriate machines.
- Reduce the weight or capacity of the object to be handled.
- Provide grips or handles to enable a load to be held closer to the body.
- Reduce load lifting, carrying and lowering by using conveyors, hand trucks, and carts.

Training

Employees should be trained in ergonomically sound work practices:

- General awareness training
- Specific training for employees whose jobs require repetitive motions.
- Task specific training for repetitive tasks and lifting tasks.

Heat Stress

Heat stress can be a significant hazard, especially for workers wearing protective clothing. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress incidents. Workers will be encouraged to immediately report any heat-related problems that they experience or observe in fellow workers.

During breaks, workers should be encouraged to drink plenty of water or other liquids to replace lost fluids and to help cool off.

Any worker exhibiting signs of heat stress and exhaustion should be made to rest in a cool location and drink plenty of water. Emergency help by a medical professional is required immediately for anyone exhibiting symptoms of heat stroke, such as red, dry skin, confusion, delirium or unconsciousness. Heat stroke is a life threatening condition that must be treated by competent medical authority.

Prevention

Whenever possible or within the control of ARCADIS, engineering controls should be utilized to protect workers from heat related hazards. For example, isolation from the heat source, ventilation such as open windows, fans or other methods of creating air flow, and heat shielding such as awnings or umbrellas.

Appropriate work practices can also lessen the chances of heat related hazards. Some of these include:

- Water intake should be about equal to the amount of sweat produced (i.e., drinking 5-7 ounces of water every 15-20 minutes).
  - Electrolyte fluids may also be necessary.
- Whenever possible, gradual exposure to heat is preferred.
- Whenever possible, adjust the work schedule. For example, postpone nonessential or heavier work to another day or a cooler part of the day.
- Whenever possible, rotate personnel.
- Increase the number and/or duration of rest breaks, but do not increase individual work periods when longer and/or more rest breaks periods are given.
  - Whenever possible, rest break areas should be in a cool area and as close to the work Area as is feasible.

PPE is available, such as thermally conditioned clothing including self-contained air conditioning in a backpack and plastic jackets/vests with pockets that can be filled with dry ice or ice. However, the type of work being done, other required PPE, and where the work is being done may prohibit or make the use of this PPE impossible or impractical.

Heat-Related Illnesses

The following guidance can be used in the identification and treatment of heat related illness.

Heat Stress: This is the mildest heat-related illness, but prompt action may prevent a more severe heat-related illness. Symptoms include irritability, lethargy, significant sweating, headache or nausea.

First Aid:

- Take the victim to a protected (e.g., shaded) area, remove any excess protective clothing, and provide cool fluids.
- If an air-conditioned spot is available, this is an ideal break location.

- Once the victim shows improvement he/she may resume working, however the work pace and practices (e.g., does fluid intake need to be increased) should be moderated to prevent recurrence of the symptoms.

Heat Exhaustion: Usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Symptoms include pale, clammy skin, and profuse sweating, vomiting, and the bowels may move involuntarily. The pulse is weak and fast, breathing is shallow. Fainting can occur.

First Aid:

- Immediately remove the victim from the work area to a shady or cool area with good air circulation (avoid drafts or sudden chilling – you do not want the victim to shiver).
- Call a physician or emergency service, or transport the victim to medical care.
- Remove all protective outerwear.
- If the victim is conscious, it may be helpful to give him/her sips of water.

Heat Stroke: Heat stoke is a severe medical condition requiring first aid and emergency treatment by a medical professional as death can occur without appropriate care. Heat Stroke represents the collapse of the body's cooling mechanisms. As a result, body temperatures often rise to between 105°-110°F. As the victim progresses toward heat stroke symptoms include hot and usually dry, red and spotted skin, headache, dizziness, nausea, mental confusion, delirium, possible convulsions and loss of consciousness.

First Aid:

- Immediately remove the victim from the work area to a shady or cool area with good air circulation (avoid drafts or sudden chilling - you do not want the victim to shiver).
- Summon emergency medical help to provide on-site treatment and transportation to a medical facility.
- Remove all protective outerwear and loosen personal clothing.
- Give no stimulants or hot drinks.
- Apply cool wet towels, ice bags, etc. to the head, armpits, and thighs. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place the victim in a tub of cool water.
  - The main objective is to cool without chilling the victim or causing him/her to shiver.

Skin Hazards

Sunburn and prickly heat are both symptoms of skin irritation/damage produced through exposure to sunlight and operating in hot work environments.

- Protect exposed skin with an appropriate sunscreen. A sunscreen with a sun protection factor (SPF) of 15 or greater is required for work in the sun with reapplication at breaks and lunch.
- Heat rash, also known as prickly heat, can be prevented by the application of a hydrophobic, water repellent barrier cream such as Kerodex 71.

Heat Stress Monitoring

The prevention of heat stress-related illnesses is best performed through continuous observation of employees and routine heat stress awareness training. Although heat stress monitoring can be accomplished using one of the techniques discussed below, any results obtained from monitoring techniques should be used as guidance only.

To properly mitigate the effects of heat stress, it is necessary to establish a work routine that incorporates adequate rest periods to allow workers to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest, and recover. The frequency and length of such work breaks must be determined by the Task Manager and SSO based upon factors such as the ambient temperature and sunshine, the amount of physical

labor being performed, the physical condition of the workers, and protective clothing being used. Breaks must be sufficient to prevent workers from manifesting symptoms of heat stress regardless of monitoring results.

Evaluation of heat stress using the methods below, to determine appropriate work/rest cycles, is performed, at the discretion of the SSO and PHSM whenever fieldwork activities are occurring.

Basic Instrument Measurements Method: Used at the discretion of the SSO and/or PHSM to monitor heat stress where workers **are not** using chemically protective clothing. The Wet Bulb Globe Temperature (WBGT) value will be determined using a WBGT meter (Reuter-Stokes 214 DL or equivalent), and compared with the values shown in Table 1 to determine appropriate work/rest cycles.

Table 1 WBGT Values for Level D Work/Rest Cycles*

Work-Rest Regimen	°F-WBGT		
	Light Work	Moderate Work	Heavy Work
Continuous Work	86	80	77
75% Work – 25% Rest	87	82	78
50% Work – 50% Rest	89	85	82
25% Work – 75% Rest	90	88	86

*Re-printed from ACGIH's 1999 Threshold Limit Values for Chemical Substances and Physical Agents

Modified Instrument Measurements Method: This method will be used whenever personnel use chemically protective clothing. The WBGT value will be determined as above with the measured value then be compared with the values shown in Table 2 to determine the appropriate work/rest cycle.

Table 2 WBGT Values for CPC Work/Rest Cycles*

Work-Rest Regimen	°F-WBGT		
	Light Work	Moderate Work	Heavy Work
Continuous Work	75	69	66
75% Work – 25% Rest	76	71	67
50% Work – 50% Rest	78	74	71
25% Work – 75% Rest	79	77	75

Modified from ACGIH's 1999 Threshold Limit Values for Chemical Substances and Physical Agents

Direct Observation: This method can be used as a substitute for the Modified Instrument Measurements Method and can be used whenever personnel use chemically protective clothing. At the start of the workday, each worker's baseline pulse will be determined by counting the number of beats per minute (bpm) and then pulses taken at the beginning and end of each break period.

- Start of Break: As recommended by the ACGIH, each worker's maximum heart rate at the start of any break should be less than 180 minus workers age bpm (e.g., a worker is 40 so their pulse should be less than 120bpm). If this value is exceeded for any worker, the duration of the following work period will be decreased by at least 10 minutes.

- End of Break: At the end of each break, all workers heart rates must have returned to within +10% of the baseline pulse rate. If any worker's pulse rate exceeds this value, the break period will be extended for at least 5 minutes with the pulse rates will be re-measured and the end-of-break criteria again applied.

Noise Exposure

OSHA generally considers any environmental condition where a person must shout to be heard from a distance of 3 feet, a hazardous noise environment. Under these conditions, personnel must be protected through the use of appropriate hearing protective devices.

Hearing protection shall be worn:

- In any situation where normal conversation cannot be heard at a distance of 3 feet regardless of the source of the noise or where noise levels as measured with approved noise monitoring equipment is above 85 dBA.
- When operating gasoline or electric powered machinery.
- When working within 25 feet of operating heavy equipment (earth working equipment, etc.) as working around this type of equipment can result in exposure to hazardous levels of noise (levels greater than 90 dBA).

    - Earplugs or earmuffs will be worn.

The PHSM may also choose to monitor employee exposure to potentially hazardous noise levels.

Severe Weather

Project work will be conducted during all seasons. Therefore, severe weather conditions (e.g., severe cold and hail, extreme heat) may be encountered during project work.

During threatening weather, the SSO will monitor radio weather forecasts and heed any warnings. In addition, in the event of lightning in the vicinity of the site, the SSO will stop all activities and have site personnel take cover. Other severe weather such as high winds, hail or heavy rain will be evaluated by the SSO, PHSM and the Task Manager to determine how site activities should proceed.

Site Control And Work Zones

Control zones shall be established by the SSO to cover a large enough area to accommodate work operations where required for the contaminants as outlined by the HAZWOPER regulations. The zones, demarcated as described next, shall be clearly communicated to all PROJECT workers.

HAZWOPER requires the development of a site map, with enough detail included to ensure adequate identification of the zones in relation to other site features. These zones are defined as:

- Exclusion Zone (EZ): area where contaminated materials exist
- Contamination Reduction Zone (CRZ): area where decontamination procedures are performed
- Support Zone (SZ): uncontaminated area designated with Access Control Points (ACP) for entry/exit points across the hotline into and out of the work operations

The hotline is the line of demarcation where the EZ ends and the CRZ begins.

Within the ACP, between those two lines, decontamination of personnel and equipment will take place.

The area that lies outside of the CRZ, is the SZ and can be considered uncontaminated for the purposes of workers performing support duties there.

The SSO will determine extent of each zone and will communicate that information to workers during tailgate briefings. Physical demarcation of zones on the site will be determined by the SSO using a variety of methods including but not limited to signs, tape, flags, etc.

Underground and Aboveground Utilities

Various forms of underground and aboveground utility lines or pipes (carrying water, wastewater, gas and or electricity) may be encountered during work activities. Prior to the start of intrusive operations activities, all utilities must be located and measures must be instituted to avoid contact with these structures. All utility line and or piping will be identified and rendered controlled (through lockout/tagout procedures) or protected from damage.

Should any operations cause equipment to come into contact with utility lines, the SSO and the PHSM will be notified immediately and an Incident Report will be completed. Work will be suspended until the appropriate actions for the particular situations can be taken.

Work involving machinery with high extensions (backhoes, etc.) in vicinity of overhead power lines shall not be conducted within the limits prescribed in the table below. The distance may be lengthened if directed by the client or the electric company and any specified distances will be strictly followed.

Safe distances from overhead power lines are as follows:

TABLE

Voltage range (phase to phase, RMS)	Approach distance (inches)
300 V and less	Avoid contact
Over 300V, not over 750V	12
Over 750V not over 2 kV	18
Over 2 kV, not over 15 kV	24
Over 15 kV, not over 37 kV	36
Over 37 kV, not over 87.5 kV	42
Over 87.5 kV, not over 121 kV	48
Over 121 kV, not over 140 kV	54

From 1910.238(b)(7)(iii)

A utilities location checklist is attached and may be used to verify that all utilities have been marked.

Walking/Working Surfaces (Floor/Wall Openings; Slips, Trips, Falls and Protruding Objects)

Hazards from floor and wall openings, and from careless movements, protruding objects, debris, spills, placement of materials on paths or foot traffic areas, present a problem with regard to slips, trips, falls, and puncture wounds. If any such hazards are identified, correct them immediately and if that is not possible, report the hazard to your Site Safety Officer or Project Manager as soon as possible.

Floor and Wall Openings

The Site Safety Officer (SSO) will identify all floor and/or wall opening hazards and ensure that guarding is in place. The SSO will convey to project site employees the location of the floor and/or wall openings and what guarding should be in place at the opening/openings. If guarding is not in place, the SSO will:

- Not allow work to continue until the appropriate guarding is in place; and
- Notify the Project Manager.

The Project Manager will notify the client and let the SSO know when the guarding has been installed.

If ARCADIS is responsible for floor and/or wall openings, the openings will be guarded in accordance with CFR 1926.1910.23 and 1926.502.

Other Slip, Trip and Fall Hazards

Personnel should stay alert at all times and if tired or distracted, take this into account when working at the site. To minimize the possibility of injury:

- 8" sturdy work boots with good tread are required and steel toed boots are recommended.
- Don't run.
- Slide feet when walking on slick/wet surfaces.
- Don't walk up or down steep embankments/hills if possible.
  - If not possible, walk at an angle when going up/down embankments/hills.
- Don't carry items that block your vision.
- Use handrails/grips when available and maintain 3-point contact whenever possible.
- Don't jump down from equipment and look down before you step down.
- Use appropriate fall protection when working at elevation.
- Report any floor openings that are not clearly marked and/or guarded to the SSO or Project Manager.
- Don't use ladders/scaffolds during high winds or when ice or snow is on the rungs/work surface.
- Don't use ladder substitutes like a box or truck fender, and don't use ladders/scaffolding that is not in good condition.
- Keep paths and work areas clear of tools, equipment, boxes, cords, etc.
  - Tape or secure cords, wires, etc. to minimize trip/fall hazard.
- If a protruding object can not be moved, make sure the object can be easily seen or guard/pad the object if possible.

- Use ancillary lighting such as flashlights & headband lights when necessary.

HEAVY MACHINERY AND CERTIFICATION REQUIREMENTS

Purpose

The purpose of this procedure is to present the minimum safety performance requirements for the operation of heavy equipment on ARCADIS project sites. Project Managers are responsible for ensuring all equipment used on an ARCADIS site is certified and that equipment owners have submitted the attached Machinery and Mechanized Equipment form.

General Requirements

All equipment shall comply with all applicable requirements for motor vehicles and material handling heavy equipment contained in 29 CFR 1926 Subpart O. Heavy equipment includes, but is not limited to, drill rigs, front-end loaders, backhoes, track hoes, bulldozers, forklifts, cranes, derricks and similar equipment used for the implementation of the project Statement of Work.

Equipment Safety Inspections

The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

- All machinery and mechanized equipment will be certified to be in safe operating condition by a competent individual, (using the attached form), within seven days of initial onsite operation.
    - Certification is valid for one year.
- Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.
- Inspections shall include, but are not limited to: all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.
- The driller in charge on a daily basis shall inspect drill rigs and related support equipment and vehicles. These inspections shall be recorded/documented.
- Preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or established internal policies, schedules, and equipment SOPs.
- Only designated qualified persons shall operate machinery and mechanized equipment.
- Records of tests and inspections shall be maintained at the site by the operating contractor, and shall be made available upon request of the designated authority, and shall become part of the official project file.
- Equipment not found to be in safe operating condition, or when a deficiency affecting the safe operation of the equipment is identified, the equipment shall immediately be taken out of service and its use prohibited until safe conditions have been corrected.
- All equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas. Note: this not typical for construction sites. It would be for remediation sites.

- All Equipment must have an audible alarm that sounds when equipment is moving in reverse.

HEAVY EQUIPMENT CERTIFICATION REQUIREMENTS

Initial Equipment Inspection Checklist

TO: DATE:

FROM:

Project Name:

Project Location: _____

1. This form provides certification of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project Site:	
Owner of equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and certification of machinery and mechanized equipment, as required by ARCADIS Project Team has been made prior to, but within seven calendar days advance of, use on the project site. Re-certification will be required for equipment that is used on the project site for more than one year.

	Identification of equipment (make, model, serial no.)	Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated above, and is CERTIFIED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title	
Company			
Signature		Date	

4. If there are any questions regarding this certification, please contact the following ARCADIS Project Team representative: _____.

Daily Inspection Form

DAILY HEAVY EQUIPMENT INSPECTION CHECKLIST

EQUIPMENT I.D. NO:_____

EQUIPMENT NAME: _____

DATE: ____/____/_____ PROJECT #: _____ CONTRACT #: _____

ITEM INSPECTED	Inspectors Initials
Falling Object Protective Structure (FOP)	
Roll-Over Protective Structure (ROP)	
Seat Belts	
Operators Seat Bar(s)	
Side Shields, Screens or Cabs	
Lift Arm Restraining Device	
Grab Handles	
Back Up Alarm(s) – Working	
Lights	
Guards	
Horn	
Anti-Skid Tread Steps Clear of Mud	
Safety Signs (Counterbalance swing area)	
Fire Extinguisher (arrow in green, monthly inspection)	
General Condition	
Fuel Condition	
Oil (Full, No Leaks)	
Clear of Extra Materials	
Controls Function Properly	
Damaged Parts	
Hydraulic System (Full, No Leaks)	
Parking Brake	
Lift Arm and Bucket	
Tires/Tracks	
Steering	
Hours at Time of Inspection	
Time Inspected	
Site Name	
Inspectors Name (Printed)	

INSTRUCTIONS – Inspect all applicable items indicated each shift prior to use. Note any unsatisfactory conditions on the back of this sheet and bring to the attention of the supervisor immediately. Operators are required to sign in on this sheet the first time that they operator the equipment each day.

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Attachment C-8

Utilities and Structures Checklist

Exhibit 3 - Utilities and Structures Checklist

Project:	**Project Number:**
Site Location:	**Date:**

Instructions: This checklist will be used as a safety measure to insure that all underground utility lines, other underground structures as well as above ground utilities are clearly marked out and identified in the area selected for boring or excavation. **DRILLING, EXCAVATION, OR ANY TYPE OF GROUND INTRUSIVE WORK MAY NOT PROCEED UNTIL LINES ARE MARKED AND THIS CHECKLIST HAS BEEN COMPLETED.**

Pre-Field Work Requirements		
Was the state one-call notified with the required advanced notice (usually 48 to 72 hours)	YES	NO
State one-call confirmation number		
What are the 2 lines of evidence used for utility clearance?		
Was a plot plan showing site features and subsurface utilities provided by the PM/TM?	YES	NO
Was the Nation-wide 811 Number called? If no, why not?	YES____	NO____
If yes, what information was provided?		

Subgrade Utility Line Location	
Where is the gas line located?	
Where is the gas meter located on the site building(s)?	
Are the electric lines subsurface or overhead? Where are they located?	
Where is electric meter located on the site building(s)?	
Where are the telephone/cable lines located? Are there any overhead lines?	
Where do these lines enter the site building(s)?	

Where are the water lines located?	
Does the site occupant use water (bathrooms, industrial uses, fire suppression, etc.)? If so where do the water lines enter the building for these purposes?	
Are there small manholes/vault covers indicating water lines? If so, where?	
Was the local municipality contacted to mark sanitary lines?	
Where are the sanitary lines located?	
Where might the sanitary lines enter the building? (i.e. what side of the building are the bathrooms, kitchens, water treatment plant, etc?)	
Where are the storm sewer lines located?	
Are there storm sewer inlets located on the property? Check inlets for direction of subsurface lines.	
Are there any gutters directing storm water to the subsurface? Evaluate for direction of lines.	
Underground Storage Tank Sites	
Where are the USTs located? How many USTs are at the site (very number of USTs by counting fill ports and vent lines)?	
Where do the vent lines run?	
Where does the piping run? (Evaluate the path between USTs to dispenser islands).	
Where are the sub-surface electrical lines located which feed power to the UST system?	
General Underground Utility Location Signs	
Are there any cracks resembling straight lines that may indicate the settling of utility lines?	
Are there any patched areas where subsurface repairs may have been conducted?	
Are there any manhole covers or valve boxes that are not associated with marked lines?	

Above ground Utility Line Location	
Are there overhead power lines? If, so where are they located?	
What is the voltage of the overhead power lines?	
Are there any above ground structures (utilities, piping, etc.) that are used by the client? If so, are they located proximal to the work area?	
Do these lines need controlled (locked out) or protected prior to starting work?	
Interviews: Site Owners/Occupants MUST be interviewed for location of private utility lines at the site (if practicable) before start of work	
Name of Owner/Occupant.	
How is this person affiliated with the Site?	
Who interviewed Owner/Occupant?	
Date of Interview	
Specific comments that should be noted from the interview:	

NOTE: If any subsurface utilities listed above are not located, do not proceed with subsurface activities. Contact PM/TM immediately.

Name and signature of person who conducted utility line checklist

Name (print) **Signature** **Date**

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Attachment C-9

Job Safety Analyses (JSAs)

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Environmental Operations
JSA No:	JSA001537
Date:	6/2/2008
Work Type:	Environmental - Soil Sampling with Geoprobe/Hydropunch
Work Activity:	Drilling, Soil and Groundwater Sampling
Project No.:	NY0014900001 - TARGET ROCK (TARGET ROCK)

SECTION 2

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Keen, Christopher .	Senior Scientist	☑	Sangiovanni, Carlo .	Principal Scientist	

SECTION 3

Job Steps	Potential Hazard(s)	Critical Action(s)	SOP Reference
Set up necessary traffic and public access controls	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
Utility Clearance	Potential to encounter underground or aboveground utilities while drilling	Complete utility clearance in accordance with the ARCADIS H&S procedure	ARCADIS H&S Procedure ARCHSFS019
Commence drilling or borehole installation	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and probe rod connections can cause pinching or crushing of body parts. Soil cores and/or water could contain chemicals of concern. Dust and debris can cause eye injury. Drilling equipment laying on the ground (i.e. probe rods, soil samplers, decon equipment, coolers, etc) create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard. Excessive noise is generated by rig operation. Geoprobe rigs possess hydraulic hoses/lines.	The drill rig should only be moved with the derrick down. Set-up rig on level surface where possible. Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Wear appropriate gloves to protect from COCs and safety glasses and hard hat to protect from flying dust, water and debris. Keep equipment and trash picked up, and store away from the primary work area. Wear ear plugs, steel-toe boots with good tread, and maintain proper footing in muddy areas. Inspect the integrity of drill rig hoses/lines before operation.	
	Injuries can result from pinch points on soil sampler, and from	Care should be taken when opening soil sampler. Look at empty containers before picking them up, and do not	

Sample Collection and Processing	sample container breakage. Workers can be exposed to COCs, and lifting heavy coolers can cause back injuries.	over-tighten container caps. Use dividers to store containers in the cooler so they do not break. Wear appropriate gloves as designated by the HASP.	
Soil cutting and purge water management	Exposure to COCs in both soil and groundwater. Moving full drums can cause back injury, or pinching/crushing injury. Purge water can splash and cause eye injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollys, lift gates, etc. Employ proper lifting techniques, and perfrom SPSA to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	

SECTION 4
Personal Protective Equipment (PPE):
Ear plugs
Level D
orange traffic safety vest
Protective Gloves - SAMPLE CONTAINERS
Safety Shoes
Required and/or Recommended Equipment and Supplies: Hard hat should be worn during drilling.

Initial - In Progress - 06/03/2008 11:16 AM EST

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Environmental Operations
JSA No:	JSA001538
Date:	6/2/2008
Work Type:	Environmental - Monitoring Well Sampling/Gauging
Work Activity:	Groundwater Sampling
Project No.:	NY0014900001 - TARGET ROCK (TARGET ROCK)

SECTION 2

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Keen, Christopher .	Senior Scientist	☑	Sangiovanni, Carlo .	Principal Scientist	

SECTION 3

Job Steps	Potential Hazard(s)	Critical Action(s)	SOP Reference
Load required sampling equipment and supplies into vehicle.	Lifting hazards and back strain. Appropriate PPE or equipment not on-site.	Review HASP for proper PPE and Work Plan for necessary equipment. Also refer to the HASP for required traffic control and emergency procedures. Use proper lifting technique. Request assistance when lifting heavy equipment. Use dolly to transport equipment.	
Working outdoors	Heat/cold stress, sunburn, severe weather, lightning.	Avoid/stop work in extreme weather conditions or if extreme weather is imminent; seek shelter as needed; take breaks and consume fluids as needed; use sunscreen and wear clothing to cover body for protection.	
Travel to site.	Vehicle accident.	Smith Defensive Course. Follow safe driving procedures (following distances, speed, headlights, safety belts, 'give the other driver a break'). Do not use cell phone when driving.	
Property access.	Vehicle traffic. Trip and fall.	Wear safety vest and face oncoming traffic. Be aware of vehicle traffic on-site. Be aware of surroundings.	
Set up necessary traffic control at well.	Struck by vehicle during placement. Vehicle accident as result of improper vehicle control placement.	Wear Class II traffic vest if wells are located proximal to vehicular traffic. Use appropriate traffic control measures (barricades and cones) to direct traffic around work area. Use a vehicle as a barrier between sampler and on-coming traffic. To the extent possible, stay out of the way of other traffic.	
	Pinchpoints on well vault		

Gauge water levels in wells.	can pinch fingers. Scraped knuckles (flush-mount wells), back strain, dermal exposure to chemical hazards, repetitive motion, knee strain from kneeling, biological hazards.	Don appropriate PPE. Bend at the knees, not the waist. Be careful opening flush-mount wells. Watch for biological hazards.	
Purge well(s), collect water quality parameters, collect purge water.	Lacerations to hand/fingers can occur when cutting tubing. Muscle strain can occur when lifting equipment, pinch point between tubing and well casing while lowering pump or bailers. Cross-contamination. Back strain. Inhalation or dermal exposure to chemical hazards. Slip and fall. Spilling/splashing contaminated water.	Wear protective gloves and lower pump/bailer slowly. Cut tubing with tube cutting device (do not use pocket knife). Decontaminate purge equipment between each sampling location or use disposable equipment/tubing. Use proper lifting techniques. Use PPE and monitoring equipment in accordance with HASP. Keep work area clear of tripping or slipping hazards. Store purge water in appropriate containers. Make sure all tubing joints are secure.	
Collect samples in accordance with sampling plan.	Cross-contamination. Back strain. Inhalation or dermal exposure to chemical hazards. Slip and fall. Improper labelling or storage. Injury from broken or leaking sampling bottles (cuts and/or acid burns).	Decontaminate sampling equipment between each well or use disposable equipment/tubing. Use proper lifting techniques. Use PPE in accordance with HASP. Label samples in accordance with sampling plan. Keep samples stored in proper containers, at proper temperature, and away from work areas. Handle bottles carefully and with gloves.	
Management of purge water.	Back strain. Splashing. Exposure to chemical hazards. Improper disposal.	Wear PPE in accordance with HASP. Lift with legs. Properly containerize water in drums.	
Clean site/demobilize.	Vehicle traffic. Lifting hazards and back strain.	Use buddy system, as necessary, when removing traffic control. Leave site clean of refuse and debris. Use proper lifting techniques.	
Package and ship samples to lab.	Bottle breakage. Injury from broken/leaking sample bottle (cuts and/or acid burn)/ Dermal exposure to chemical hazards. Back strain when lifting samples. Leaking coolers.	Handle and package bottle carefully (bubble wrap bags, if available). Use proper lifting techniques. Double-bag ice. Wrap potential leak points on coolers with duct/clear tape.	

SECTION 4
Personal Protective Equipment (PPE):
Level D
orange traffic safety vest
Protective Gloves - Nitrile
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies: Water-level indicator, submersible pump, decon supplies, sample containers, ice, drinking water.

Initial - In Progress - 06/03/2008 11:16 AM EST

ARCADIS

Appendix D

Citizen Participation Plan

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Infrastructure, environment, facilities

Imagine the result

Curtiss-Wright Flow Control Corporation, Target Rock Division

Appendix D

Citizen Participation Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site Number 1-52-119

December 30, 2008

ARCADIS

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Senior Scientist

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Project Manager/Hydrogeologist

Appendix D
Citizen Participation Plan

Target Rock Site
1966E Broadhollow Road
East Farmingdale, New York
NYSDEC Site # 1-52-119

Prepared for:
Curtiss-Wright Flow Control Corporation,
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Our Ref.:
NY001490.0001.00001

Date:
December 30, 2008

1. Introduction

This Citizen Participation Plan (CPP) has been prepared by ARCADIS on behalf of Curtiss-Wright Flow Control Corporation, Target Rock Division (Target Rock) as a component of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Target Rock Site (Site) in East Farmingdale, New York (NYSDEC Site Number 1-52-119). The CPP describes the citizen participation (CP) activities that will be conducted during the RI. Target Rock, in cooperation with the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH), is committed to informing and involving the public during the environmental evaluation of the Site. The intent of this CPP is to promote communication among all parties involved with, or affected by, contamination at the Site. This CPP provides the public and other parties with an opportunity to become informed and involved, and to influence the development and implementation of remedial actions (if necessary) for the Site.

This CPP has been prepared as a component of the Sampling and Analysis Plan (SAP), which is the umbrella document that consists of Appendices A through D of the RI/FS Work Plan. The SAP includes the following required elements:

- The Field Sampling Plan (FSP) (Appendix A) defines sampling and data gathering methods consistent with NYSDEC Draft DER-10 (NYSDEC, 2002) and the "Field Methods Compendium," OER 9285.2-11 (draft July 1993).

- The Quality Assurance Project Plan (QAPP) (Appendix B) describes the quality assurance/quality control (QA/QC) protocols necessary to achieve the project data quality objectives.

- The Health and Safety Plan (HASP) (Appendix C) details procedures for protecting persons at and near the Site during performance of the RI/FS (in accordance with 29 CFR 1910).

- This CPP (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC, 1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002).

The investigation and remediation of the Site is regulated by New York Codes, Rules and Regulations (NYCRR) Title 6 Part 375, Environmental Remediation Programs. CP activities related to the Site are prescribed by 6 NYCRR Part 375, Subpart 375-1, Paragraph 1.10 and Subpart 375-2, Paragraph 2.10.

The objectives of this CPP are to:

1. Inform the affected and interested public about the Site, the nature of environmental conditions at the Site, the environmental and/or health threats posed by the Site, the planned activities for the Site, and the progress being made.

2. Establish and identify opportunities for the public to provide meaningful input into the decision making process for the Site.

3. Factor the public's input, as appropriate, into the process.

Specifically, this CPP identifies community officials, groups, and individuals that may be affected by or have interest in the Site activities, and identifies locations where these parties can obtain additional information about the Site. Specific opportunities for public and community input into the decision-making process are outlined in this CPP. The CPP is a working document and will be modified, as needed, to accommodate major changes either in public attitude or in the nature and scope of technical activities at the Site.

2. Site Description and Background

The Site is located at 1966E Broadhollow Road, East Farmingdale, Town of Babylon, Suffolk County, New York and is identified by Tax Map Number: District 0100, Section 031, Block 1, Lots 2.2 through 2.4. The approximately 11-acre Site contains two manufacturing buildings (east building and west building), each situated on 5-acre lots, and a 1-acre right-of-way. The west building is used for manufacturing and contains office space; the east building is used for shipping and receiving, valve testing, and contains additional manufacturing and office space. The areas of the Site not occupied by buildings are largely paved and used for parking. The Site is secured by a

perimeter fence and automatic gate. The Site is situated on relatively flat topography on the western edge of an industrial area. Residential areas are located to the west and south of the Site. A commercial building is located to the north of the Site.

Target Rock manufactures valves used primarily for nuclear power applications. Manufacturing processes include machining and testing of valves. One of the elements of the manufacturing process is the non-destructive testing of the valves for minor cracks. Target Rock began manufacturing operations at the Site in 1982 and operations have been ongoing to the present.

2.1 Previous Investigations and Remedial Activities

A series of investigations and remedial activities were completed at the Site between 1983 and 2004. These completed investigations and findings and the remedial work that was implemented at the Site are described in Sections 2.4.1 and 2.4.2 of the RI/FS Work Plan. In summary, the following findings were reported:

- VOCs (primarily 1,1,1-TCA; tetrachloroethene [PCE]; trichloroethene [TCE]; 1,1-dichloroethane [1,1-DCA]) were detected above applicable NYSDEC Recommended Soil Cleanup Objectives (RSCOs) and Suffolk County Department of Health Services (SCDHS) Action Levels in some soil samples collected at the Site.

- Metals (primarily chromium, copper, and nickel) were detected above applicable NYSDEC RSCOs and SCDHS Action Levels in some soil samples collected at the Site.

- VOCs (primarily 1,1,1-TCA; PCE; TCE; 1,2-dichloroethene [1,2-DCE]; 1,1-DCA) were detected above applicable NYSDEC standards in some groundwater samples collected at the Site.

The data from these investigations are currently being evaluated and will be presented in the final RI Report. The RI/FS Work Plan describes the proposed work scope for the RI.

Remedial activities were conducted at the former dry well located toward the rear of the east manufacturing building (i.e., south side of the building) in 1983. These activities included the cleaning out of the dry well, the removal of the dry well, and the removal of surrounding impacted soils.

Remedial activities were conducted at the former UST area located on the western side of the west building in 2003 and 2004. These activities included the removal of the UST and the excavation and off-site disposal of impacted soil.

3. Project Description

The proposed RI/FS activities are summarized in the RI/FS Work Plan, of which this CPP is Appendix D. Upon approval by the NYSDEC, the RI/FS Work Plan will be implemented. The goals of the RI are provided in Section 5.2 of the RI/FS Work Plan. The media to be investigated during the RI will include soil, groundwater, and soil vapor. The goal of the FS is to evaluate the need for, develop, and evaluate alternatives for remedial action, if any, to prevent, mitigate, or otherwise respond to or remedy a release or potential release of contamination at or from the Site.

4. Citizen Participation Activities

Target Rock, in coordination and cooperation with the NYSDEC and the NYSDOH, will be responsible for implementing this CPP. The CP activities enumerated and described below will be conducted as part of the CP Program. The CP activities summarized below include required CP activities (as specified in NYSDEC's June 1998 "Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook" [NYSDEC, 1998] and 6 NYCRR Part 375).

1. Prepare Site Contact List.

2. Establish document repositories as follows:

    - Farmingdale Public Library, 116 Merritts Road, Farmingdale, New York 11735. Phone: (516) 249-9090.

    - NYSDEC Region 1, SUNY @ Stony Brook, 50 Circle Road, Stony Brook, New York 11790. Phone: (631) 444-0350. Contact: William Fonda.

3. Place NYSDEC-approved RI/FS Work Plan into the document repositories.

4. Prepare and send out a Fact Sheet to the Contact List that announces the availability of the RI/FS Work Plan. The Fact Sheet will provide a brief history of the Site, description of the proposed RI activities and their locations, the

planned start date and general project schedule, and action that is likely to affect the public or require the public to take action. Additionally, the Fact Sheet will describe the CP Program and the remaining CP activities, and provide information about the locations of the document repositories and the names and addresses of the NYSDEC Project Manager and Citizen Participation Specialist.

5. As data are generated and evaluated during the RI, it may be necessary to propose additional, supplemental RI work scope.

6. Upon completion of the RI, an RI Report will be prepared and submitted to the NYSDEC. Upon NYSDEC approval, a copy of the RI Report will be placed in the document repositories.

7. Upon completion of the FS and the NYSDEC-prepared Proposed Remedial Action Plan (PRAP), these documents will be placed in the document repositories. A Fact Sheet will then be prepared and sent to the Contact List announcing the availability of the FS and PRAP. This Fact Sheet will summarize the alternatives evaluated in the FS and describe the PRAP and why the proposed remedy was selected by the NYSDEC. The Fact Sheet will also announce the start of a 30-day comment period and the location and date of a Public Meeting to discuss the proposed remedy and gather public comment/input. The NYSDEC may extend the public comment period a minimum of an additional 30 days if timely request is made.

8. NYSDEC, in cooperation and conjunction with the NYSDOH and Target Rock, will hold a Public Meeting to describe the proposed remedy and gather public comment.

9. Following the close of the public comment period, the NYSDEC and NYSDOH will review the comments submitted. The NYSDEC will then prepare the Record of Decision (ROD) that presents the selected remedy for the Site. The ROD will be placed in the document repositories.

10. Following issuance of the ROD, the NYSDEC will prepare and send to the Contact List a Fact Sheet that summarizes the selected remedy and any significant changes from the proposed remedy. In addition, the NYSDEC will prepare a Responsiveness Summary that summarizes and responds to any significant public comment received during the public meeting on the PRAP.

5. Contact List of Potentially Affected/Interested Parties

A Contact List of potentially affected or interested parties will be developed to support the CP activities for the Site. The Contact List includes the following groups:

- Citizens near the study area.
- Citizens that have requested to be on the mailing list.
- Elected officials.
- Commissioners of local public water supply districts.
- Local news media.
- Community action groups.
- Regulators.

Individuals participating in future Site activities may, if requested, be added to the Contact List for this project. Individuals or groups wishing to be added to or removed from the Contact List can do so by contacting William Fonda of the NYSDEC at (631) 444-0350.

6. Project Contacts

The NYSDEC and NYSDOH have established toll-free numbers that citizens can call to ask questions or discuss the project. The toll free numbers are as follows:

NYSDEC: 1-800-388-8223

NYSDOH: 1-800-388-8223, ext. 27890

The following project-related individuals may also be contacted for information about the project:

Robert Corcoran, P.E.
Division of Environmental Remediation, Bureau A, Section C
New York State Department of Environmental Conservation
625 Broadway

Albany, New York 12233
(518) 402-9625

Gary Litwin
Bureau of Environmental Exposure Investigation
New York State Department of Health
Flanigan Square
547 River Street
Troy, New York 12180
(518) 402-7850

Records related to this project are available by request under New York State's Freedom of Information Law (FOIL). Interested parties may also discuss information needs with the contacts listed above.

7. Glossary of Key Terms and Major Program Elements

Definitions of key terms and program elements are provided below.

7.1 Key Terms

CITIZEN PARTICIPATION: A process to inform and involve the interested/affected public in the decision-making process during the investigation and remediation of sites. The process helps to assure that the best decisions are made from an environmental, human health, economic, social, and political perspective.

CITIZEN PARTICIPATION PLAN: A document that describes the site-specific citizen participation activities that will complement site investigative and remedial activities. It also provides site background and the rationale for the selected citizen participation program for the site.

CITIZEN PARTICIPATION SPECIALIST: A NYSDEC staff member within the Division of Environmental Remediation (DER) who provides guidance, evaluation, and assistance to the NYSDEC project manager in carrying out the site-specific Citizen Participation Plan.

CONSENT ORDER: A legal, enforceable, negotiated agreement between NYSDEC and responsible parties where the latter agrees to undertake or pay for the costs of an investigation and/or cleanup of a site. The order includes a description of the actions to be undertaken at the site and the schedule for implementation.

CONTACT LIST: Names, addresses, and telephone numbers of individuals, groups, organizations, and media interested and/or affected by a particular site in the remedial program. It is used to inform and involve the interested/affected public.

DOCUMENT REPOSITORY: Typically a local NYSDEC office and/or public building, such as a library, at which documents related to site investigation, remediation, and citizen participation activities are available for public review.

FACT SHEET: A written discussion of a site's investigation and/or remedial process, or some part of it, prepared for the public and written in easily understandable language. A sheet may be prepared for the general public or a particular sector. Its uses may include discussion of an element of the investigation/remedial program, opportunities for public involvement, availability of a report or other information, or announcement of a public meeting. It may be mailed to all or part of the interested public, distributed at meetings or during sampling efforts, or sent when requested.

NYSDEC PROJECT MANAGER: A NYSDEC staff member, usually an engineer, geologist, or hydrogeologist within the DER who is responsible for the day to day administration and ultimate disposition of one or more hazardous waste sites. The project manager works with the Division of Public Affairs and Education as well as fiscal and legal staff to accomplish site-related goals and objectives.

PUBLIC AVAILABILITY SESSION: Scheduled gathering of appropriate DEC staff with the affected/interested public to give and receive information in a casual setting, without formal presentations or agenda. Staff from other state agencies and /or local government may also participate along with staff from consultants and the responsible parties. Usually focuses on a specific aspect of a site's investigation/remedial process.

PUBLIC MEETING: Scheduled gathering of appropriate DEC staff with the affected/interested public to give and receive information, ask questions, and discuss concerns about a site's remedial program. Staff from other state agencies and/or local government may also participate along with staff from consultants and the responsible parties. Generally features a detailed agenda with formal presentations.

PUBLIC NOTICE: A written informational technique used to inform the public of an important upcoming activity or phase in a site's remedial program. Some public notices are formal and meet legal requirements, such as those published in a local newspaper of general circulation. Others are informal notices, which may be made through telephone calls to key citizen leaders or through targeted mailings.

RESPONSIVENESS SUMMARY: A formal or informal written or verbal summary and response to public questions and comments. It is usually prepared during or after important elements in a site's remedial program. The responsiveness summary may list and respond to each question or summarize and respond to questions in categories.

7.2 Major Program Elements

The following two definitions represent major elements of the site investigation and remedial process. They are presented in the order in which they occur, rather than in alphabetical order, to provide a context to aid in their definition.

REMEDIAL INVESTIGATION (RI): A process to determine the existence, nature, and extent of contamination through data collection and analysis. The process may include sampling, monitoring, and other information-gathering techniques, which are used to determine the necessity for, and proposed extent of, a remedial program for the site.

FEASIBILITY STUDY (FS): A process for developing, evaluating, and selecting remedial actions and alternatives. Data gathered during the RI are used to define the objectives of the site remedial program and broadly develop remedial action alternatives; perform an initial screening of alternatives; and perform a detailed analysis of a limited number of alternatives that remain after the initial screening stage.

8. References

New York State Department of Environmental Conservation (NYSDEC). 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation. December 2002.

New York State Department of Environmental Conservation (NYSDEC). 1998. Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook. June 1998.

U.S. Environmental Protection Agency (USEPA). 1993. Draft Field Methods Compendium, OER 9285.2-11. July 1993.