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15 September 2011
File No. 37294-001

Hazardous Waste Program, Superfund Section
Missouri Department of Natural Resources
1738 East Elm Street
Jefferson City, MO 65101

Attention: Dennis Stinson, Superfund Section Chief

Subject: Revised Site Investigation Workplan, Revision No. 2
Former Leeds Assembly Plant - Northern Parcel
South of 6817 Stadium Drive
Kansas City, Missouri

Dear Mr Stinson:

On behalf of the Revitalizing Auto Communities Environmental Response (RACER) Trust, Haley & Aldrich, Inc. is pleased to submit this Revision No. 2 to the Revised Site Investigation Workplan (Workplan) for the Former Leeds Assembly Plant - Northern Parcel. This Revision No. 2 incorporates verbal input provided by the Missouri Department of Natural Resources (MDNR) on the Revised Workplan submitted 16 August 2011.

Specific revisions are provided in the Workplan Section 5.1.4.3 "Drum Inspection and Sampling" and in the corresponding Appendix A, Quality Assurance Project Plan (QAPP) Section 6.2.11, to reflect a revised intact drum strategy. Revisions have also been made in Appendix A, QAPP Section 5.2 "Decision Rules" to clarify the decision rule statements. No other changes have been made to the document since the 16 August 2011 submittal, except for those noted here.

Additionally, while no changes were made in the Workplan text, it is understood that MDNR concurs that a ground penetrating radar survey (rather than magnetic/electromagnetic survey) will be selected as the geophysical survey method to be implemented. These options are discussed in Section 5.1.2 of the Workplan.

Please feel free to contact Mr. Bruce Wilkinson at 913-217-6910 or bwilkinson@haleyaldrich.com with any questions or request for additional information.

Sincerely yours,
HALEY & ALDRICH, INC.

Bruce A. Wilkinson
Project Manager

Richard W. Volpi, PG
Senior Hydrogeologist

Enclosure: Revised Site Investigation Workplan, Revision No. 2, September 2011

Cc: MDNR; Attn: Robert Hinkson
MDNR; Attn: Wane Roberts
RACER Trust; Attn: Robert Hare

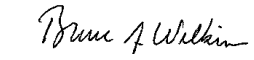
REVISED SITE INVESTIGATION WORKPLAN
FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
RACER TRUST
KANSAS CITY, MISSOURI

by

Haley & Aldrich, Inc.
Lenexa, Kansas

for

RACER Trust
Birmingham, Michigan



DATE: 9/15/11

Bruce A. Wilkinson
Haley & Aldrich, Inc.
Project Manager

DATE: 9/15/11

Richard W. Volpi
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Missouri Registered Geologist
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File No. 37294-001
Revision No. 2
15 September 2011

HALEY & ALDRICH

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Description
3D	3-dimensional
bgs	below ground surface
Burns & McDonnell	Burns & McDonnell Engineering Company
CFR	Code of Federal Regulations
CM	Clean-up Manager
CSM	conceptual site model
DO	dissolved oxygen
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
FWDS	former waste disposal site
GM	General Motors
GPR	ground penetrating radar
Haley & Aldrich	Haley & Aldrich, Inc.
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	inner diameter
IDW	investigation-derived waste
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MLC	Motors Liquidation Company
NELAP	National Environmental Laboratory Accreditation Program
ORP	oxidation-reduction reaction potential
OSC	Onsite Safety Coordinator
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RACER	Revitalizing Auto Communities Environmental Response
RMP	Remedial Project Manager
RSL	Regional Screening Level
SVOC	Semi-volatile organic compound
TBD	To Be Determined
TCLP	Toxicity Characteristic Leaching Procedure
TestAmerica	TestAmerica Laboratories, Inc. of Nashville Tennessee
VOC	Volatile organic compound

1. INTRODUCTION

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this Revised Site Investigation Workplan (Workplan) for the Former Leeds Assembly Plant - Northern Parcel (herein referred to as the Site or Northern Parcel) on behalf of the Revitalizing Auto Communities Environmental Response (RACER) Trust. RACER Trust, as successor to Motors Liquidation Company (MLC), currently owns the Site (ID 1007) and is responsible for environmental response and promoting redevelopment of the RACER property.

The Site is located in the southern portion of the property located at 6817 Stadium Drive in Kansas City, Missouri (Site) as shown on Figure 1 and Figure 2. The northern portion of the property at 6817 Stadium Drive is currently owned and operated by the Leeds Industrial Park and was the location of the Former General Motors (GM) Leeds Assembly Plant (Former GM Plant). The southern portion of the property is further divided into the Northern Parcel (the Site) and the Southern Parcel.

This Revised Workplan specifically addresses proposed investigation activities for the Northern Parcel and incorporates draft informal comments and verbal input provided by Missouri Department of Natural Resources (MDNR) on the initial submittal of the previous Workplan dated 17 December 2010.

1.1 Purpose and Objectives

The purpose of this Revised Workplan is to present proposed soil and groundwater investigation efforts for characterizing the nature and extent of impacts from historical filling operations on the Site. The data collected during investigation activities will be evaluated to attain the following objectives:

1. Characterize the nature of anomalous areas of possible metallic objects as identified during a geophysical survey conducted at the site from January 26 through January 28, 2000;
2. Identify the potential for additional, unknown hot spots of buried objects beyond the area of buried drums discovered onsite in 1999; and
3. Characterize overburden groundwater quality at the Site from the water table down to the top of bedrock for contaminants that may be mobile within the groundwater..

1.2 Project Organization

The project organization, which includes key project personnel, lines of authority, communication, and coordination, is depicted graphically in Figure 3. The following subsections describe the primary responsibilities of key project personnel who are accountable for ensuring the project is conducted to meet objectives and requirements set forth in this Revised Workplan. Specialized training requirements such as Hazardous Waste Operations and Emergency Response (HAZWOPER), Missouri Water Well Drillers Regulations, and professional certifications are discussed in Section 5.3 of the Quality Assurance Project Plan (QAPP) (Appendix A).

1.2.1 Key Project Personnel

- **Wane Roberts – MDNR Remedial Project Manager (RPM)**: The MDNR RPM or other MDNR designee will oversee the planning and implementation of site investigation activities to confirm project objectives are met.

- **Robert Hare – RACER Trust Clean-up Manager (CM)**: The RACER Trust CM will provide oversight and input regarding site investigation activities, and will review and approve each deliverable before submission to MDNR. Changes in the scope of work due to field change orders or other unforeseen circumstances will be approved by the CM prior to implementing changes.

- **David Hagen – Haley & Aldrich Client Manager:** The Client Manager will provide final review of significant submittals to MDNR and may participate in technical meetings with the MDNR. The Client Manager will ensure that overall quality is maintained and has overall responsibility for ensuring that the project meets investigation objectives for both the Client (RACER Trust) and MDNR.

- **Daniel Putz – Haley & Aldrich RACER Program Manager:** The Haley & Aldrich Program Manager for RACER projects will provide contract management, project budget review, and communications to ensure site investigation activities are conducted within the contract requirements between RACER Trust and Haley & Aldrich and according to the budget approved by MDNR.

- **Bruce Wilkinson – Haley & Aldrich Project Manager (PM)**: The Haley & Aldrich Project Manager (PM) is responsible for the overall review and tracking of the project schedule and budget, coordination of field and office activities, management of subcontractors, and development of deliverables. The PM is also the primary point of contact for site investigation communications.

- **Mariruth Gruis – Haley & Aldrich Quality Assurance (QA) Officer:** The QA Officer reports directly to the PM and will be responsible for ensuring that quality assurance and quality control (QA/QC) procedures are followed. The QA Officer will be responsible for approving the QAPP, overseeing the review of field and laboratory data, and providing input to the PM as to actions that may be required as a result of data review.

- **To Be Determined (TBD) – Haley & Aldrich Field QA Officer:** The Field QA Officer is responsible for the overall operation of the field team and reports directly to the PM. The Field QA Officer works with the project Onsite Safety Coordinator (OSC) to conduct operations in compliance with the project Health & Safety Plan (HASP) (Appendix B). The Field QA Officer will facilitate communication and coordinate efforts between the PM and the field team members.

1.2.2 Laboratory Services

- **TestAmerica Laboratories, Inc. (TestAmerica) PM**: The Laboratory PM reports directly to the Haley & Aldrich QA Officer and PM, and is responsible for ensuring the resources of the laboratory are available on an as-required basis. The Laboratory PM is responsible for the approval of the final analytical reports and approval of the laboratory's ability to adhere to the QAPP.

1.2.3 Subcontractors

Subcontractors are responsible for the health and safety of their employees and for complying with the standards established in the HASP (Appendix B) and all other project requirements. The following are general requirements that apply to subcontractors:

- Subcontractors under the direction of Haley & Aldrich will report to the Haley & Aldrich PM.

- An assigned safety representative for each subcontractor will be present on each day that work is being performed. The name of the assigned safety representative will be conveyed to the Haley & Aldrich PM and OSC.

- The Site Entry Log will be signed at the beginning and end of each workday by subcontractor employees working onsite.

- Subcontractor personnel will attend a project safety orientation prior to beginning work onsite.

- Subcontractor personnel will attend the morning tailgate safety meeting. If scheduling precludes attendance, then subcontractors will hold and document their own safety meeting. Safety meeting documentation will be submitted to the OSC.

- Heavy equipment will be inspected daily by the equipment operator. Inspection documentation will be submitted to the OSC.

- Subcontractors will frequently inspect work sites for safety deficiencies and correct each deficiency. Documentation of these inspections, as well as the corrective actions implemented will be submitted to the OSC.

The OSC will conduct inspections to confirm that operations are conducted in accordance with the HASP, Occupational Safety and Health Administration (OSHA) regulations, the Missouri Water Well Drillers Law, and the subcontract specifications.

2. SITE BACKGROUND AND PHYSICAL SETTING

2.1 Site Setting

The approximate 15-acre Northern Parcel (Figure 2) is bordered to the north by the Leeds Industrial Park (the Former GM Plant, not owned by RACER), to the east by a Kansas City Southern Railroad, to the south by the Former Leeds Assembly Plant - Southern Parcel (owned by RACER, ID 1109), and to the west by a Missouri Pacific Railroad. A portion of the Site's southwest corner is bordered by the Blue River. The Site is zoned M2 Heavy Industrial and generally lies within an industrial area; however, a mixed commercial and residential area lies to the northwest of the Site beyond a railroad. The Site is in Jackson County, Missouri.

2.2 Site History

The Site was used for agriculture until the Former GM Plant was constructed on the parcel adjacent to the north of the Site in 1928. Around that time, railroads were constructed across the Site. The Rail Loading Building near the eastern edge of the property boundary (Figure 2) was built between 1964 and 1965. The former propane and storage area in the northwest corner of the site was built between 1969 and 1976. Fill placement on the east half and northern edge of the Site occurred between 1950 and 1952 as shown on Figure 4. Fill placement in the southwestern portion of the Site occurred between 1952 and 1960. By 1963 nearly the entire Site was paved and has remained largely unchanged since except for the addition of an open concrete structure built northwest of the site at the northern end of the drainage ditch located on the west side of the Site. The concrete structure is labeled as a propane stand on historic figures suggesting it was a propane storage area in the past.

2.3 Geologic and Hydrogeologic Setting

The Site is located in the Dissected Till Plains physiographic province, which was formed by glacial scouring and deposition by the Laurentide ice sheet during the Pre-Illinoian Stage glaciation and later accumulation of loess during the Wisconsin Stage.

The Site is located on the edge of the alluvial valley of the Blue River and is covered nearly entirely with asphalt pavement. Fill material composed of anthropomorphic material mixed with native material lies below the pavement. Fill thickness ranges from a few feet to over 15 feet thick. Native soil underlying the fill consists of fine grained alluvial materials such as silty clay, clayey silt and fine sand. A thin (1 to 5 feet) deposit of gravely sandy clay is present at the base of the overburden deposit. Overburden thickness is approximately 50 to 60 feet. Shale bedrock of the Pleasanton Group has been encountered beneath the overburden.

The Site is generally flat with an elevation of approximately 761 feet along the northern, eastern and southern property boundaries and approximately 758 or 759 in the central portion of the Site and along the western property boundary. A land survey completed in 2000 indicated the Drum Discovery Area (discussed further in Section 2.4) drains to a ravine located west of the Site. There is approximately 30 feet of relief between the pavement surface at the Drum Discovery Area and the bottom of the ravine. Surface water draining through the ravine flows southward to the Blue River.

The piezometric surface has typically been found at approximately 15 feet below grade in wells screened across the water table and in wells screened at the bottom of the overburden (i.e., atop bedrock). Groundwater flow direction, based on previous investigation data, has been shown to be west-southwest toward the Blue River. Previously installed monitoring wells which could be located at the time were abandoned in the mid-1990s.

2.4 Site Investigation History

In 1990 and 1991 four monitoring wells and two borings were installed at the Site along the southern property boundary. Advancement of soil borings and installation of monitoring wells were part of an investigation into a former waste disposal site (FWDS) (shown on Figure 4) on the parcel south of the Site. Results of this study can be found in the *Report on the Site Characterization of the Former Waste Disposal Area* (Burns & McDonnell Engineering Company, Inc. [Burns & McDonnell], 1992). The wells were abandoned in 1994 and the details of the abandonment can be found in the *Well Abandonment Report* (Burns & McDonnell, 1997).

Buried drums were discovered at the Site in 1999 during trenching activities for utilities installation (see Drum Discovery Area on Figure 2). Later that year, 13 soil borings were drilled around the area of the drum discovery. Review of the results of this investigation (*Subsurface Investigation Report, Buried Drum Discovery*, Burns & McDonnell, 1999) indicated that buried drums were limited to a 45 foot by 45 foot by 12 foot deep area.

Based on the findings of the 1999 soil boring program, an excavation was conducted to verify the limits and remove the drums. The excavation was started in December 1999 but the extent of drums was not fully delineated. Trenches started from the Drum Discovery Area and delineated the extent of drums to the west, but did not define the extent to the north, south, and east before going beyond the intended scope of the project. The trenching was halted in the delineation phase. Samples were collected from a buried drum containing paint and both a green layer and a red layer of material observed in the eastern portion of the excavation. Four soil samples were collected by GM and MDNR from the bottom of the main excavation (approximately 15 feet deep) at the starting point of the trenching. A sample of a greenish material was collected from a drum recovered from the trench south of the main excavation. At the conclusion of the trenching, four samples were collected from the suspected clean soil stockpile. After filling the trenches and repaving the area, a geophysical survey was performed in the vicinity of the Drum Discovery Area. The findings of the trenching investigation and geophysical survey can be found in the *Remedial Action Report, Recovery of Buried Drums* (Burns & McDonnell, 2000), and anomalous zones of possible buried objects identified in the 2000 geophysics survey are shown on Figure 5.

In 2003 an investigation of historical documents and aerial photographs was performed in an effort to evaluate the nature and extent of historic fill operations on the Site. Review of the investigation results indicated that filling operations on a large portion of the eastern portion the Site occurred from 1950 to 1952 and filling operations on a large portion of the western portion the Site occurred from 1952 to 1960. In particular, a small ponded area was created during filling operations in the central low area of the western portion of the Site. Results of this investigation can be found in the *Report of Historical*

Activities in the Waste Disposal Site Vicinity (Burns & McDonnell, 2003), and historic filling activities are shown on Figure 4.

2.5 Current and Anticipated Future Site Use

The Site and surrounding area are currently zoned M2 – Heavy Industrial. The majority of the Site is currently used for vehicle and equipment storage. Activities associated with the Rail Loading Building in the eastern portion of the Site were not reviewed for this Revised Workplan. The Site is located within a highly industrialized area of Kansas City, Missouri and zoning is not expected to change in the future. Therefore, the industrial nature of the land use is likely to remain unchanged. Additionally, the Site is located in the 100-year floodplain of the Blue River which limits potential future land uses. For these reasons, it is anticipated that the future land use will remain industrial.

3. CONCEPTUAL SITE MODEL

A conceptual site model (CSM) serves as a basis for evaluating the interaction between contaminant sources, exposure pathways, and receptors. At present, the Site is not well characterized and a CSM has not been developed to represent site conditions. The investigation activities defined in this Revised Workplan will help to further define the nature and extent of contaminants at the site and data obtained during the investigation will be use to develop a CSM and present a pathway and media exposure assessment for the Site.

The following subsections provide the nature and extent and areas of concern for what is currently known about the Site.

3.1 Nature and Extent

As discussed in Section 2, the Northern Parcel is bounded by the Leeds Industrial Park (Former GM Plant) to the north and the Southern Parcel to the south. The Southern Parcel includes the known extent of the FWDS (Figure 4). The majority of subsurface investigation activities conducted to date in the vicinity of the Site have been associated with the GM Plant and the FWDS, rather than at the Northern Parcel.

In 1999, buried drums were discovered on the Northern Parcel during a sewer line extension project. This area was not previously known to have been the location of waste disposal activities. The Drum Discovery Area was investigated (soil borings) and excavation activities were conducted in an attempt to remove drums and associated material. During excavation activities, paint material was observed in drums and green and red material layers were observed in the eastern portion of the excavation. Debris (e.g., brick, metal fragments, foam rubber, bottles, concrete, etc.) was recovered from several of the investigation borings and from within the excavations. The observed paint material may have been from automobile finishing activities at the GM Plant. The green material is suspected to be zinc phosphate undercoating for automobiles and the origin of the red material is unknown though may be a naturally occurring material (Burns & McDonnell, 2000).

During drum removal activities, it became apparent that the vertical and lateral extent of buried drums was greater than anticipated. Removal activities were halted, the excavation was backfilled, and the area was repaved. Pertinent information gleaned from the 1999 drum discovery investigation and recovery includes:

- Pavement encountered at the Site consisted of 4 inches of asphalt and 4 inches of granular sub-base.
- Groundwater was not encountered within the excavation at total depth of 15 feet below ground surface (bgs).
- Fill beneath the pavement ranged from approximately 8 to 12 feet in thickness.
- The debris layer within the Drum Discovery Area dipped steeply to the east. In the western portion of the excavation, the top of debris was found immediately below the pavement whereas the debris layer in the eastern portion of the excavation (approximately 40 feet away) was at 15 feet bgs.

- Soil samples collected during the investigation for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals analysis did not exceed the Toxicity Characteristic Leaching Procedure (TCLP) hazardous levels defined in Code of Federal Regulations (CFR) Chapter 40, Section 261.24.
- Results from a sample of the paint material indicated elevated concentrations of several VOCs, SVOCs, and lead. TCLP analysis of the paint material detected lead and benzene above levels characteristic of hazardous waste.
- A sample of greenish material was collected from the excavation during drum recovery activities with results indicating elevated concentrations of several metals and benzene.
- Horizontal and vertical extents were not defined in the Drum Discover Area.

In January 2000, a geophysical survey was conducted along the western half of the Site to further evaluate the horizontal limits of metal-containing debris (Burns & McDonnell, 2000). The eastern half of the Site was not surveyed due to the presence of parked vehicles that would have interfered with the geophysical equipment performance. Review of the results of the survey indicated that metal debris appeared to extend east and south of the Drum Discovery Area, and likely further toward the eastern half of the Site. Buried metal debris did not appear to extend north or west of the Drum Discovery Area. Figure 5 depicts the survey findings for metal-containing debris.

As discussed above, the majority of investigation activities conducted to date has been associated with the Former GM Plant (to the north of the Site) and the FWDS (to the south of the Site). In 1990 and 1991, four monitoring wells and two borings were installed along the southern Site boundary to investigate the FWDS. Results of this study can be found in the *Report on the Site Characterization of the Former Waste Disposal Area* (Burns & McDonnell, 1992). These wells were abandoned in 1994. No other groundwater monitoring wells have been installed or currently exist to characterize groundwater on the Site.

3.2 Constituents of Concern

Due to limited existing site characterization data, current understanding of potential constituents of concern are based on review of prior investigations at areas to the north and south of the Site and results of samples collected during the drum recovery effort in 1999. The potential constituents of concern have been identified as the VOCs, SVOCs, polychlorinated biphenyls (PCBs), and metals listed in Table I. Soil and groundwater samples collected during investigation activities defined in this Revised Workplan will be analyzed for these constituents of concern. It is anticipated that results from these investigation activities may be used to modify the Site-specific constituents of concern; this information will be documented in the site investigation report discussed further in Section 6.3.

3.3 Potential Exposure Pathways and Receptors

Soil and groundwater are the primary environmental media that may be impacted by potential constituents of concern at the Site.

Potential exposure pathways to soil could include direct contact (incidental ingestion and dermal contact), inhalation of dust and vapor released from the soil to ambient (outdoor) air, or by inhalation of vapors released from soil into current or future buildings (i.e. vapor intrusion to indoor air).

It is not anticipated that groundwater at and in the vicinity of the Site is used as a source of potable water. This will be evaluated further as part of the groundwater survey to be conducted as discussed in Section 5.1. In addition, there are no current or planned groundwater wells that would be used for extraction of groundwater for non-potable purposes. Data collected during proposed investigation activities will be used to evaluate the hydrology of groundwater at the Site and demonstrate whether migration of contaminated groundwater may be occurring. Because the water table at the Site is at or below 15 feet bgs, potential exposure pathways to contaminated groundwater are not currently considered complete for ingestion or dermal contact by Site workers or construction workers. The only potential exposure pathway to groundwater under current land use conditions would be associated with vapor intrusion into current or future buildings.

Data collected during proposed investigation activities will be used to further evaluate the potential exposure pathways and receptors for the Site; this information will be documented in the site investigation report discussed further in Section 6.3.

3.4 Areas of Concern

Geophysical survey findings (Burns & McDonnell, 2000), topography, and fill placement chronology for the Site were reviewed to identify areas of concern that are the focus of investigation activities defined in this Revised Workplan. As documented in the *Report on Historical Activities in the Waste Disposal Site Vicinity* (Burns & McDonnell, 2003), aerial photograph stereo pairs were reviewed to develop a chronology of fill placement across the Site. Topographic low areas south of the GM Plant appear to be abandoned meander loop channels within the floodplain of the Blue River (Burns & McDonnell, 2003). Figure 4 identifies the former location of an apparent meander loop channel and graphically depicts the chronology of fill placement across the Site.

Based on review of available data, two primary areas of concern for subsurface fill/potential buried objects have been identified as shown on Figure 6. These areas are generally described as: 1) the area of anomalous zones identified in the 2000 geophysical survey that appear to have significant buried objects; and, 2) the eastern portion of the Site for which no prior geophysical survey has been conducted and the presence of potential buried objects is unknown. These areas will be the focus of test pit activities during the initial field event. Additionally, shallow (water table) and deep (top of bedrock) groundwater monitoring wells will be installed during investigation activities to provide information on groundwater concentrations and stratigraphic profile of subsurface Site conditions.

Supplemental groundwater investigation locations have also been selected as shown on Figure 6. As discussed further in Section 4.2, real-time findings during initial field investigation activities may be used to alter supplemental investigation locations and/or depths as necessary.

4. WORKPLAN RATIONALE

4.1 Data Requirements

As stated in Section 1.1, this Workplan has been prepared for data collection activities that will support the following project objectives:

- Characterize the nature of anomalous areas of possible metallic objects as identified during a geophysical survey conducted at the site from January 26 through January 28, 2000;
- Identify the potential for additional, unknown areas of buried drums beyond the area of buried drums discovered onsite in 1999; and
- Characterize overburden groundwater quality at the Site from the water table down to the top of bedrock for contaminants that may be mobile within the groundwater.

Results from data collection activities will provide additional information regarding Site stratigraphy, hydrogeology, and the nature and extent of potentially hazardous constituents in soil and groundwater. This information can then be used to develop a CSM for the Site (discussed in Section 3.) and to evaluate the potential risk to human health and the environment associated with constituents that may be present in soil and/or groundwater.

Site-specific health-based action levels have not been selected for the Northern Parcel. As a preliminary screening tool during Site investigation activities, the U.S. Environmental Protection Agency's (EPAs) Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (EPA, 2011) will be used. As discussed in Section 2.5, future land use at the site is expected to remain industrial; therefore, the industrial RSLs for soil will be used. Maximum contaminant levels (MCLs) will be used as conservative screening levels for groundwater. These preliminary screening levels for comparing investigation results are documented in Table I. As discussed further in the QAPP (Appendix A), laboratory reporting and detection limits will be identified at sufficiently low levels to enable effective screening using the RSLs.

Once sufficient data has been obtained and a CSM has been prepared, site-specific risk-based standards may be developed to identify health-based action levels for soil and groundwater that are appropriate for Site conditions and use.

The QAPP provides further detail regarding specific objectives for field and laboratory data to ensure project objectives (defined above) can be achieved.

4.2 Approach

A phased investigation approach will be implemented to allow for a systematic approach at identifying areas of concern and providing sufficient and appropriate data for further evaluation of stratigraphy, hydrogeology, and potential risk due to hazardous constituents at the Site. The phased investigation approach assumes an initial field event followed by supplemental field activities to be determined based on review of data collected during the initial event.

Proposed initial and supplemental groundwater monitoring well and test pit investigation locations have been selected as shown in Figure 6 based on findings of past investigations and/or historic site conditions. Results from the proposed geophysical survey (see Section 5.1.2) may be used to alter selected groundwater monitoring well and test pit locations planned for the initial field event (discussed further in Section 5.1). The final decision regarding supplemental groundwater monitoring well locations will be evaluated based on results from the geophysical survey and initial investigation activities as discussed in Section 5.2. Adjustments to monitoring well and/or test pit locations will be discussed with RACER and MDNR prior to implementation in the field. Further investigation may be warranted based on findings of the proposed investigation activities defined in this Revised Workplan. Additional investigation efforts would be discussed with RACER and MDNR and would be addressed in a Workplan Addendum.

5. INVESTIGATION ACTIVITIES

The proposed investigation will consist of the following activities designed to meet the project objectives defined in Section 1.1:

- A geophysical survey by means of either ground penetrating radar (GPR) or magnetic/electromagnetic instruments to identify the potential presence of additional unknown areas of buried objects;
- Installation of monitoring wells to characterize stratigraphy and groundwater quality from the water table down to bedrock; and
- Test pits to identify the nature of anomalous areas and buried objects and to characterize potential site constituents in soil.

As discussed in Section 4.2, investigation activities will be conducted in a phased approach. The proposed phases included the following activities:

Initial Investigation:
- Planning
- Geophysical Survey
- Initial Monitoring Well Installation and Groundwater Sampling
- Test Pit Exploration and Sampling

Supplemental Investigation:
- Supplemental Monitoring Well Installation and Groundwater Sampling

The following sections define the tasks required to execute the proposed investigation activities and additional details of proposed investigation activities are provided in the QAPP.

5.1 Initial Investigation

5.1.1 Planning

Prior to mobilizing for field activities, Haley & Aldrich will provide RACER and MDNR with a minimum two-week notice of the start date and anticipated schedule for field activities. This will allow interested parties to plan for oversight of work performed at the Site and sufficient time for MDNR to plan for collecting split samples, if desired.

Requirements for monitoring well installation and construction per MDNR Publication 2175, *Missouri Well Construction Rules*, dated August 2009, will be reviewed and if necessary, exemption requests will be submitted to the State of Missouri prior to investigation implementation.

5.1.1.1 ***Site Reconnaissance***

A reconnaissance of the Site will be conducted to assess current conditions. This task will include a visual inspection of the drainage pathway(s) across the Site, identification of equipment

parked and/or stored onsite, and verification of historical information and/or review of as-built drawings if they become available. The entire area will also be photographed to document site conditions prior to intrusive site activities. Information obtained during Site reconnaissance may be used to coordinate with facility management to temporarily move vehicles and equipment that may interfere with planned site activities.

5.1.1.2 ***Groundwater Use Survey***

A groundwater use survey will be conducted to evaluate current groundwater use within a one-mile radius of the Site. This evaluation will include review of Jackson County Health Department records and MDNR potable water well logs in an attempt to determine if current groundwater users exist within a one-mile radius of the Site and to evaluate, to the extent possible, well depth, static water levels, pumping rates and perforated intervals of the identified wells. Finally, customer lists from community water supply systems, if any, located within one mile of the site will be obtained. A "windshield survey" will then be conducted to verify the locations and addresses of potential groundwater users identified in the above data sources. These data sources will then be compared and evaluated, with a map prepared to depict each identified potable water well location and other pertinent information. Based on this evaluation, wells located within one mile of the Site will be labeled either "used for potable purposes", "not used for potable purposes", "abandoned", or "results unclear, more evaluation needed".

5.1.1.3 ***Utility Survey***

Proposed test pit and groundwater monitoring well locations will be marked onsite using lathe/flags and/or fluorescent paint and a utility location survey will be performed prior to mobilization through the use of the Missouri one-call utility locator service. If Site as-built drawings are available, these will also be reviewed and private utility locations will be marked to avoid buried Site utility features during investigation activities. If drawings showing private utilities are not available, consideration will be given to hiring a private utility locator service or using the GPR survey equipment (if selected, as discussed further in Section 5.1.2) to locate utilities within Site boundaries. Additionally, the site will be viewed in detail for physical evidence of buried lines or structures, including pavement cuts and patches, variation in or lack of vegetation, variations in grading, etc. Care must also be taken to observe and avoid overhead utilities during investigation activities. Presence of surface elements of buried utilities should be documented, such as manholes, gas or water service valves, catch basins, monuments or other evidence. If obstructions are observed at the location of proposed test pit and/or groundwater monitoring wells, the locations will be adjusted; modified locations will be reviewed with RACER and MDNR to ensure they still meet project objectives.

5.1.1.4 ***Site Survey***

A metes and boundary survey and a topographic survey of the Site will be completed as described in the QAPP, Section 6.2.6. A Professional Surveyor, licensed in the State of Missouri, will complete this survey.

5.1.2 Geophysical Survey

A geophysical survey is proposed for accessible areas across the Northern Parcel as shown on Figure 5. Pending agreement and approval by MDNR regarding methodology, the survey will be conducted by means of GPR or magnetic/electromagnetic instruments.

The geophysical survey will be conducted prior to monitoring well installation or test pit excavation to identify the potential presence of additional unknown areas of buried objects within the bounds of the Site. Results of the geophysical survey will be tied into the Site survey and may then be used to refine monitoring well and/or pit locations, as appropriate.

The GPR works by sending an electromagnetic "pulse" in the microwave band directly into the ground. This "pulse" is then reflected off of objects under the surface and sent back to the antenna and processed by a control unit. The control unit interprets the reflected "pulses" and provides the technician a visual representation of the reflections. This display is then used to identify targets in the subsurface such as metallic and non-metallic conduits, drums, and other debris. The GPR may also be used to identify private utility lines not located by a public one-call service. A Site benchmark location is provided to the GPR subcontractor prior to initiating the survey so the GPR survey locations can be tied to the Site map.

Penetration depth of the radio frequency is dependent upon subsurface conditions; however, it is anticipated that a depth of approximately 40 feet may be obtained at the Site using a 200 MHz antenna. Data obtained by the reflected “pulses” can be graphically presented in a 3-dimensional (3D) image showing what is in the subsurface. This 3D image can provide a sense of what is in a specific area by showing size, orientation, and depth of the buried objects.

The electromagnetic instrument works on the principle of induction, using a transmitter and a receiver. An alternating voltage applied to the transmitter causes electrical eddy currents to be induced in the earth. The electrical currents flowing in the earth are proportional to electrical conductivity of the medium. These currents in turn generate a secondary magnetic field that is detected and measured by the receiver. The responses are recorded and displayed by an integrated digital data logger. Depth of detection for a drum is approximately 10 feet bgs. This instrument works well to pinpoint metallic targets in the subsurface and can be used in proximity to metallic surface features, such as fences or buildings, without interference.

A magnetic survey is conducting using an instrument with magnetometer and gradiometer sensors. This instrument is highly sensitive and can detect a single drum buried to a depth of approximately 20 feet bgs. However, due to the sensitivity of the sensors, interference with surrounding metal objects and/or multiple buried metallic objects may provide a broader footprint reading (i.e., not as accurate or pinpointed).

Procedures for conducting the geophysical survey will be specific to the method (i.e., GPR or magnetic/electromagnetic) agreed upon with RACER and MDNR and selected for implementation at the Site.

5.1.3 Initial Monitoring Well Installation and Groundwater Sampling

The initial groundwater investigation event includes installation of nine shallow overburden groundwater monitoring wells to approximately 20 feet bgs and four deep overburden wells to approximately 60 feet bgs. Proposed well construction information is provided in Table II. As noted in Table II, well depths, screened zones, and associated construction material intervals may be altered based on findings during drilling to ensure wells are installed in the proper water bearing zones (water table and top of bedrock) to provide hydrogeologic characterization. The proposed well locations are identified on Figure 6. As discussed in Section 4.2, the initial locations may be adjusted based on results of the geophysical survey; adjustments will be discussed with RACER and MDNR prior to implementing in the field.

5.1.3.1 *Monitoring Well Drilling and Installation*

Monitoring wells will be installed by a well driller licensed in the State of Missouri in accordance with the Missouri Water Well Drillers Act, Sections 256.600 to 256.640 RSMo. Well borings will be advanced using a hollow stem auger (HSA), rotosonic, or equivalent method as described in Section 6.2.1 of the QAPP (Appendix A).

Lithologic logs will be prepared for each well boring based on the visual examination of auger cuttings and drill core. As described in QAPP Section 6.2.2, the following information will be recorded on the well boring log: soil description, recovery results, field screening (photoionization detector [PID] readings), and depth to water. Collection of cores for logging and field screening are discussed further in the QAPP, Sections 6.2.1 and 6.2.3, respectively. A Well Boring Log form is provided in Appendix C. The naming scheme identified in Table II will be used for all newly installed monitoring wells. No soils samples will be collected from monitoring well boreholes for chemical analysis.

Monitoring wells will be constructed using 2-inch diameter (ID) Schedule 40 polyvinyl chloride (PVC) well screen and riser pipe. The well screens will be factory-slotted to 0.010-inch. Proposed well installation and construction details are provided in Table II; however, lengths of well screen and riser pipe may be adjusted based on field conditions. Additional details for well construction requirements are described in the QAPP, Section 6.2.4.

Due to vehicular traffic at the Site, monitoring wells will be completed flush with the surrounding grade per the *Missouri Well Construction Rules*. Construction details for each monitoring well will be recorded in the field logbook during installation and subsequently reported on a well construction diagram; a Well Installation Log form is provided in Appendix C.

The well driller will complete State-required well certification forms and submit to the State as required by Missouri Water Well Drillers Act, Section 256.614.

5.1.3.2 *Well Development*

After 24 hours following installation, each newly installed well will be developed as described in the QAPP, Section 6.2.5. The pumping method and rate, volume of water removed, observations of groundwater color and clarity, and parameter stabilization measurements obtained during

development will be recorded on individual well development forms. A template Monitoring Well Development Log Form is provided in Appendix C.

5.1.3.3 ***Water Level Measurements***

Water level measurements will be collected at each monitoring well installed during investigation activities. Wells will be allowed to stabilize for a minimum of one week following development before groundwater levels are collected. One round of static water levels from the newly installed monitoring wells will be collected prior to collecting groundwater samples. Water level measurements, measuring point locations, and time and date of collection will be entered in the field logbook and/or on field sampling forms. Additional details regarding water level measurements are provided in the QAPP, Section 6.2.7.

5.1.3.4 ***Groundwater Sampling***

Groundwater samples will be collected from each well using low-flow methods (e.g., bladder pumps or submersible variable rate pumps). If low-flow cannot be used for location-specific reasons, bailers may be used to collect groundwater samples. Section 6.2.8 of the QAPP (Appendix A) provides sampling procedures for both low-flow and bailers. During purging of the well, the following field indicator parameters will be monitored and recorded on the Low-Flow Groundwater Sampling Record (template provided in Appendix C): pH, temperature, specific conductivity, oxidation-reduction reaction potential (ORP), dissolved oxygen (DO), and turbidity. Stabilization is considered achieved when three consecutive readings for each parameter are within 10 percent of each other. Section 6.2.8 of the QAPP (Appendix A) provides additional details regarding stabilization and sample collection.

Samples collected will be submitted to TestAmerica located in Nashville, Tennessee, an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Samples collected from monitoring wells will follow the sample collection, sample handling, and sample preservation methods provided in the QAPP. Sample names will follow the naming convention provided in the QAPP, Section 6.3.2 Samples will be analyzed for the list of potential constituents of concern documented in Table I and further discussed in the QAPP, Section 6.4 (Appendix A).

5.1.3.5 ***In-Situ Permeability Testing***

Slug tests will be conducted to estimate the permeability of the aquifer(s) identified at the Site as further described in Section 6.2.9 of the QAPP. Slug test data from each well will be analyzed to calculate hydraulic conductivity values using AQTESOLV™ or an equivalent commercially available software program.

5.1.3.6 ***Decontamination Procedures***

The drill rods, augers and down-hole equipment will be steam cleaned before startup of field operations and after each boring using a high-pressure, high temperature, hot water cleaner. Non-dedicated sampling equipment (e.g., water level meter, pumps, etc.) will be decontaminated prior to and immediately after use at each sampling point or location. Additional details regarding decontamination procedures are provided in the QAPP, Section 6.2.12.

Tubing will be dedicated to each monitoring well during purging and sampling activities and will be disposed of after sampling of each well is completed.

5.1.3.7 ***Well Abandonment***

At this time, no plans are in place for abandoning Site monitoring wells. Monitoring wells will remain in place until an agreement has been reached with MDNR that sufficient groundwater data has been collected. Borings not completed as monitoring wells, if any, will be properly plugged in accordance with MDNR Publication 2175, *Missouri Well Construction Rules*, dated August 2009.

5.1.4 Test Pit Exploration and Sampling

A focused subsurface exploration investigation will be completed by installing approximately 20 to 22 test pits at proposed locations specified on Figure 6. Test pit locations have been selected to target the Drum Discovery Area, geophysical survey anomalies, and areas of concern for subsurface fill/potential buried objects as shown on Figure 6. Test pit exploration activities will help determine the depth of buried materials at the Site and to the extent practicable, the volume of waste present in the subsurface. The number and location of test pits may be adjusted in the field based on results obtained from the proposed geophysical survey and/or initial monitoring well installations.

5.1.4.1 ***Test Pit Excavations***

Test pits will be excavated to total depths corresponding to approximately 3 to 5 feet into native soil (assumed to be between approximately 15 to 20 feet bgs in most locations) unless the capability of the excavator is exceeded by depth or obstructions. Section 6.2.10.1 of the QAP provides additional details for test pit excavations.

Test pits will be logged and photographed to document the nature of the material/soil within the test pit, identify soil/backfill horizons, and other observations such as water level (if encountered), PID readings, visual staining, and stratification. Dimensions (length, width, and depth) of each test pit will be graphically shown on the Environmental Test Pit Log (template provided in Appendix C). The naming scheme for all newly excavated test pits will be TP-1001, TP-1002, etc.

The spoils from the test pits will be collected on polyethylene sheeting, and the open excavation and spoils will be photographed. If intact drums are encountered during excavating, these will be left in place for future remediation, except as noted in Section 5.5. Observations and locations of drum remnants, intact drums, or other significant findings (e.g., condition of containers, layers of colored fill material, etc.) will be documented in the field logbook with clear location identification in the event that removal is required in the future. Due to safety concerns, work area access concerns, and surface water runoff concerns, test pits will be backfilled immediately after sampling is complete. No test pit excavations will remain open overnight.

5.1.4.2 ***Test Pit Sampling***

One to three soil samples will be collected from each test pit with sample locations determined by field conditions such as: total depth, stratigraphy, olfactory and visual observations (i.e., staining, drum remnants, etc.), and PID readings. Representative samples will be collected from soils brought to the surface in the bucket of the excavator. Soil samples will be sent to TestAmerica for analysis of potential constituents of concern as documented in Table I and further discussed in the QAPP, Section 6.4 (Appendix A).

Presence of groundwater within a test pit may be one selection criteria used for selecting sample locations within the pit. If groundwater is encountered within a test pit, conditions within the pit will be evaluated and if sampling is deemed appropriate, a grab water sample and a grab soil sample from above the water table may be collected. Samples will be submitted to TestAmerica for analysis of potential constituents of concern (Table I). Additional information on soil and/or groundwater samples collected from within a test pit is provided in Section 6.2.10.2 of the QAPP.

Samples collected from the test pits will follow the sample collection, sample handling, and sample preservation methods provided in the QAPP. Sample names will follow the naming convention provided in the QAPP, Section 6.3.2

5.1.4.3 ***Drum Inspection and Sampling***

The intent of the test pit exploration activities is to characterize soil and identify the nature of anomalous areas and buried objects within the Site boundaries. If drums and/or drum remnants are uncovered in a test pit, they will be inspected by field staff from the ground surface or by bringing the drum to the surface using the excavator (if the drum appears to be structurally intact). For safety reasons, no work will be conducted from within the excavations. Additional details regarding drum inspections are provided in the QAPP, Section 6.2.11.

It is anticipated that excavated material will be returned back to the test pits upon completion. However, in the event drums are encountered, the following contingency procedures have been identified.

Drum Remnants: If drum remnants are encountered during test pit exploration, remnants may be excavated and placed on the plastic sheeting as discussed in Section 5.1.4.1. These locations will be evaluated at the time they are discovered and may be selected as locations for soil sampling (Section 5.1.4.2) to evaluate potential release of contaminants at those locations. Drum remnants will be returned to the test pit along with excavated soils.

Intact Drums: In the event that intact drums are encountered during test pit exploration, a provision has been included within this Revised Workplan to remove the intact drums from the test pits for characterization testing and disposal, as appropriate and agreed upon between RACER and MDNR. Results of drum inspections may be used to select drums for sampling, determine appropriate sampling methods, and determine appropriate analytical methods. Decisions will be made in the field regarding intact drums selected for characterization testing. In particular, a drum will not be selected for sampling if it is bulging, shows signs of corrosion,

and/or has mineralization around the bungs or drum tops. Intact drums encountered but not selected for characterization testing will be left in the test pits for future remediation.

Drums removed from the excavation for characterization testing will be placed in over-pack vessels and the contents will be sampled. Additional detail on drum selection, sampling, health & safety and disposal are provided in Section 6.2.11.2 of the QAPP.

5.1.4.4 ***Decontamination Procedures***

The excavator will be steam cleaned before startup of field operations and after each test pit using a high-pressure, high temperature, hot water cleaner. Non-dedicated sampling equipment will be decontaminated prior to and immediately after use at each sampling point or location. Additional details regarding decontamination procedures are provided in the QAPP, Section 6.2.12.

5.2 Supplemental Investigation

Supplemental investigation activities assume up to nine additional groundwater monitoring wells may be installed; proposed locations are identified on Figure 6. Geophysical survey and sample results from the initial investigation activities will be reviewed and used to confirm if proposed supplemental monitoring well locations are deemed appropriate or necessary. Additional consideration will be given to whether wells should be screened as shallow (water table) or deep (atop bedrock). Proposed supplemental well installations will be discussed with RACER and MDNR prior to implementation.

Groundwater monitoring wells will be installed, developed and sampled as discussed in Section 5.1.3. Once supplemental investigation monitoring wells have been installed and developed, a second round of static water level measurements will be collected from each well installed (initial and supplemental). A second round of groundwater samples will also be collected that will include each monitoring well installed at the Site during both initial and supplemental investigation activities. The need for additional groundwater sampling will be evaluated based on results from investigation activities and documented in the site investigation report discussed further in Section 6.3.

5.3 Waste Handling

Spoils from test pit exploration activities will be returned to the excavation, thereby minimizing the amount of investigation-derived waste (IDW) generated during investigation activities.

IDW consisting of drill cuttings, and development and decontamination fluids derived during the soil boring advancement/monitoring well installation, testing and sampling activities, will be containerized in 55-gallon Department of Transportation (DOT)-approved steel drums, labeled, and stored temporarily onsite. Results from soil and groundwater sampling may be used to characterize the IDW and determine appropriate methods for disposal. Disposable materials generated during field activities (i.e., bailers, disposable bladders, gloves, paper towels, tyvek, visqueen, and tubing) will be collected and contained for proper disposal as municipal solid waste. Additional details on waste handling procedures are provide in Section 6.2.13 of the QAPP.

5.4 Site Restoration

It is expected that minimal surface disturbance will result from the monitoring well drilling and installation. Restoration of the well sites will consist of removing cuttings, and trash or debris. Ruts created will be smoothed.

Test pit locations will be compacted with the excavator, and the asphalt pavement will be replaced. Based on information from prior investigation activities, it is assumed that a 4-inch granular sub-base will be placed at the top of the test pit and a 4-inch asphalt cover will complete the restoration activities.

5.5 Final Site Survey

Once the wells have been installed and test pit locations have been resurfaced, a final horizontal and vertical survey will be conducted for new site objects and sampling locations. This survey will include ground surface and top of casing measurement points for groundwater monitoring wells, surveyed to the nearest 0.01 foot, as discussed in Section 6.2.6 of the QAPP. The top of casing elevation will be marked for future reference, with the north side of the casing as the default location. Approximate locations for soil samples, buried debris, or other features may also be marked at the surface by field staff using lathe and/or paint for final survey. A Professional Surveyor, licensed in the State of Missouri, will conduct the aforementioned work.

6. PROJECT MANAGEMENT

6.1 Staffing and Coordination

Haley & Aldrich will oversee site investigation activities. This includes being the primary point of contact for site investigation communications and coordinating approvals and modification approvals (if necessary) with RACER and MDNR. Haley & Aldrich will provide overall review and tracking of the project schedule and budget, coordinate field and office activities, contract and manage subcontractors, coordinate with the analytical laboratory, and develop deliverables.

Haley & Aldrich will coordinate the site investigation schedule with the RACER CM and MDNR RPM. This includes providing a minimum two-week notice prior to initiating field events so that RACER and/or MDNR may schedule to be onsite and/or to collect split samples, if desired.

6.2 Health and Safety

A Site-specific HASP has been prepared which includes Site engineering controls, monitoring requirements, action levels, personal protection equipment requirements, a list of emergency contacts, and a map to the nearest health care facility. The HASP is included in Appendix B.

Field personnel will be given time to review and sign the HASP prior to commencement of field activities. In addition, a health and safety meeting will be conducted at the start of each day during activities to identify and address Site- and project-specific health and safety issues, and to discuss individual concerns of the field personnel.

6.3 Reporting

A report will be submitted within sixty days of receipt of validated analytical results from the second round of groundwater sampling.

The project report will provide illustrations, tables, and graphs summarizing the geophysical survey, soil boring advancement, well construction, test pit excavation, and sampling activities and the analytical results. These will include lithologic logs, development logs, well construction schematics, water level data tables and contour maps, and groundwater analytical data tables.

The report will present a discussion, conclusions and recommendations for further assessment, if warranted, and/or recommended next steps for remediation activities.

6.4 Schedule

A Site specific schedule is included as Figure 7. This schedule is dependent upon MDNR review and approval of this Revised Workplan and approval of the budget by MDNR and RACER for conducting the of the proposed investigation work.

7. REFERENCES

1. Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell); Report on the Site Characterization of the Former Waste Disposal Site, Leeds Assembly Plant, General Motors Corporation, Kansas City, Missouri; January 1992.

2. Burns & McDonnell; Former General Motors Leeds Plant, Kansas City, Missouri, Well Abandonment Report; September 1997.

3. Burns & McDonnell; Subsurface Investigation Report, Buried Drum Discovery, Former General Motors Leeds Assembly Plant, Kansas City, Missouri; July 1999.

4. Burns & McDonnell; Remedial Action Report, Recovery of Buried Drums, Former General Motors Leeds Assembly Plant, Kansas City, Missouri; August 2000.

5. Burns & McDonnell; Report of Historical Activities in the Waste Disposal Site Vicinity, Former GM Leeds Assembly Plant, Kansas City, Missouri; October 2003.

6. U.S. Environmental Protection Agency (EPA); Regional Screening Levels for Chemical Contaminants at Superfund Sites; http://www.epa.gov/region09/superfund/prg/; last updated June 2011.

TABLES

TABLE I
PRELIMINARY RISK-BASED SCREENING LEVELS FOR POTENTIAL CONSTITUENTS OF CONCERN
RACER TRUST - FORMER LEEDS ASSEMPLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Potential Constituent of Concern	CAS No.	Preliminary Risk-Based Screening Levels [a]	
		Industrial Soil (mg/kg)	MCL (µg/L)
Volatile Organic Compounds (VOC)			
Acetone	67-64-1	6.30E+05	-
Benzene	71-43-2	5.40E+00	5.00E+00
Bromochloromethane	74-97-5	6.80E+02	-
Bromodichloromethane	75-27-4	1.40E+00	8.00E+01
Bromoform	75-25-2	2.20E+02	8.00E+01
Bromomethane	74-83-9	3.20E+01	-
2-Butanone	78-93-3	-	-
Carbon disulfide	75-15-0	3.70E+03	-
Carbon tetrachloride	56-23-5	3.00E+00	5.00E+00
Chlorobenzene	108-90-7	1.40E+03	1.00E+02
Chloroethane	75-00-3	-	-
Chloroform	67-66-3	1.50E+00	8.00E+01
Chloromethane	74-87-3	5.00E+02	-
Cyclohexane	110-82-7	2.90E+04	-
Dibromochloromethane	124-48-1	3.30E+00	8.00E+01
1,2-Dibromo-3-chloropropane	96-12-8	6.90E-02	2.00E-01
1,2-Dibromoethane	106-93-4	1.70E-01	5.00E-02
1,2-Dichlorobenzene	95-50-1	9.80E+03	6.00E+02
1,3-Dichlorobenzene	541-73-1	-	-
1,4-Dichlorobenzene	106-46-7	1.20E+01	7.50E+01
Dichlorodifluoromethane	75-71-8	4.00E+02	-
1,1-Dichloroethane	75-34-3	1.70E+01	-
1,2-Dichloroethane	107-06-2	2.20E+00	5.00E+00
1,1-Dichloroethene	75-35-4	1.10E+03	7.00E+00
cis-1,2-Dichloroethene	156-59-2	2.00E+03	7.00E+01
trans-1,2-Dichloroethene	156-60-5	6.90E+02	1.00E+02
1,2-Dichloropropane	78-87-5	4.70E+00	5.00E+00
cis-1,3-Dichloropropene	10061-01-5	-	-
trans-1,3-Dichloropropene	10061-02-6	-	-
Ethylbenzene	100-41-4	2.70E+01	7.00E+02
2-Hexanone	561-78-6	1.40E+03	-
Isopropylbenzene	98-82-8	-	-
Methyl acetate	79-20-9	1.00E+06	-
Methylene chloride	75-09-02	5.30E+01	5.00E+00
Methylcyclohexane	108-87-2	-	-
4-Methyl-2-pentanone	108-10-1	5.30E+04	-
Methyl tert-butyl ether	1634-04-4	2.20E+02	-
Propyl benzene,n-	103-65-1	2.10E+04	-
Styrene	100-42-5	3.60E+04	1.00E+02
1,1,2,2-Tetrachloroethane	79-34-5	2.80E+00	-
Tetrachloroethene	127-18-4	2.60E+00	5.00E+00
Tetrahydrofuran	109-99-9	-	-
Toluene	108-88-3	4.50E+04	1.00E+03
1,2,4-Trichlorobenzene	120-82-1	9.90E+01	7.00E+01

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RACER TRUST - FORMER LEEDS ASSEMPLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Potential Constituent of Concern	CAS No.	Preliminary Risk-Based Screening Levels [a]	
		Industrial Soil (mg/kg)	MCL (µg/L)
1,1,1-Trichloroethane	71-55-6	3.80E+04	2.00E+02
1,1,2-Trichloroethane	79-00-5	5.30E+00	5.00E+00
Trichloroethene	79-01-6	1.40E+01	5.00E+00
Trichlorofluoromethane	75-69-4	3.40E+03	-
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	-	-
Vinyl Chloride	75-01-4	1.70E+00	2.00E+00
Xylenes (total)	1330-20-7	2.70E+03	1.00E+04
Semi-Volatile Organic Compounds (SVOC)			
Acenapthene	83-32-9	-	-
Acenaphthylene	208-96-8	-	-
Acetophenone	98-86-2	1.00E+05	-
Anthracene	120-12-7	-	-
Atrazine	1912-24-9	7.50E+00	3.00E+00
Benzaldehyde	100-52-7	1.00E+05	-
Benzo(a)anthracene	56-55-3	-	-
Benzo(b)fluoranthene	205-99-2	-	-
Benoz(k)fluorathene	207-08-9	-	-
Benzo(g,h,I)perylene	191-24-2	-	-
Benzo(a)pyrene	50-32-8	-	-
1,1-Biphenyl	92-52-4	2.10E+02	-
4-Bromophenylphenyl ether	101-55-3	-	-
Butyl benzyl phthalate	85-68-7	9.10E+02	-
di-n-Butyl phthalate	87-74-2	-	-
Caprolactam	105-60-2	3.10E+05	-
Carbazole	86-74-8	-	-
4-Chloroaniline	106-47-8	8.60E+00	-
bis(2-Chloroethoxy)methane	111-91-1	1.80E+03	-
bis(2-Chloroethyl)ether	111-44-4	1.00E+00	-
bis(2-Chloroisopropyl)ether	108-60-1	-	-
4-Chloro-3-methylphenol	59-50-7	-	-
2-Chloronaphthalene	91-58-7	8.20E+04	-
2-Chlorophenol	95-57-8	5.10E+03	-
4-Chlorophenyl phenyl ether	7005-72-3	-	-
Chrysene	218-01-9	-	-
Dibenz(a,h)anthracene	53-70-3	-	-
Dibenzofuran	132-64-9	-	-
3,3-Dichlorobenzidine	91-94-1	3.80E+00	-
2,4-Dichlorophenol	120-83-2	1.80E+03	-
Diethylphthalate	84-66-2	4.90E+05	-
2,4-Dimethylphenol	105-67-9	1.20E+04	-
Dimethylphthalate	121-11-3	-	-
4,6-Dinitro-2-methylphenol	534-52-1	-	-
2,4-Dinitrophenol	51-28-5	1.20E+03	-
2,4-Dinitrotoluene	121-14-2	5.50E+00	-

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RACER TRUST - FORMER LEEDS ASSEMPLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Potential Constituent of Concern	CAS No.	Preliminary Risk-Based Screening Levels [a]	
		Industrial Soil (mg/kg)	MCL (µg/L)
2,6-Dinitrotoluene	606-20-2	6.20E+02	-
bis(2-Ethylhexyl)phthalate	117-81-7	1.20E+02	6.00E+00
Fluoranthene	206-44-0	-	-
Fluorene	86-73-7	-	-
Hexachlorobenzene	118-74-1	1.10E+00	1.00E+00
Hexachlorobutadiene	87-68-3	2.20E+01	-
Hexachlorocyclopentadiene	77-47-4	3.70E+03	5.00E+01
Hexachloroethane	67-72-1	1.02E+02	-
Indeno(1,2,3-cd)pyrene	193-39-5	-	-
Isophorone	78-59-1	1.80E+03	-
2-Methylnaphthalene	91-57-6	-	-
2-Methylphenol	95-48-7	-	-
3/4-Methylphenol	106-44-5	-	-
Naphthalene	91-20-3	-	-
2-Nitroaniline	88-74-4	6.00E+03	-
3-Nitroaniline	99-09-2	-	-
4-Nitroaniline	100-01-6	8.60E+01	-
Nitrobenzene	98-95-3	2.40E+01	-
2-Nitrophenol	88-75-5	-	-
4-Nitrophenol	100-02-7	-	-
N-Nitroso-di-n-propylamine	621-64-7	2.50E-01	-
N-Nitrosodiphenylamine (diphenylamine)	86-30-6	3.50E+02	-
di-n-Octyl phthalate	117-84-0	-	-
Pentachlorophenol	87-86-5	2.70E+00	1.00E+00
Phenanthrene	85-01-8	-	-
Phenol	108-95-2	1.80E+05	-
Pyrene	129-00-0	-	-
2,4,5-Trichlorophenol	95-95-4	6.20E+04	-
2,4,6-Trichlorophenol	88-06-2	1.60E+02	-
Polychlorinated Biphenyls (PCBs)			
Aroclor 1016	12674-11-2	2.10E+01	-
Aroclor 1221	11104-28-2	5.40E-01	-
Aroclor 1232	11141-16-5	5.40E-01	-
Aroclor 1242	53469-21-9	7.40E-01	-
Aroclor 1248	12672-29-6	7.40E-01	-
Aroclor 1254	11097-69-1	7.40E-01	-
Aroclor 1260	11096-82-5	7.40E-01	-
Glycols			
Ethylene glycol	107-21-1	1.20E+06	-
Metals			
Antimony	7440-36-0	4.10E+02	6.00E+00
Arsenic	7440-38-2	1.60E+00	1.00E+01

TABLE I
PRELIMINARY RISK-BASED SCREENING LEVELS FOR POTENTIAL CONSTITUENTS OF CONCERN
RACER TRUST - FORMER LEEDS ASSEMPLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Potential Constituent of Concern		CAS No.	Preliminary Risk-Based Screening Levels [a]	
			Industrial Soil (mg/kg)	MCL (µg/L)
	Barium	7440-39-3	1.90E+05	2.00E+03
	Beryllium [b]	7440-41-7	2.00E+03	4.00E+00
	Cadmium	7440-43-9	8.00E+02	5.00E+00
	Chromium [b]	7440-47-3	-	1.00E+02
	Hexavalent Chromium [b]	18540-29-9	5.60E+00	-
	Cobalt	7440-48-4	3.00E+02	-
	Copper	7440-50-8	4.10E+04	1.30E+03
	Cyanide (total) [b]	57-12-5	2.00E+04	2.00E+02
	Lead	7439-92-1	8.00E+02	1.50E+01
	Manganese	7439-96-5	2.30E+04	-
	Mercury	7439-97-6	4.30E+01	2.00E+00
	Nickel	7440-02-0	2.00E+04	-
	Selenium	7782-49-2	5.10E+03	5.00E+01
	Silver	7740-22-4	5.10E+03	-
	Thallium	7440-28-0	1.00E+01	2.00E+00
	Vanadium	7440-62-2	5.20E+03	-
	Zinc	7440-66-6	3.10E+05	-

- Risk Screening Level (RSL) not provided for this parameter and exposure route. For screening purposes during investigation activities, the laboratory method detection and reporting limits will be used to evaluate the data.

[a] As discussed in the Revised Workplan, Section 4.1, it is proposed that EPA's RSLs for Chemical Contaminants at Superfund Sites (EPA, 2011) be used as a preliminary screening tool. Future land use at the site is expected to remain industrial; therefore, the industrial RSLs for soil will be used. Maximum contaminant levels (MCLs) will be used as conservative screening levels for groundwater.

[b] These metals required for initial sampling of all newly installed monitoring wells and for soil samples. Results may be reviewed and need to further analyze for these parameters can be adjusted, in conjunction with RACER and MDNR.

TABLE II
PROPOSED MONITORING WELL CONSTRUCTION DETAILS
RACER TRUST - FORMER LEEDS ASSEMPLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

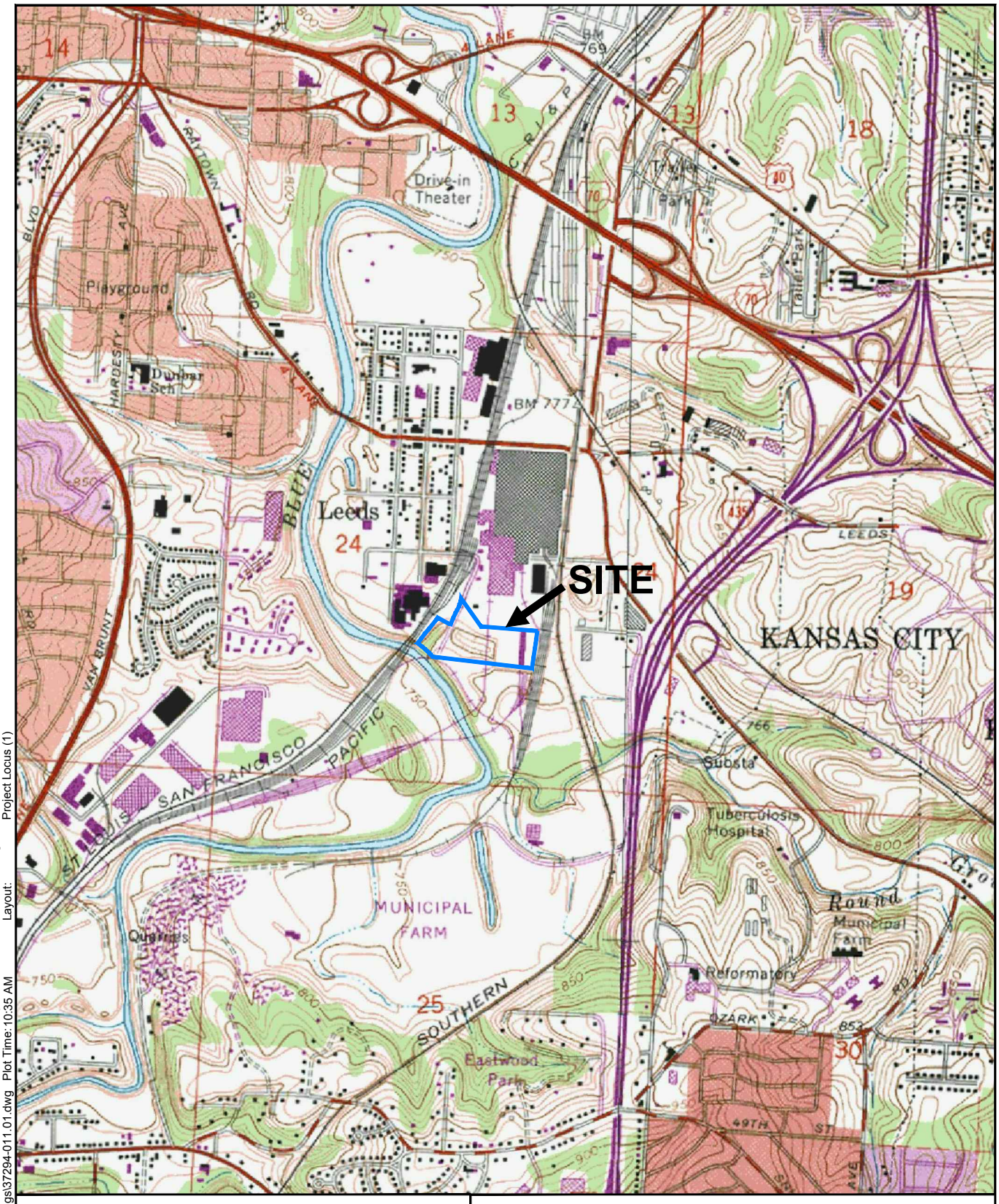
General		Borehole [a]		Casing [a]			Well [a]						
Phase	Identifier	Diameter (inches)	Interval (feet bgs)	Diameter (inches)	Interval (feet bgs)	Material	Total Depth (feet)	Screened Geology	Screened Interval (feet bgs)	Filter Pack (feet bgs)	Seal (feet bgs)	Cement (feet bgs)	Rationale
Initial	9 Shallow Wells (e.g., MW-1001, MW-1002, etc.)	6.25	0 - ~20 [c]	2	0.5-15	Schedule 40 PVC	~20 [c]	Silty Clays, Clayey Silts, Find Sands	15-20 [c]	13-20	11-13	2-11	* Findings of past investigations * Historic site conditions * Results of geophysical survey
Initial	4 Deep Wells (e.g., MW-1001D, MW-1005D, etc.)	6.25	0 - ~60 [c]	2	0.5-50	Schedule 40 PVC	~60 [c]	Clayey Sand, Gravel	50-60 [c]	48-60	46-48	2-46	* Findings of past investigations * Historic site conditions * Results of geophysical survey
Supplemental	Up to 9 additional wells (e.g., MW-1010, MW-1010D, MW-1011, etc.)	- [b]	- [b]	- [b]	- [b]	- [b]	- [b]	- [b]	- [b]	- [b]	- [b]	- [b]	* Findings of past investigations * Historic site conditions * Results of geophysical survey * Findings from installation of initial monitoring well locations

[a] Wells to be constructed per MDNR Publication 2175, Missouri Well Construction Rules, dated August 2009. Proposed construction details may be altered based on findings during borehole advancement to ensure wells are installed in the proper water bearing zones to provide useful Site information.

[b] Construction details for supplemental well installations are assumed to be similar to proposed construction for initial well installations. However, construction will be field truthed and altered based on findings during drilling.

[c] Final depths and screen intervals will be determined during borehole advancement to ensure that shallow wells are appropriately screened in the water table zone and deep wells are screened in the water zone atop bedrock.

FIGURES



SITE COORDINATES: 39°3'9"N 94°30'19"W

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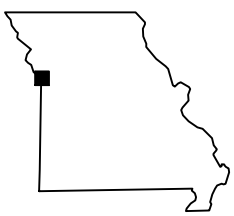

U.S.G.S. QUADRANGLE: KANSAS CITY, MO

HALEY & ALDRICH

REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

PROJECT LOCUS

SCALE: 1:24000
AUGUST 2011

FIGURE 1

File Name: G:\37294\011\CAD\Drawings\37294-011.01.dwg Plot Date: August 8, 2011 Plot Time: 10:35 AM Layout: Attached Images: 37294-LOCUS-blank; Project Locus (1)

LEGEND

- PROPERTY LINE
- RAIL ROAD TRACKS
- FORMER RAIL ROAD TRACKS
- RIVER / SWALE
- FENCE

NOTES

1. ALL LOCATIONS APPROXIMATE.
2. THIS FIGURE WAS GENERATED WITH THE USE OF SEVERAL SOURCES:
   - MAIN SITE FEATURES WERE DIGITIZED FROM AN AERIAL IMAGE OBTAINED FROM GOOGLE EARTH PRO.
   - PROPERTY LINES WERE DIGITIZED FROM MAPS OBTAINED FROM JACKSON COUNTY AUDITOR'S WEBSITE.
   - EXPLORATION LOCATIONS, AND DRUM AREA WERE DIGITIZED FROM MAPS PROVIDED BY THE CLIENT.

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APPROXIMATE SCALE IN FEET

HALEY & ALDRICH

REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

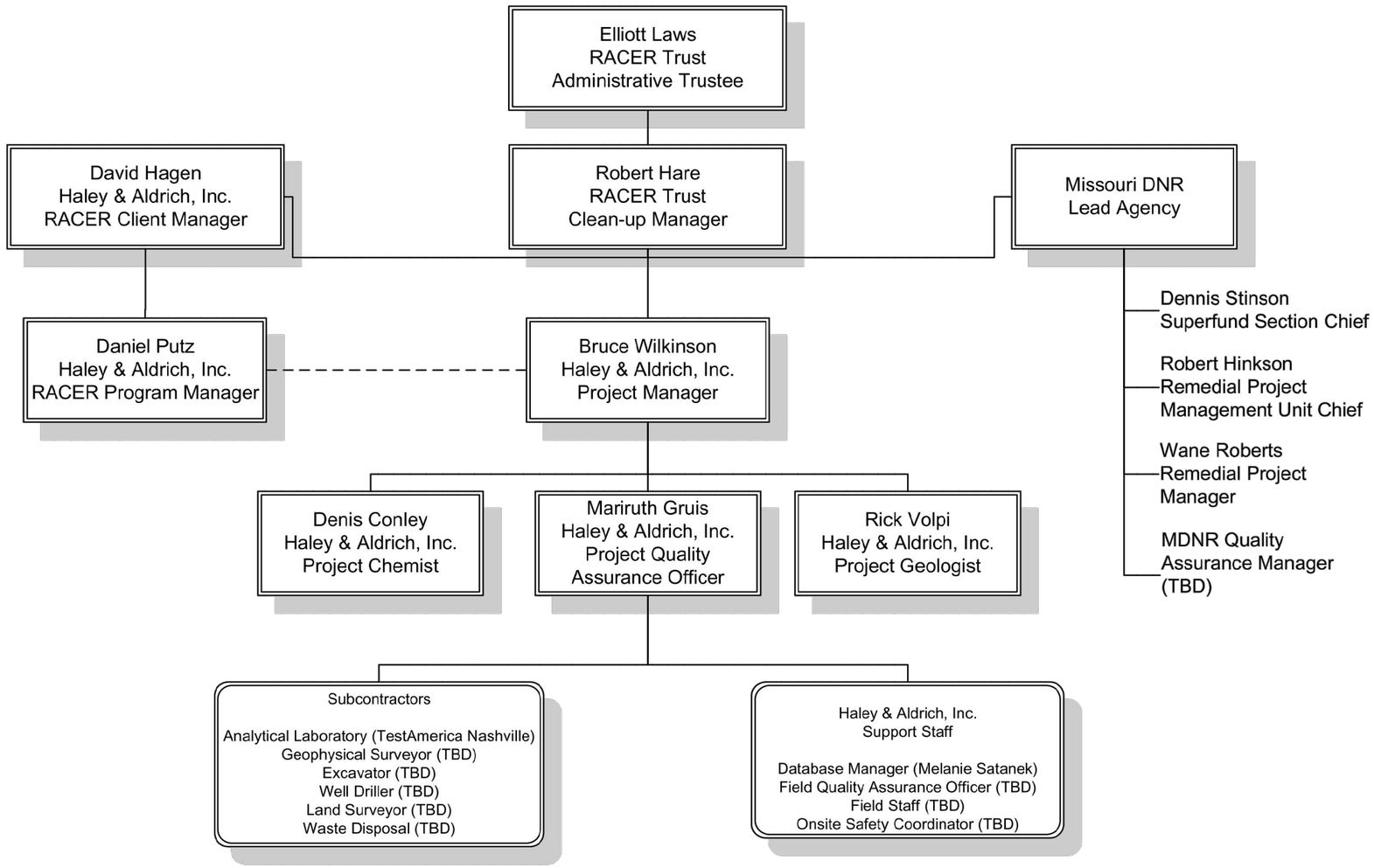
SITE PLAN

SCALE: AS SHOWN
AUGUST 2011

FIGURE 2

File Name: G:\37294\011\CAD\Drawings\37294-011.02.dwg Plot Date: August 8, 2011 Plot Time: 10:33 AM Attached Images: AERIAL; Layout: Site Plan (2)

Project Organizational Chart
Former Leeds Assembly Plant – Northern Parcel
RACER Trust



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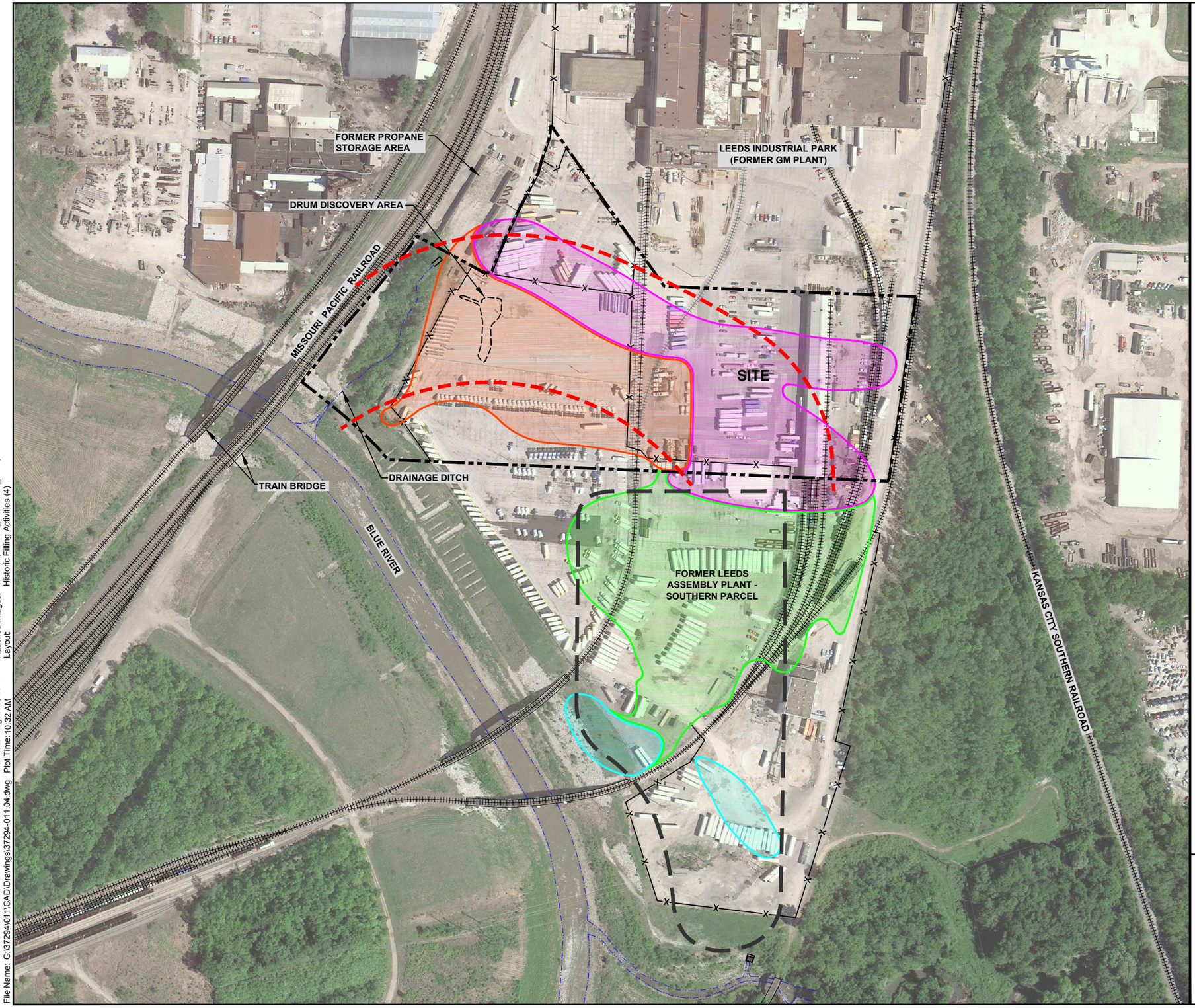
REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

PROJECT ORGANIZATIONAL CHART

SCALE: AS SHOWN
AUGUST 2011

FIGURE 3

File Name: G:\37294\011\CADD\Drawings\37294-011.03.dwg Plot Date: August 8, 2011 Plot Time: 9:20 AM
Attached Images: Leeds Org Chart; Layout: Organizational Chart (3)



LEGEND

- PROPERTY LINE
- RAIL ROAD TRACKS
- FORMER RAIL ROAD TRACKS
- RIVER / SWALE
- FENCE
- APPROXIMATE EXTENT OF FILL PLACED BETWEEN 1950 AND 1952
- APPROXIMATE EXTENT OF FILL PLACED BETWEEN 1952 AND 1960
- APPROXIMATE EXTENT OF FILL PLACED BETWEEN 1957 AND 1969
- APPROXIMATE EXTENT OF FILL PLACED BETWEEN 1978 AND 1989
- APPROXIMATE KNOWN EXTENTS OF FORMER WASTE DISPOSAL SITE
- FORMER LOCATION OF APPARENT MEANDER LOOP CHANNELS

NOTES

1. ALL LOCATIONS APPROXIMATE.
2. THIS FIGURE WAS GENERATED WITH THE USE OF SEVERAL SOURCES:
   - MAIN SITE FEATURES WERE DIGITIZED FROM AN AERIAL IMAGE OBTAINED FROM GOOGLE EARTH PRO.
   - PROPERTY LINES WERE DIGITIZED FROM MAPS OBTAINED FROM JACKSON COUNTY AUDITOR'S WEBSITE.
   - EXPLORATION LOCATIONS, AND DRUM AREA WERE DIGITIZED FROM MAPS PROVIDED BY THE CLIENT.

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APPROXIMATE SCALE IN FEET

HALEY & ALDRICH

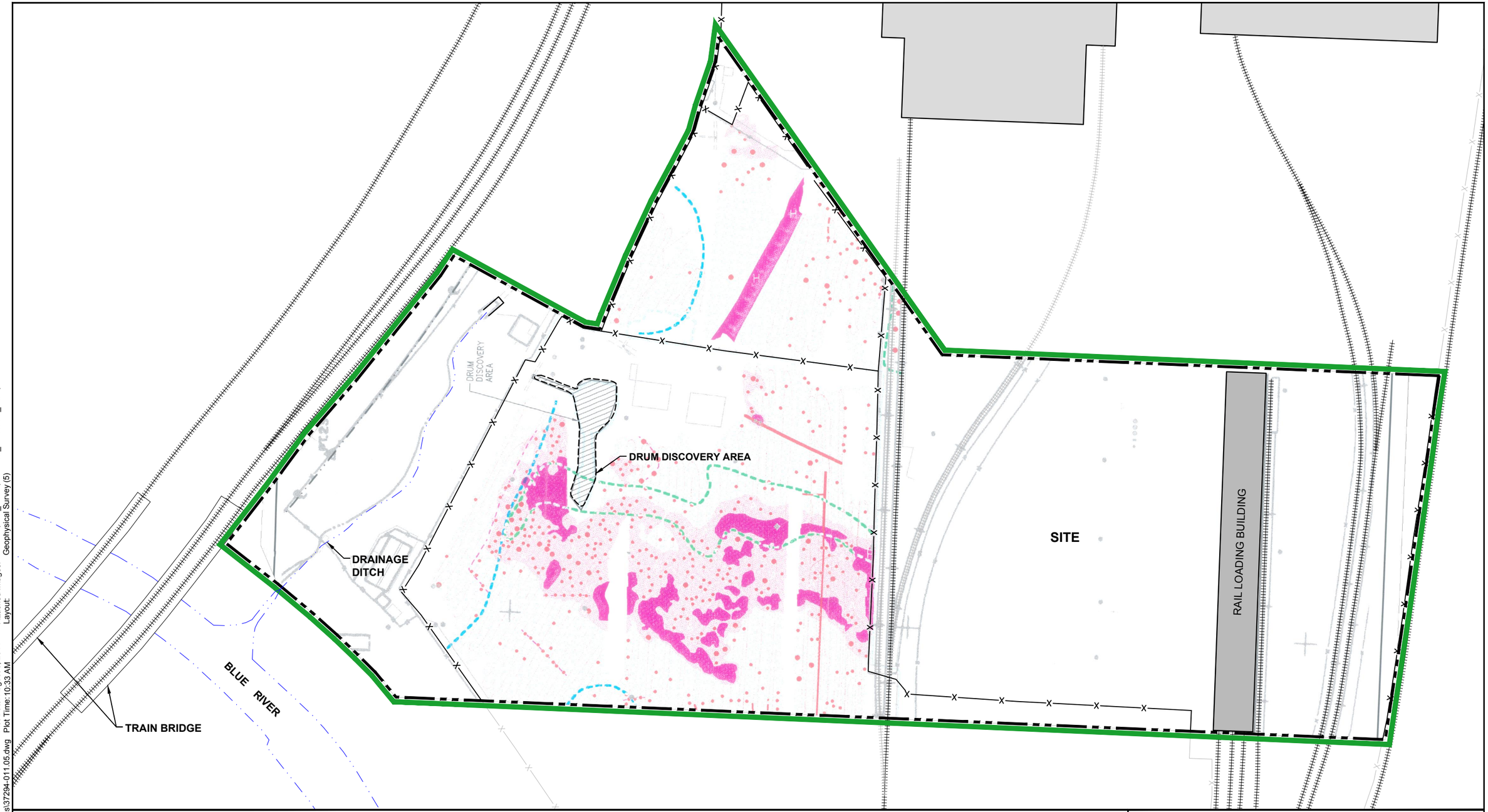
REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

HISTORICAL FILLING ACTIVITIES

SCALE: AS SHOWN
AUGUST 2011

FIGURE 4

File Name: G:\37294\011\CADDrawings\37294-011.04.dwg Plot Date: August 8, 2011 Plot Time: 10:32 AM Attached Images: AERIAL: Scans_20100916_0007; Layout: Historic Filling Activities (4)



File Name: G:\37294\011\CAD\Drawings\37294-011.05.dwg Plot Date: August 8, 2011 Plot Time: 10:33 AM Layout: Attached Images: AERIAL; Fill_Areas; SCANS_20100916_0001; Geophysical Survey (5)

LEGEND

- PROPERTY LINE
- RAIL ROAD TRACKS
- FORMER RAIL ROAD TRACKS
- RIVER / SWALE
- FENCE
- EXISTING STRUCTURE
- JANUARY 2000 GEOPHYSICAL SURVEY RESULTS AS ANOMALOUS ZONES OF POSSIBLE METALLIC OR OTHER MATERIAL BURIED OBJECTS
- BOUNDS OF PROPOSED GEOPHYSICAL SURVEY

NOTES

1. ALL LOCATIONS APPROXIMATE.
2. THIS FIGURE WAS GENERATED WITH THE USE OF SEVERAL SOURCES:
   - MAIN SITE FEATURES WERE DIGITIZED FROM AN AERIAL IMAGE OBTAINED FROM GOOGLE EARTH PRO.
   - PROPERTY LINES WERE DIGITIZED FROM MAPS OBTAINED FROM JACKSON COUNTY AUDITOR'S WEBSITE.
   - EXPLORATION LOCATIONS, AND DRUM AREA WERE DIGITIZED FROM MAPS PROVIDED BY THE CLIENT.

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APPROXIMATE SCALE IN FEET

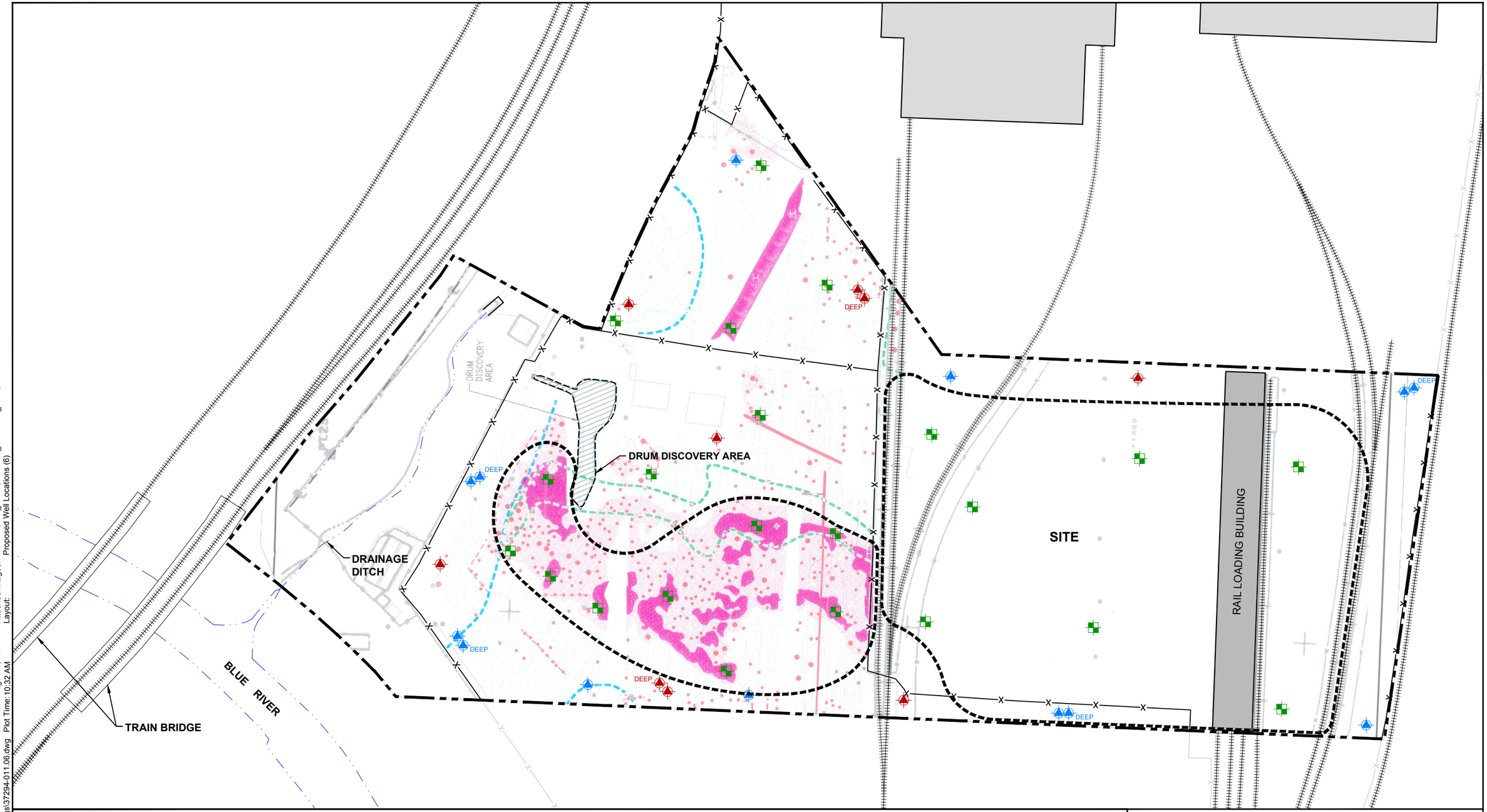
HALEY & ALDRICH

REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

PROPOSED GEOPHYSICAL SURVEY PLAN WITH OVERLAY OF JANUARY 2000 GEOPHYSICAL RESULTS

SCALE: AS SHOWN
AUGUST 2011

FIGURE 5



LEGEND

- PROPERTY LINE
- RAIL ROAD TRACKS
- FORMER RAIL ROAD TRACKS
- RIVER / SWALE
- FENCE
- EXISTING STRUCTURE
- PROPOSED TEST PIT LOCATION
- PROPOSED (INITIAL EVENT) DEEP MONITORING WELL LOCATION
- PROPOSED (INITIAL EVENT) WATER TABLE MONITORING WELL LOCATION
- PROPOSED (SUPPLEMENTAL) DEEP MONITORING WELL LOCATION
- PROPOSED (SUPPLEMENTAL) MONITORING WELL LOCATION
- AREAS OF CONCERN FOR SUBSURFACE FILL / POTENTIAL BURIED OBJECTS
- JANUARY 2000 GEOPHYSICAL SURVEY RESULTS AS ANOMALOUS ZONES OF POSSIBLE METALLIC OR OTHER MATERIAL BURIED OBJECTS

NOTES

1. ALL LOCATIONS APPROXIMATE.
2. THIS FIGURE WAS GENERATED WITH THE USE OF SEVERAL SOURCES:
   - MAIN SITE FEATURES WERE DIGITIZED FROM AN AERIAL IMAGE OBTAINED FROM GOOGLE EARTH PRO.
   - PROPERTY LINES WERE DIGITIZED FROM MAPS OBTAINED FROM JACKSON COUNTY AUDITOR'S WEBSITE.
   - EXPLORATION LOCATIONS, AND DRUM AREA WERE DIGITIZED FROM MAPS PROVIDED BY THE CLIENT.

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APPROXIMATE SCALE IN FEET

HALEY & ALDRICH

REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

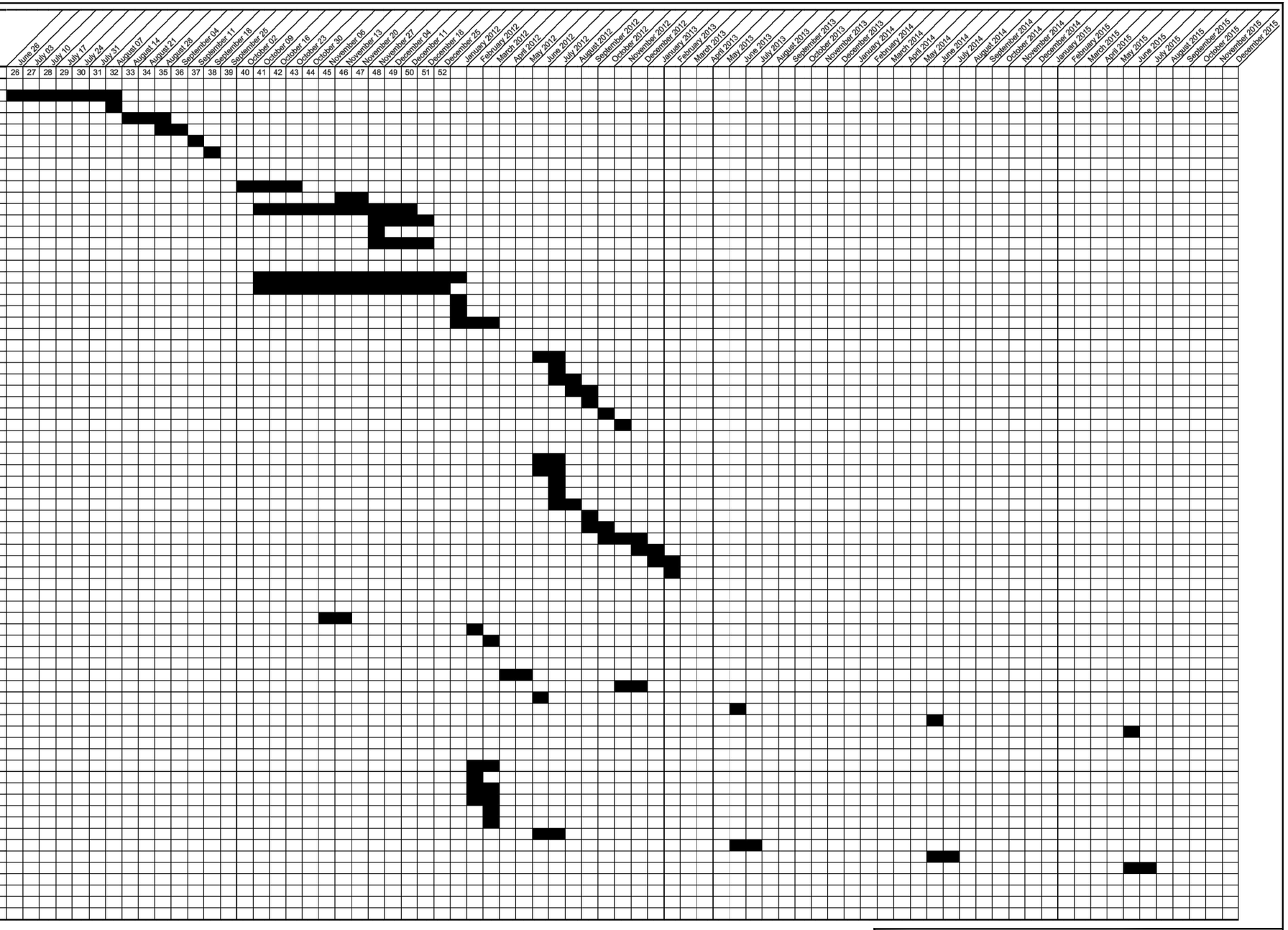
PROPOSED MONITORING WELL AND TEST PIT LOCATIONS

SCALE: AS SHOWN
AUGUST 2011

FIGURE 6

File Name: G:\37294011\CADDrawings\37294-011.06.dwg Plot Date: August 8, 2011 Plot Time: 10:32 AM Attached Images: AERIAL; Fill_Areas; SCANS_20100916_0001; Layout: Proposed Well Locations (6)

Task ID	Project Tasks and Milestones	Dates	
		Start	Finish
1	**Revised Site Investigation Work Plan**		
1.01	Revised Draft Field Investigation Work Plan	07/01/11 Fri	08/08/11 Mon
1.02	RACER Review	08/08/11 Mon	08/10/11 Wed
1.03	MDNR Review, Comment and Approval	08/15/11 Mon	08/30/11 Tue
1.04	Revise/Finalize Field Investigation Work Plan	08/30/11 Tue	09/09/11 Fri
1.05	Submit final Work Plan to MDNR	09/12/11 Mon	09/12/11 Mon
1.06	MDNR Approval of Work Plan	09/22/11 Thu	09/22/11 Thu
2	**Site Investigation**		
2.01	Field Investigation - Initial	10/07/11 Fri	10/25/11 Tue
2.02	Field Investigation - Follow-up	11/14/11 Mon	11/22/11 Tue
2.03	Laboratory Analysis	10/14/11 Fri	12/13/11 Tue
2.04	Groundwater Sampling	11/28/11 Mon	12/23/11 Fri
2.04.01	Sampling	11/28/11 Mon	12/02/11 Fri
2.04.02	Lab Analysis	11/30/11 Wed	12/23/11 Fri
3	**Site Investigation Report**		
3.01	Field Investigation Data Report	10/14/11 Fri	01/03/12 Tue
3.02	Data Evaluation	10/14/11 Fri	12/27/11 Tue
3.03	RACER Review	01/03/12 Tue	01/10/12 Tue
3.04	Revise/Finalize Field Investigation Data Report	01/10/12 Tue	01/17/12 Tue
3.05	MDNR Review and Comment	01/20/12 Fri	03/20/12 Tue
4	**Deed Restriciton**		
4.01	Identify Areas for Restriction	06/17/12 Sun	07/18/12 Wed
4.02	Develop Draft Deed Restriction	07/11/12 Wed	07/25/12 Wed
4.03	RACER and Legal Review of Draft Deed Restriction	07/25/12 Wed	08/08/12 Wed
4.04	MDNR Deed Restriciton Review	08/15/12 Wed	09/12/12 Wed
4.05	Revise Deed Restriction	09/12/12 Wed	09/19/12 Wed
4.06	Survey Restriction Areas	10/03/12 Wed	10/24/12 Wed
4.07	File Deed Restriction	11/21/12 Wed	11/21/12 Wed
5	**Soil and Drum Removal**		
5.01	Identify Areas for Remediation	06/17/12 Sun	07/08/12 Sun
5.02	Develop Remedial Action Work Plan	06/24/12 Sun	07/12/12 Thu
5.03	RACER Review	07/12/12 Thu	07/19/12 Thu
5.04	Finalize and Submit Remedial Action Work Plan	07/19/12 Thu	07/26/12 Thu
5.05	MDNR Review and Comment	07/26/12 Thu	08/27/12 Mon
5.06	Revised Remedial Action Work Plan	09/16/12 Sun	09/30/12 Sun
5.07	Contractor Bidding and Selection	09/16/12 Sun	10/07/12 Sun
5.08	Implement Soil and Drum Removal Activities	10/28/12 Sun	12/06/12 Thu
5.09	Prepare Remedial Action Report	12/09/12 Sun	01/10/13 Thu
5.10	MDNR Review, Comment and Approval	01/10/13 Thu	02/11/13 Mon
5.11	Revise/Finalize Remedial Action Report	02/11/13 Mon	02/25/13 Mon
6	**Project Management, Meetings with MoDNR**		
6.01	Initial Project Meeting/Call	04/06/11 Wed	04/06/11 Wed
6.02	Review of Initial Field Results Meeting/Call	11/13/11 Sun	11/13/11 Sun
6.02	Field Investigation Result Meeting	02/05/12 Sun	02/05/12 Sun
6.04	Remedial Action Planning Meeting	03/18/12 Sun	03/18/12 Sun
7	**Cap Monitoring & Maintenance**		
7.01	2012 Initial Cap Inspection	04/30/12 Mon	05/02/12 Wed
7.02	2012 Cap Sealing	11/22/12 Thu	12/06/12 Thu
7.03	2012 Cap Inspection	06/11/12 Mon	06/11/12 Mon
7.04	2013 Cap Inspection	06/10/13 Mon	06/12/13 Wed
7.05	2014 Cap Inspection	06/09/14 Mon	06/09/14 Mon
7.06	2015 Cap Inspection	06/08/15 Mon	06/08/15 Mon
8	**Groundwater Monitoring and Reporting**		
8.01	2011 Q3 Groundwater Sampling and Reporting	02/06/12 Mon	03/30/12 Fri
8.01.01	Sampling	02/06/12 Mon	02/10/12 Fri
8.01.02	Lab Analysis	02/08/12 Wed	03/02/12 Fri
8.01.03	Draft Groundwater Summary Report	02/13/12 Mon	03/16/12 Fri
8.01.04	MLC Review	03/16/12 Fri	03/23/12 Fri
8.01.05	Finalize and Submit Groundwater Report	03/23/12 Fri	03/30/12 Fri
8.04	2012 Annual Groundwater Sampling and Reporting	06/11/12 Mon	07/27/12 Fri
8.05	2013 Annual Groundwater Sampling and Reporting	06/10/13 Mon	07/26/13 Fri
8.06	2014 Annual Groundwater Sampling and Reporting	06/09/14 Mon	07/25/14 Fri
8.07	2015 Annual Groundwater Sampling and Reporting	06/08/15 Mon	07/24/15 Fri
9	**Agency Oversight and Fees**		



File Name: G:\37294\011\CAD\Drawings\37294-011.07.dwg Plot Date: August 8, 2011 Plot Time:10:31 AM Attached Images: Layout: Project Schedule (7)

HALEY & ALDRICH

REVITALIZING AUTO COMMUNITIES ENVIRONMENTAL RESPONSE TRUST
FORMER LEEDS ASSEMBLY PLANT-NORTHERN PARCEL
SOUTH OF 6817 STADIUM DRIVE
KANSAS CITY, MISSOURI

PROJECT SCHEDULE

SCALE: AS SHOWN
AUGUST 2011

FIGURE 7

APPENDIX A

Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
RACER TRUST
KANSAS CITY, MISSOURI

by

Haley & Aldrich, Inc.
Lenexa, Kansas

for

RACER Trust
Birmingham, Michigan

APPROVED BY: _____ **DATE:** 9/15/11
Haley & Aldrich Project Manager

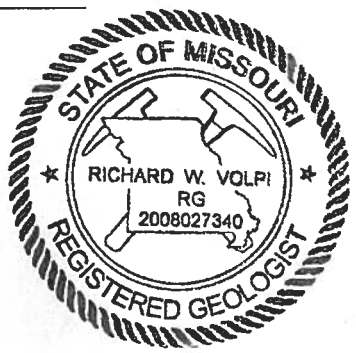
APPROVED BY: _____ **DATE:** 9/15/11
Haley & Aldrich Quality Assurance Officer

APPROVED BY: _____ **DATE:** 9/15/11
Haley & Aldrich Project Geologist

APPROVED BY: _____ **DATE:** _____
MDNR Remedial Project Manager

APPROVED BY: _____ **DATE:** _____
MDNR Quality Assurance Manager

File No.: 37294-001
Revision No. 2
15 September 2011



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LIST OF ACRONYMS AND ABBREVIATIONS

3D	3-dimensional
bgs	below ground surface
Burns & McDonnell	Burns & McDonnell Engineering Company
CFR	Code of Federal Regulations
CM	Clean-up Manager
CSM	conceptual site model
DO	dissolved oxygen
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
FWDS	former waste disposal site
GM	General Motors
GPR	ground penetrating radar
Haley & Aldrich	Haley & Aldrich, Inc.
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	inner diameter
IDW	investigation-derived waste
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MLC	Motors Liquidation Company
NELAP	National Environmental Laboratory Accreditation Program
ORP	oxidation-reduction reaction potential
OSC	Onsite Safety Coordinator
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RACER	Revitalizing Auto Communities Environmental Response
RMP	Remedial Project Manager
RSL	Regional Screening Level
SVOC	Semi-volatile organic compound
TBD	To Be Determined
TCLP	Toxicity Characteristic Leaching Procedure
TestAmerica	TestAmerica Laboratories, Inc. of Nashville Tennessee
VOC	Volatile organic compound

1. DISTRIBUTION LIST

The following personnel will receive a copy of this Quality Assurance Project Plan (QAPP) and are responsible for its implementation as it applies to their roles in site investigation activities. Needed clarifications of items presented in this QAPP should be directed to the Haley & Aldrich Inc. (Haley & Aldrich) Project Manager (PM).

Name	**Company/Agency**	**Title**
Dennis Stinson	Missouri Department of Natural Resources (MDNR)	Superfund Section Chief
Robert Hinkson	MDNR	Remedial Project Management Unit Chief
Wane Roberts	MDNR	Remedial Project Manager (RPM)
To Be Determined	MDNR	Quality Assurance (QA) Manager
Robert Hare	RACER Trust	Clean-up Manager (CM)
David Hagen	Haley & Aldrich	Revitalizing Auto Communities Environmental Response (RACER) Client Manager
Daniel Putz	Haley & Aldrich	RACER Program Manager
Bruce Wilkinson	Haley & Aldrich	Project Manager
Rick Volpi	Haley & Aldrich	Project Geologist
Mariruth Gruis	Haley & Aldrich	Project QA Officer
Denis Conley	Haley & Aldrich	Project Chemist
Roxanne Conner	TestAmerica Laboratory Inc.	Laboratory PM

2. PROJECT/TASK ORGANIZATION

On behalf of RACER Trust, Haley & Aldrich has the overall responsibility of implementing the Revised Site Investigation Workplan (Revised Workplan) for the Former Leeds Assembly Plant - Northern Parcel (herein referred to as the Site or Northern Parcel). The project organization, which includes lines of authority, communication, and coordination, is depicted in Figure 3 of the Revised Workplan. Descriptions of the primary responsibilities of key project personnel are presented in Section 1.2.1 of the Revised Workplan. TestAmerica Laboratories, Inc. (TestAmerica) of Nashville, Tennessee is anticipated to be the environmental laboratory contracted for environmental sample analysis.

3. INTRODUCTION

This QAPP has been prepared to supplement the Revised Workplan with regard to data collection activities. The primary purpose of this QAPP is to describe the project organization, functional activities, sampling objectives, protocol, and quality assurance/quality control (QA/QC) requirements for proposed site investigation activities. This QAPP also supports select data collection activities that will support development of a Conceptual Site Model (CSM) and recommended remedial measures. The QAPP generally follows the format and content guidelines in the U.S. Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans, EPA QA/R-5, dated March 2001 (EPA, 2001a).

4. PROJECT BACKGROUND AND DESCRIPTION

4.1 Project Background

As documented in Section 1 of the Revised Workplan, the Site is located in the southern portion of the property located at 6817 Stadium Drive in Kansas City, Missouri (Revised Workplan Figure 1). The northern portion of the property at 6817 Stadium Drive is the location of the Former General Motors (GM) Leeds Assembly Plant (Former GM Plant) and the southern portion of the property is further divided into the Northern Parcel (the Site) and the Southern Parcel (including known extents of a Former Waste Disposal Site (FWDS) (Revised Workplan Figure 2). The Revised Workplan and this QAPP specifically address proposed investigation activities for the Northern Parcel.

The majority of investigation activities conducted to date in the vicinity of the Site have been associated with the Former GM Plant and the FWDS. Buried drums were discovered at the Site during a sewer line extension project in 1999. This area was not previously known to have been the site of waste disposal activities. The Drum Discovery Area (Revised Workplan Figure 2) was investigated and excavated to remove drums and associated debris. During removal activities, it became apparent that vertical and lateral extent of buried drums was greater than anticipated and removal activities were halted.

In January 2000, a geophysical survey was conducted along the western half of the Site as a field screening technique in an effort to evaluate the horizontal limits of metal-containing debris. The eastern half of the Site was not surveyed due to the presence of parked vehicles that would have interfered with the geophysical equipment performance. Review of the results of the survey indicated that metal debris appeared to extend east and south of the Drum Discovery Area, and likely further toward the eastern half of the Site. Buried metal debris did not appear to extend north or west of the Drum Discovery Area. Revised Workplan Figure 5 depicts the survey findings for metal-containing debris.

As discussed above, the majority of investigation activities conducted to date has been associated with the Former GM Plant (to the north of the Site) and the FWDS (to the south of the Site). Groundwater monitoring wells installed in the vicinity of the Site to investigate the parcels to the north and south were abandoned in the mid-1990s. No other groundwater monitoring wells have been installed or currently exist to characterize groundwater on the Site.

4.2 Purpose and Objectives

The purpose of the Revised Workplan is to present proposed soil and groundwater investigation efforts for characterizing the nature and extent of impacts from historical filling operations on the Site. The data collected during investigation activities will be evaluated to attain the following objectives:

1. Characterize the nature of anomalous areas of possible metallic objects as identified during a geophysical survey conducted at the site from January 26 through January 28, 2000;
2. Identify the potential for additional, unknown hot spots of buried objects beyond the area of buried drums discovered onsite in 1999; and
3. Characterize overburden groundwater quality at the Site from the water table down to the top of bedrock for contaminants that may be mobile within the groundwater.

4.3 Project/Task Description

As described in the Revised Workplan, data collection tasks proposed to achieve the site investigation data quality objectives (DQOs) include:

- Geophysical survey;
- Soil boring advancement, monitoring well installation, and monitoring well development;
- Groundwater level measurements and sampling;
- Test pit excavations and subsurface soil and/or fill material sampling; and
- Horizontal and vertical datum survey.

5. QUALITY OBJECTIVES AND CRITERIA

"Data quality" refers to the level of reliability associated with a particular data set or data point. Data quality associated with environmental measurement data is a function of the Revised Workplan rationale, sample collection procedures, and analytical methods and instrumentation used in making the measurements. The overall quality assurance (QA) objective is to develop and implement procedures for field sampling, sample custody, laboratory analysis, and data reporting that will provide data that meet task-specific DQOs and are legally defensible. This section discusses the DQOs and measurement performance criteria established for proposed site investigation activities.

5.1 Data Quality Objectives

In order to achieve the project objectives, the appropriate amount and type of data must be collected. Development of site-specific DQOs helps determine what type and amount of data are needed. DQOs are qualitative and quantitative statements that specify the data quality necessary to support specific decisions or regulatory actions. The DQOs describe which data are needed, why the data are needed, and end use of the data. The DQOs also establish numeric limits for the data, to allow the data user (or reviewers) to determine whether the data collected are of sufficient quality for their intended use. The EPA seven-step DQO process was used to prepare DQOs for site investigation activities (EPA, 2006).

5.2 Decision Rules

The decision rules for the primary site investigation activities are provided below.

5.2.1 Subsurface/Soil Investigation

The primary decision for the subsurface/soil investigation is to determine the nature of anomalous areas of buried objects and whether or not residuals in soil exceed the preliminary screening levels as documented in Table I of the Revised Workplan. The inputs to the decision will be the observations made during test pit excavations and analytical data from soil samples collected from the test pits.

The decision rules for the soil investigation are:

- If the concentrations of organic and inorganic potential constituents of concern detected in soil samples collected at depth from test pits are less than the preliminary screening levels, then the vertical extent of residuals in soil has been delineated;
- If the concentrations of organic and inorganic potential constituents of concern detected in soil samples collected from sidewalls of the test pits are less than the preliminary screening levels, then the horizontal extent of residuals in soil have been delineated; and
- For metals listed as potential constituents of concern, if concentrations exceed potential screening levels but are less than background, the extent of residuals in soil has been delineated.
- If the concentrations of organic and/or inorganic potential constituents of concern detected in soil samples collected from any location within the test pits are greater than preliminary screening levels, then further investigation and/or remediation may be warranted. This

condition would be discussed with RACER and MDNR and an appropriate path forward will be determined.

- For metals listed as potential constituents of concern, if concentrations exceed potential screening levels and background concentrations, further investigation and/or remediation may be warranted. This condition would be discussed with RACER and MDNR and an appropriate path forward will be determined.

5.2.2 Groundwater Investigation

The primary decision for the groundwater investigation is to determine whether or not overburden groundwater quality meets the preliminary screening levels (as Maximum Contaminant Levels [MCLs]) as documented in Table I of the Revised Workplan. A secondary decision for the groundwater investigation is to evaluate whether or not offsite impacts may exist based on observations conducted at onsite groundwater monitoring wells. The inputs to the decision will be analytical data from groundwater samples collected at newly installed monitoring wells and test pits and hydrogeologic data collected during well installation activities.

The decision rules for the groundwater investigation are:

- If the concentrations of organic and inorganic potential constituents of concern detected in groundwater samples are less than their respective MCLs, (or if MCLs do not exist, other applicable screening criteria) then the vertical and horizontal extent of impacted groundwater have been defined;
- For metals, if concentrations exceed MCLs (or if MCLs do not exist, other applicable screening criteria) and are less than background, then the extent of impacted groundwater from metals has been delineated.
- If the concentrations of organic and/or inorganic potential constituents of concern detected in groundwater samples are greater than their respective MCLs, (or if MCLs do not exist, other applicable screening criteria) then the vertical and horizontal extent of impacted groundwater has not been defined and further investigation and/or remediation may be warranted. This condition would be discussed with RACER and MDNR and an appropriate path forward will be determined.
- For metals, if concentrations exceed MCLs (or if MCLs do not exist, other applicable screening criteria) and background concentrations, then the extent of impacted groundwater from metals has not been delineated and further investigation and/or remediation may be warranted. This condition would be discussed with RACER and MDNR and an appropriate path forward will be determined.

5.3 Measurement Performance Criteria

While the DQO development process determines the type and number of data points to be collected, measurement performance criteria for data collection assess whether the generated data quality satisfies the DQOs. Measurement performance criteria are often expressed as data quality indicators (DQIs) that assess data quality in quantitative and qualitative terms. The principal DQIs are precision, accuracy,

representativeness, comparability, completeness, and sensitivity. Quantitative DQIs include precision, accuracy, completeness, and sensitivity. Representativeness and comparability are qualitative DQIs.

For each DQI, acceptable limits are established based on data characteristics, such as sample matrix or analyte. These established limits are referred to as measurement quality objectives (MQOs). Data are evaluated against the MQOs to determine data usability to meet project objectives.

The DQIs are defined and discussed in this section in terms of site investigation sample collection and analysis. The related MQOs are provided in Tables A-I, A-II, and A-III.

5.3.1 Precision

Precision is defined as a quantitative measure of the degree to which two or more measurements are in agreement. Precision will be determined by collecting and analyzing field duplicate samples and by creating and analyzing laboratory duplicates from one or more of the field samples. Precision will be stated in terms of relative percent difference (RPD). The overall precision of measurement data is a mixture of sampling and analytical factors. The analytical results from the field duplicate samples will provide data on sampling precision. The results from duplicate samples created by the laboratory will provide data on analytical precision.

5.3.1.1 *Field Precision*

Field precision will be assessed through collection and analysis of field duplicate samples.

5.3.1.2 *Laboratory Precision*

Laboratory precision will be assessed through the use of field duplicate pairs, calibration standards, matrix spike/matrix spike duplicates (MS/MSD) for organic and inorganic parameters, laboratory control standard/laboratory control standard duplicates (LCS/LCSD) pairs, laboratory duplicate pairs, and serial dilution of metal samples.

5.3.2 Accuracy

Accuracy relates to the bias in a measurement system. Bias is the difference between the observed and the "true" value. Sources of error are the sampling process, field contamination, preservation techniques, sample handling, sample matrix, sample preparation and analytical procedure limitations.

5.3.2.1 *Field Accuracy*

A qualitative assessment of field data will be conducted by reviewing instrument calibration, sample collection, preservation, handling, and shipping procedures. A quantitative assessment of the field program will include evaluating the results of field blank, equipment blank, and trip blanks. Field blanks are used to assess potential bias associated with water used for equipment blanks, air in contact with sample media during sample collection, and sample containers. Equipment blanks are used to assess potential bias associated with use of non-dedicated equipment following equipment decontamination. Trip blanks are used to assess potential bias associated with sample transport and storage.

5.3.2.2 ***Laboratory Accuracy***

Analytical bias will be assessed quantitatively through the analysis of the following sample, standard, or evaluation:

- Initial calibration.
- Method blanks.
- MS/MSD samples.
- LCS/LCSDs.
- Initial calibration verification standards (ICVs).
- Continuing calibration verification standards (CCVs).
- Mass tune standard evaluation (mass spectrometer analysis only).
- Surrogate spikes (organic analysis only).
- Internal standards (mass spectrometer analysis only).
- Initial calibration blanks (ICBs) (metals analysis only).
- Continuing calibration blanks (CCBs) (metals analysis only).
- Post-digestion spikes (metals analysis only).
- Interference check standards (inductively coupled plasma [ICP] analysis only).

5.3.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the design of the sampling program. The representativeness criterion is satisfied by proper selection of sampling locations and quantity of samples collected.

5.3.3.1 ***Field Data***

Representativeness of field data is dependent upon the proper design of the data collection procedures. Representativeness of the field data will be evaluated by assessing whether the sampling procedures defined in this QAPP were followed during sample collection. In addition, the RPD of analytical results from field duplicate sample pairs will be used to evaluate the representativeness of the field sampling procedures.

5.3.3.2 ***Laboratory Data***

Representativeness in the laboratory is ensured by using proper analytical procedures and analyzing field duplicate samples. By definition, field duplicate samples are collected to be representative of a given point in space and time. Thus, sample duplicates provide both precision and representativeness information. Compliance with sample preservation, holding time, and MRLs criteria will also be evaluated.

5.3.4 Completeness

Completeness is a measure of the amount of valid (usable) data obtained from a measuring system compared to the amount that was expected to be obtained under normal conditions. The completeness goal for each data use is that a sufficient amount of valid data be generated so that determinations can be made related to the intended data use with a high degree of confidence.

5.3.4.1 ***Field Data***

Completeness is a measure of the amount of valid measurements obtained from the total number of measurements taken in this project. The field completeness objective for this project will be 90 percent or greater.

5.3.4.2 ***Laboratory Data***

Laboratory data completeness objective is a measure of the amount of valid data obtained from the total number of laboratory measurements. The evaluation of the data completeness will be performed at the conclusion of each sampling and analysis effort. Corrective actions, such as revised sample handling procedures, will be implemented if problems are noted.

The completeness of the data generated will be determined by comparing the amount of valid data, based on independent validation, with the total data set. The laboratory completeness goal for this project will be 90 percent or greater.

5.3.5 Comparability

Comparability is a qualitative expression of the measure of confidence that one data set can be compared to another and combined for decision-making purposes.

5.3.5.1 ***Field Data***

Field data comparability is dependent on the use of similar sampling and analytical methodology and the use of standard units of measure for similar tasks at a site. Field data will be collected using standard sampling and measurement procedures and will be recorded in the field logbook and on applicable field forms (i.e., groundwater sample collection records and chain-of-custody forms). Comparability of field data will be evaluated by reviewing the field documentation to determine whether the field data collection procedures and sample collection, handling, and shipping protocols specified in this QAPP and the Revised Workplan were followed.

5.3.5.2 ***Laboratory Data***

Laboratory data comparability is dependent on the use of similar sampling and analytical methodology and the use of standard units of measure for similar tasks at a specific site. Chemical data will be collected using USEPA-approved standard sampling procedures and analysis procedures at laboratories certified by an Environmental Laboratory Accreditation Program (NELAP) or equivalent accreditation organization. Data comparability will also be assessed by comparing investigative sample data to QA or quality control (QC) sample data.

5.3.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate among measurement responses representing different levels of the variable of interest. MRLs will be evaluated to ensure proper sensitivity.

5.4 Special Training/Certification

Project personnel will have sufficient training to safely, effectively, and efficiently perform their assigned tasks.

5.4.1 Haley & Aldrich Registered Geologist

The Haley & Aldrich Registered Geologist will be a registered geologist who is qualified in the technical area in the State of Missouri.

5.4.2 Haley & Aldrich Project Staff

Haley & Aldrich project staff will be required to read and understand the Revised Site Investigation Work Plan, the site-specific HASP, and this QAPP, including potential amendments. The project staff will also attend a project kickoff meeting prior to initiation of field work. The project kickoff meeting will be conducted by the Haley & Aldrich PM or designee with the objectives of ensuring staff will be comfortable with the procedures and requirements presented in the Revised Workplan and QAPP, identifying additional training required, and addressing questions or issues project staff may have.

5.4.3 Haley & Aldrich Field Staff and Subcontractors

Field personnel must have successfully completed a training course of at least 40 hours that meets the requirements specified in 29 Code of Federal Regulations (CFR) Part 1910.120(e) on safety and health at hazardous waste operations. In addition, personnel who completed the initial 40-hour training more than one year before the commencement of site work must successfully complete a refresher course of at least 8 hours that meets the requirements of 29 CFR Part 1910.120(e) on safety and health at hazardous waste operations. Additionally, the Field Team Leader responsible for overseeing drilling and test pit activities, will have successfully completed an 8-hour supervisor training that meets requirements specified in 29 CFR 1910.120(e)(4).

The On-Site Safety Coordinator (OSC), who may be the same person as the Field Team Leader, will be responsible for ensuring field personnel for each participating organization have current health and safety training prior to commencement of field sample collection activities. The health and safety training records will be maintained as discussed in the HASP.

Field personnel performing sample collection and measurement activities will be properly trained in equipment use and procedures necessary for each task prior to entering the field. Each subcontractor will employ internal procedures for ensuring personnel are adequately experienced in the tasks they are expected to perform and are receiving needed training. Training courses or workshops on operation of specific equipment, techniques, or procedures will be documented. The requirements of this QAPP will be reviewed by management and field personnel of each participating organization involved with data collection, generation, and interpretation activities to ensure persons with appropriate credential and experience are assigned to the tasks to be performed. It will be the responsibility of the Haley & Aldrich Field Team Leader to ensure field

personnel understand and comply with the applicable QAPP requirements for their individual tasks.

Personnel overseeing soil boring advancement and well installation will be under the supervision of a geologist registered by the State of Missouri. Personnel overseeing soil boring advancement will have the experience and training to collect, screen, and evaluate environmental samples and will have a valid Missouri Well Drillers and/or Pump Installers Permit. No other specialized training is anticipated.

5.4.4 Laboratory

The environmental laboratory contracted for site investigation efforts will participate in the NELAP and hold State of Missouri certification for the analytical methods in this QAPP that are included in the State of Missouri Certification program. The laboratory will employ personnel with the necessary education, training, technical knowledge, and experience for their assigned functions. Laboratory training records are maintained by the laboratory and will be available for review upon request.

5.5 Documentation and Records

Appropriate records will be maintained to provide adequate documentation of the entire data generation process.

5.5.1 QAPP

This QAPP will be distributed to each contractor responsible for the collection, generation, and interpretation of field and analytical data. Personnel working on the project will be required to comply with the procedures documented in this QAPP to maintain comparability and representativeness of the resulting data.

If the Haley & Aldrich PM or QA Officer determine that addenda or revisions to the QAPP are necessary, the Haley & Aldrich PM will notify the RACER Clean-up Manager and the MDNR RPM. After agreement by each party, the proposed changes will be incorporated into the current version of the QAPP and the revised QAPP or amendment will be redistributed. The Haley & Aldrich PM will ensure a distribution list of QAPP recipient organizations or individuals is maintained. The document control format used in this QAPP will identify the QAPP revision number and revision date. A QAPP revision history will be maintained by the Haley & Aldrich PM that identifies each revision and a summary of the revision. This revision history will be incorporated into Section 5.4.1 of the QAPP in subsequent issues of the revised or updated QAPP.

5.5.2 Field Documentation

Field activities will be documented in field sampling records, which may include field logbooks, test pit logs, soil boring logs/well construction diagrams, well development logs, groundwater sample collection records, calibration records, chain-of-custody documentation, and photographs.

Field data will be reported, as described in Table A-IV, and presented in a format that will facilitate data review and evaluation. Tables, graphs, or figures will be used to present the data in associated project documents.

5.5.3 Laboratory Documentation

Analytical data for the project will be reported in both an electronic data deliverable (EDD) and a hardcopy or portable document format (PDF) data package. The EDD will be generated by the participating laboratory and used to facilitate transfer of analytical data into a project database.

5.5.4 Document Storage

Data, documentation, and reports generated for site investigation activities will be stored for a minimum of ten years.

A final evidence file will be the central repository for data, documentation, and reports that constitute evidence relevant to sampling and analysis activities, as described in this QAPP and the Revised Workplan. On behalf of the RACER, Haley & Aldrich will be the custodian of and will maintain the contents of the evidence files for the site activities. The final evidence file will include the following items, if generated:

- Field records (field logbooks, sample collection records, boring logs, well construction diagrams).
- Field data.
- Correspondence.
- Invoices.
- Photographs.
- Drawings.
- Laboratory data deliverables.
- Data verification and validation reports.
- Field and laboratory audit reports.
- Final, progress, and QA reports.
- Custody documentation (tags, forms, bills of lading, etc.).

6. DATA GENERATION, ACQUISITION, AND MANAGEMENT

This section addresses the methods and materials required to collect, analyze, and manage the data needed to satisfy the site investigation DQOs.

6.1 Sample Process Design

Field measurements and groundwater and soil samples will be collected for the project using a judgmental sampling approach. The field measurement and sample locations and rationale are identified in Section 4 of the Revised Workplan.

6.2 Data Collection Procedures

Procedures for data collection activities to meet the site investigation DQOs are provided in the following subsections.

6.2.1 Borehole Advancement

Borings will be advanced by a well driller licensed in the State of Missouri in accordance with Missouri Water Well Drillers Act, Sections 256.600 to 256.640 RSMo, using hollow-stem auger (HSA), rotosonic, or equivalent drilling method. The selected method will be capable of advancing the drill string to an assumed maximum depth of 60 feet bgs in both fill and native soil of silty clay, clayey silt and fine sand.

A hand auger or air knife will be used to advance each proposed boring location to at least 4 feet bgs prior to advancement of the entire soil boring in an effort to prevent damage to unknown utilities not identified by site drawings, private utility locate, or the geophysical survey. Borings will be advanced to the desired depth or until refusal. The borings will be continuously cored with soil samples collected for further analysis. A composite sample of the core will be placed in a Whirl-Pak® bag, or equivalent, for VOC field screening (see Section 6.2.3). Water depths and soil stratigraphy will be logged by Field Staff. No soil samples from monitoring well boreholes will be submitted to the analytical laboratory for chemical analysis.

Coordinates of each boring location will be recorded with a hand-held global positioning system (GPS) device, marked, and surveyed, as described in Section 6.2.6. Cuttings will be containerized and handled as investigation-derived waste (IDW), as described in Section 6.2.14. Borings not completed as monitoring wells, if any, will be properly plugged in accordance with MDNR Publication 2175, *Missouri Well Construction Rules*, dated August 2009.

Required equipment and materials include the following:

- HSA, rotosonic, or equivalent drill system.
- Drilling method appropriate samplers.
- Nitrile or equivalent gloves.
- Whirl-Pak® bags, or equivalent.

- Decontamination equipment (steam cleaner, potable water, low phosphate soap, brushes, etc.).
- 55-gallons DOT approved drums of soil cuttings and decontamination water.
- Hand-held GPS device.
- Field logbook.
- Pen or marker with indelible ink.

6.2.2 Well Boring Log

The soil description (soil type, United Soil Classification System [USCS] symbol, color, consistency/density, moisture, grain size, cementation, plasticity, and miscellaneous features) of the soil cores, recovery results, field screening (PID results), and depth to water will be logged on a Well Boring Log form (see Revised Workplan, Appendix C) by Field Staff. The naming scheme identified in Table II of the Revised Workplan will be used for all newly installed monitoring wells.

Required equipment and materials include the following:
- USCS field guide.
- Field logbook
- Well Boring Log forms.
- Pen or marker with indelible ink.

6.2.3 Soil Field Screening

Field Staff will conduct soil sample field screening procedures to vertically profile relative VOC impacts at each borehole location. As noted in Section 6.2.1, representative soil core samples will be collected from each discreet 2- to 2.5-foot interval and placed into individual Whirl-Pak® bags, or equivalent, and labeled with the sample location and depth interval for field screening of volatile organic compounds (VOCs). Samples will be set aside for at least 30 minutes to equilibrate prior to screening. Soil samples collected for VOC field screening will be analyzed using a properly calibrated Photovac MicroTip™ or equivalent photoionization detector (PID) equipped with a 10.6-electron volt (eV) lamp. The VOC screening will be performed by carefully opening the bag containing the soil sample and inserting the PID probe through the opening. The highest PID reading from each soil sample will be recorded in the field logbook. The PID will be allowed to return to a background reading between measurements. Headspace readings should be collected in an area that is not subject to wind. In the winter, it is necessary to allow the samples to equilibrate in a warm area (e.g., site trailer, van, etc.).

Required equipment and materials include the following:
- Nitrile or equivalent gloves.
- Whirl-Pak® bags, or equivalent.
- PID with 10.6 eV lamp.
- PID calibration gas and regulator.
- Field logbook or boring log forms.
- Pen or marker with indelible ink.

6.2.4 Monitoring Well Construction

Monitoring wells will be constructed by a well driller licensed in the State of Missouri in accordance with the *Missouri Well Construction Rules*. Upon completion of soil boring advancement at each monitoring well location, the monitoring well will be constructed through the drill system pipe. The wells will be constructed of 2-inch inside diameter (ID) Schedule 40 polyvinyl chloride (PVC) well screen and riser pipe. The well screens will be factory-slotted to 0.010 inch. The length of the well screen and riser pipe will be field determined for each well location.

Appropriately sized filter pack sand will be placed in the annular space of each well around the well screen to at least 2 feet above the screen. Filter pack placement will be performed by adding small amounts of sand through the augers and retracting the augers in small increments to keep the bit of the augers just above the filter pack during its placement. Frequent measurements will be made during filter pack installation to ensure proper placement of filter pack material. Filter pack materials will be given adequate time to fully settle through the column of water within the augers during placement. If needed, to facilitate settling out of the filter pack, water will be used to thin viscous (muddy) water that develop during drilling, or to flush the filter pack material through the augers. Water used to facilitate adequate placement of the filter sand will be obtained from a municipal water source. One sample of the water will be submitted to the laboratory and analyzed for VOCs to verify water quality. In the event that the water source is changed, a sample will be collected and analyzed for VOCs from the new source. The volume of water added during well installation activities will be recorded and, if possible, one times the volume added will be removed during well development as discussed in Section 6.2.5.

A minimum 3-foot layer of bentonite chips or pellets will be placed as an annular seal above the filter pack to prevent infiltration of grout into the gravel pack. Above the minimum 3-foot layer of bentonite, the annular seal will consist of bentonite chips or pellets, cement grout, neat cement grout, or high solids bentonite grout. Mixing of grout will be performed per the *Missouri Well Construction Rules* and the manufacturer's instructions. Grout will be installed using a tremie pipe. The bentonite seal will be allowed to cure/hydrate for a minimum of eight hours prior to installing the surface completion of the well.

Due to vehicular and pedestrian traffic around the site, wells will be completed flush with the surrounding grade. Flush-mount completions will be installed per the *Missouri Well Construction Rules*. Construction details for each monitoring well will be recorded in the field logbook during installation and subsequently reported on well construction diagrams.

If conditions are known to exist at the site that would prevent meeting any well construction requirement, a waiver request to the rule will be submitted to MDNR prior to mobilization for field activities. If any well construction requirements cannot be met due to site-specific conditions encountered during field efforts, the reason for the variance will be noted on the well certification form submitted to the MDNR.

Required equipment and materials include the following:

- HSA, rotosonic, or equivalent drill system.
- PVC riser pipe.
- PVC 10-slot well screen.
- PVC bottom plug.
- Filter pack sand.
- Bentonite grout or chips.
- Cement.
- Municipal water.
- Expandable well plugs.
- Padlocks.
- Locking, protective well cover.
- Reinforced, flush-mount, metal manhole cover.
- Measuring tape.
- Field logbook, boring log form, and/or monitoring well construction diagram form.
- Pen or marker with indelible ink.

6.2.5 Monitoring Well Development

After 24 hours following installation of the filter pack and annular seal, each newly installed well will be developed by a combination of mechanical surging and over-pumping using bailers, inertial pumps with surge blocks, or mechanical submersible pumps. During development, groundwater will be removed until a minimum of one times the volume of water added during drilling or well installation activities will be removed, if feasible. Development will continue until the temperature, pH, and specific conductance of the purged well water have stabilized to within 10 percent for three consecutive readings at regular volume intervals (e.g., 1-gallon intervals) or until six additional well volumes have been removed, whichever occurs first. If possible, a turbidity less than 50 nephelometric turbidity units (NTUs) will be obtained in addition to the achievement of stable analytical parameters. If the well purges dry before meeting well development criteria, the well will be developed by bailing it dry a minimum of two times over a period of 48 hours.

Additional details regarding well development are provided as a standard operating procedure (SOP) in Appendix B. The pumping method and rate, volume of water removed, observations of groundwater color and clarity, and parameter stabilization measurements obtained during development will be recorded on individual well development forms. A template Well Development Log Form is included in Appendix C of the Revised Workplan. Monitoring wells will be allowed to stabilize for a minimum of one week following development before groundwater sampling.

Required equipment and materials include the following:

- Nitrile or equivalent gloves.
- Bailers.
- Polypropylene cord.
- Inertial pumps and tubing.

- Surge blocks.
- Inertial pump mechanical actuator.
- Submersible whale pump and tubing.
- Multiparameter water quality meter.
- Calibration standards for meter.
- 5-gallon buckets with lids.
- Decontamination equipment (potable water, low phosphate soap, brushes, etc.).
- 55-gallon DOT approved drums for development and decontamination water.
- Field logbook or well development forms.
- Pen or marker with indelible ink.

6.2.6 Surveying

Horizontal and vertical surveys will be conducted for topographic surface and for locations of new monitoring wells, test pit bounds, soil sample locations, and other pertinent site objects. Survey will be to North American Datum of 1983 (NAD83) projected to the Missouri West State Plane Coordinate System Zone to the nearest 0.1 foot by a land surveyor licensed in the State of Missouri. Available survey information (e.g., existing benchmark, if available) and a site map showing known Site boundaries will be provided to the surveyor. If one does not already exist, a permanent benchmark will be established onsite.

Elevations will be measured in feet to the National American Vertical Datum of 1988 (NAVD88). Top-of-casing elevations and adjacent ground surface for the monitoring wells will be surveyed to the nearest 0.01 foot. The point on each monitoring well casing where the top of casing elevation is measured will be marked for future reference, with the north side of the casing used as the default location.

The surveyor will provide electronic survey data and a Site map in AutoCAD with a scale of one-inch equals forty feet, or smaller, and will include a topographic interval of one foot. In addition, pertinent surface features will be depicted on the map including fences, buildings/structures, roads, and other relevant features.

Required equipment and materials include the following:
- Existing benchmark, if available.
- Survey equipment.
- Field logbook.
- Pen or marker with indelible ink.

6.2.7 Groundwater Level Measurement

Water levels in monitoring wells will be measured to the nearest 0.01 foot from the reference point at the top of the riser pipe using a Solinst® Model 101, or equivalent, electronic water level indicator. If a well contains free-phase materials, the top and bottom elevation of the free-phase layers will be measured using a Solinst® Model 122, or equivalent, oil/water interface probe and, if needed, a graduated, weighted, stainless steel tape for dense nonaqueous phase liquid. If field

conditions warrant, a disposable bailer may be used in the well to verify thickness of free-phase material present in a well.

Water level measurements, free-phase measurements (if present), measuring point locations, and time and date of collection will be entered in the field logbook and/or on field sampling forms.

Required equipment and materials include the following:

- Nitrile or equivalent gloves.
- Solinst® Model 101, or equivalent, electronic water level indicator.
- Solinst® Model 122, or equivalent, oil/water interface probe.
- Graduated, weighted, stainless steel tape.
- Bailers.
- Decontamination equipment (potable water, low phosphate soap, brushes, etc.).
- 55-gallon DOT approved drums decontamination water.
- Field logbook or field forms.
- Pen or marker with indelible ink.

6.2.8 Groundwater Sample Collection

Groundwater samples will be collected from each well using low-flow methods (e.g., bladder pumps or submersible variable rate pumps). If low-flow cannot be used for location-specific reasons, bailers may be used to collect groundwater samples. Additional details regarding groundwater sample purging and collection procedures are provided as a SOP in Appendix B.

If free-phase material is present in a well, groundwater sampling and analysis will not be performed at that location. However, it may be appropriate to collect a sample of the free-phase material for characterization. This condition would be discussed with RACER and MDNR and proper sampling method would be selected if deemed appropriate.

Each sample will be collected in the appropriate laboratory-supplied container specified in Table A-V will be packaged and shipped to the analytical laboratory for analysis of VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and metals as documented in Table I the Revised Workplan and further discussed in Section 6.4 of this QAPP. Samples collected from monitoring wells will use the following example naming convention: MW-1001-GW-001 (groundwater sample #1 from monitoring well MW-1001). Duplicate samples will follow the same naming convention with a unique sample number (i.e., MW-1001-GW-002) such that they are submitted blind to the laboratory (i.e., the laboratory cannot tell that the sample is a field duplicate). Notes will be kept in the field log book and/or sampling record to identify which samples are primary and field duplicate pairs. Purged water will be containerized and handled as IDW as described in Section 6.2.13. Details of well purging, where applicable, and groundwater sample collection will be recorded on individual groundwater sample collection records (template provided in Revised Workplan Appendix C).

One or more of the methods described in the following subsections will be used for groundwater sample collection.

6.2.8.1 ***Low Flow***

Monitoring wells will be purged prior to groundwater sample collection using a low-flow purging procedure until parameter stabilization is reached in general accordance with Low-Flow (Minimal Drawdown) Sample Procedures (USEPA, 1996). Stabilization parameters (temperature, pH, specific conductance, ORP, DO, and turbidity) will be measured with a mulitparameter water quality meter, flow-through cell, and independent digital turbidity meter at regular volume intervals every three to five minutes and recorded on individual groundwater sample collection records. Depth to water measurements will also be recorded at the same intervals to monitor groundwater drawdown. Parameter stabilization is achieved when three consecutive readings for each parameter are within 10 percent of each other. Groundwater sample collection may proceed if groundwater stabilization has not occurred after the removal of six well volumes or as determined and documented by Field Staff.

A portable bladder pump with dedicated twin-line Teflon® -lined polyethylene tubing or other small submersible pump with dedicated Teflon® -lined polyethylene tubing will be used to purge and sample the wells. The pump inlet will be set as near the middle of the well screen as practicable depending on the level of water in the well. The purging rate for the wells will target approximately 100 milliliters per minute (ml/min) to minimize groundwater drawdown and will not exceed 500 ml/min. The volume of water removed from each well will be measured by collecting the purge water in a graduated beaker or equivalent container.

Once a well has been adequately purged, groundwater samples will be collected directly from the discharge end of the dedicated tubing into laboratory-supplied containers. Sample bottles will be filled without rinsing at the rate that achieved stabilization. Groundwater samples will be placed in coolers with ice to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory.

Required equipment and materials include the following:

- Electronic water level indicator.
- Bladder pump or small submersible pump, pump controller, and gas supply.
- Twin-line Teflon® -lined polyethylene tubing.
- Stainless steel compression fittings or dedicated grab plates.
- Disposable polyethylene bladders.
- Nitrile or equivalent gloves.
- Multiparameter water quality meter, flow-through cell, and calibration solutions.
- Turbidity meter and calibration standards.
- Graduated beaker, or equivalent.
- 5-gallon buckets with lids.
- Decontamination equipment (potable water, low phosphate soap, brushes, etc.).
- 55-gallon DOT approved drums for purge and decontamination water.
- Coolers, ice, and freezer bags.
- Laboratory-supplied sample containers specified in Table A-V and sample labels.
- Chain-of-custody forms, custody seals, and shipping forms.
- Field logbook or groundwater sample collection records.

- Pen or marker with indelible ink.

6.2.8.2 ***Bailers:***
Disposable high density polyethylene (HDPE) bailers dedicated to individual wells will be used to purge and sample monitoring wells. Bailers will be slowly lowered into and raised from wells with disposable polypropylene cord dedicated to each well to minimize disturbance of sediment in the well and prevent splashing. Contact between the bailer and cord and the ground or unclean surfaces will be prevented. Purged groundwater will be poured out of the top of the bailer into a graduated 5-gallon bucket, or equivalent, to measure volume. Wells will be purged until three well volumes have been removed or until dryness. If a well is purged dry, groundwater samples will be collected after the water level returns to 80 percent of the original level before purging, or after 48 hours, whichever occurs first.

Water samples will be collected into laboratory-supplied containers by connecting a dedicated bailer sampling attachment to the check valve end of the bailer. The attachment provides a slow and steady stream of water to reduce volatilization of VOCs. The bailers and cords will be disposed following sample collection, as described in Section 6.2.13. Groundwater samples will be placed in coolers with ice to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory.

Field parameters (temperature, pH, specific conductance, ORP, and DO) will be measured following sample collection.

Required equipment and materials include the following:
- Electronic water level indicator.
- HDPE bailers.
- Nitrile or equivalent gloves.
- Polypropylene cord.
- Graduated buckets.
- Coolers, ice, and freezer bags.
- Decontamination equipment (potable water, low phosphate soap, brushes, etc.).
- 55-gallon DOT approved drums for purge and decontamination water.
- Laboratory-supplied sample containers specified in Table A-V and sample labels.
- Chain-of-custody forms, custody seals, and shipping forms.
- Multiparameter water quality meter.
- Calibration standards for water meter.
- Field logbook or groundwater sample collection records.
- Pen or marker with indelible ink.

6.2.9 In-Situ Permeability Testing

Slug tests will be conducted to estimate the permeability of the aquifer(s) identified at the Site.

A pressure transducer will be installed in the well to be tested at a depth greater than the depth at which the slug tool will extend. The transducer cable will then be secured and connected to a Hermit 3000 data logger, or equivalent. The data logger will be programmed and checked for

proper operation. After the water level has returned to the original static level following insertion of the transducer, a slug-in (falling head) test will be performed by inserting a stainless steel slug tool, or equivalent, into the well at a time coordinated with the activation of the data logging equipment. Changes in the monitoring well water level will then be monitored and recorded by the data logger for a minimum of 10 minutes, until the water level has recovered to approximately 80 percent the initial static level, or for a maximum of 30 minutes. Following completion of the slug-in test, a slug-out (rising head) test will be performed by removing the slug tool, or equivalent, and activating the data logging equipment simultaneously. The slug-out test will be monitored in the same manner, as described for the slug-in test.

Slug test data will be subsequently downloaded from the data logger to a computer. The data from each well will then be analyzed to calculate hydraulic conductivity values using AQTESOLV™ or an equivalent commercially available software program. Methods described by Bouwer and Rice (1976); Cooper, Bredehoft and Papadopolus (1967); or Hvorslev (1951) will be used to analyze the data with the program.

Required equipment and materials include the following:

- Electronic water level indicator.
- Polypropylene cord.
- Stainless steel slug tool.
- Pressure transducer with cable.
- Data logger.
- Field logbook.
- Pen or marker with indelible ink.

6.2.10 Test Pits

Test pits will be excavated to allow visual observation and sampling of containerized and uncontainerized materials within the subsurface based on results of prior investigations and geophysical surveys. Additional details regarding test pit excavations, sampling, and drum remnant procedures are provided as a SOP in Appendix B.

6.2.10.1 *Test Pit Excavations*

Test pits will be excavated using a 300 Series excavator (or equivalent equipment sufficient to meet the total depth requirements) at the proposed locations shown on Revised Workplan Figure 6. The total depth of the test pits will be approximately 3 to 5 feet into native soil (assumed to be as deep as approximately 15 to 20 bgs feet in some locations) unless the capability of the excavator is exceeded by depth or obstructions. Excavation width will be between 3 to 5 feet (approximate with of excavator bucket) and anticipated pit length will be approximately 15 feet.

Test pits will be logged and photographed to document the nature of the material/soil within the test pit, identify soil/backfill horizons, and other observations such as water level (if encountered), PID readings, visual staining, and stratification. Dimensions (length, width, and depth) of each test pit will be measured and recorded in a field logbook and shown on the Environmental Test Pit Log (template provided in Appendix C of the Revised Workplan).

Sample locations within the test pit will also be graphically shown on the Environmental Test Pit Log. The naming scheme for newly excavated test pits will be TP-1001, TP-1002, etc.

Spoils from the test pits will be collected on polyethylene sheeting and the open excavation and spoils will be photographed. Test pits will be inspected for buried drums and debris and conditions within the pit will be evaluated. As discussed in Section 6.2.10.2, soil sample locations within the pit will be selected based on field screening, visual and olfactory conditions, total depth, and stratigraphy.

If intact drums are encountered during excavating, these will be left in place for future remediation with the exception as noted in Section 6.2.11.2. Observations and locations of drum remnants, intact drums (rusted, perforated, etc.), or other significant findings (e.g., condition of containers, layers of colored fill material, etc.) will be documented in the field logbook with clear location identification in the event that removal is required in the future. In the event of rain, spoils collected on polyethylene sheeting will be covered with visqueen and straw berms will be erected around the spoils pile to limit potential for surface runoff. These materials will be readily available onsite to accommodate potential weather conditions. Spoils will be returned to the excavation within the same working day that they are excavated.

Due to safety concerns, work area access concerns, and surface water runoff concerns, test pits will be backfilled immediately after sampling is complete. No test pit excavations will remain open overnight.

Required equipment and materials include the following:

- 300 Series Excavator, or equivalent.
- Polyethylene sheeting.
- Whirl-Pak® bags, or equivalent.
- PID with 10.6 eV lamp.
- PID calibration gas and regulator.
- Measuring tape.
- Field logbook.
- Camera and/or video recorder
- Pen or marker with indelible ink.

6.2.10.2 ***Test Pit Sampling***

One to three soil samples will be collected from each test pit with sample locations determined by field conditions such as: total depth, stratigraphy, olfactory and visual observations (i.e., staining, drum remnants, etc.), and PID readings. Samples will be collected from soils brought to the surface in the bucket of the excavator.

Each sample will be collected in the appropriate laboratory-supplied container specified in Table A-V will be packaged and shipped to the analytical laboratory for analysis of VOCs, SVOCs, PCBs, and metals as documented in Table I the Revised Workplan and further discussed in Section 6.4 of this QAPP. The soil samples will be placed, not forced, into sample jars. Additional soil from each sample location will be collected and placed in a Whirl-Pak® bag, or

equivalent for VOC field screening, as described in Section 6.2.3. The sample jars will be placed in coolers with ice to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory. Sample collection, sample handling, and sample preservation will be performed in accordance with Section 6.3.

Presence of groundwater within a test pit may be one selection criteria used for selecting sample locations within the pit. If groundwater is encountered within a test pit, conditions within the pit will be evaluated and if sampling is deemed appropriate, a grab water sample using a stainless steel sample cup mounted on a telescoping pole and a grab soil sample from above the water table may be collected. Samples will be submitted to TestAmerica for analysis of VOCs, SVOCs, PCBs, and metals (Table I of Revised Workplan). Water samples will be placed in coolers with ice to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory.

Samples collected from within the test pits will use the following example naming conventions: TP-1001-SO-001 (soil sample #1 from within test pit TP-1001) and TP-1001-GW-001 (groundwater sample #1 from within test pit TP-1001). Duplicate samples will follow the same naming convention with a unique sample number such that they are submitted blind to the laboratory (i.e., the laboratory cannot tell that the sample is a field duplicate); notes will be kept in the field log book and/or sampling record to identify which samples are primary and field duplicate pairs.

Required equipment and materials include the following:

- Nitrile or equivalent gloves.
- Whirl-Pak® bags, or equivalent.
- PID with 10.6 eV lamp.
- PID calibration gas and regulator.
- Coolers, ice, and freezer bags.
- Laboratory-supplied sample containers specified in Table A-V and sample labels.
- Chain-of-custody forms, custody seals, and shipping forms.
- Field logbook.
- Pen or marker with indelible ink.

6.2.11 Drum Inspection and Sampling

The intent of the test pit exploration activities is to characterize soil and identify the nature of anomalous areas and buried objects within the Site boundaries. If drums and/or drum remnants are uncovered in a test pit, they will be inspected by field staff from the ground surface or by bringing the drum to the surface using the excavator (if the drum conditions appear structurally sufficient). For safety reasons, no work will be conducted from within the excavations.

Drum and/or drum remnant inspection will consist of the following:

- Observing conditions of the drums and remnants (holes, perforations, rusting, pitting, etc.);
- Observing labeling that may be helpful in identifying drum contents (spray paint labels or waste codes, written labels, etc.);

- Observing the presence of other uncontainerized waste materials/pallets, etc.;
- Conducting field screening measurements with a PID; and
- Photographing and videotaping of the test pit installation and inspection activities.

It is anticipated that excavated material will be returned back to the test pits upon completion. However, in the event drums are encountered, the following contingency procedures have been identified.

6.2.11.1 ***Drum Remnants***

If drum remnants are encountered during test pit exploration, remnants may be excavated and placed on the polyethylene sheeting as discussed in Section 6.2.10.1. These locations will be evaluated at the time they are discovered and may be selected as locations for soil sampling (Section 6.2.10.2) to evaluate potential release of contaminants at those locations. Drum remnants will be returned to the test pit along with excavated soils.

6.2.11.2 ***Intact Drums***

In the event that intact drums are encountered during test pit exploration, a provision has been included in this Revised Workplan to remove the intact drums from the test pits for characterization testing. Results of drum inspections may be used to select drums for sampling, determine appropriate sampling methods, and determine appropriate analytical methods. Decisions will be made in the field regarding intact drums selected for characterization testing. Drum selection will be biased based on the following: a drum in good condition with labels; a drum present in the uppermost layer within a test pit; and/or a drum that does not appear to be consistent with information in the operational records. A drum will <u>not</u> be selected for sampling if it is bulging, shows signs of corrosion, and/or has mineralization around the bungs or drum tops. Drum selection may also be based on direction from MDNR field personnel. Intact drums encountered but not selected for characterization testing will be left in the test pits for future remediation.

Seventy (70) gallon over-pack vessels will be brought to the site at the beginning of test pit activities for use in the event that intact drums are selected for sampling and removed from the test pit excavations. Each removed drum will be placed in an over-pack vessel prior to sampling. The sampling will consist of the following:

1. don Level B personal protective equipment (PPE) with a full face supplied-air respirator,
2. open/pierce the drum with non-sparking tools,
3. collect a representative of the drum contents, and
4. seal the drum.

Removed drums will not be returned to the test pits. Over-pack vessels will be sealed, labeled, and set aside for appropriate disposal based on the sample results. As discussed above, additional intact drums encountered but not removed from the test pit excavations will be left in place for future remediation.

After collection, drum samples will be submitted to the laboratory for analysis. Analytes are assumed to be the same as for soil sampling plus Toxicity Characteristic Leaching Procedure (TCLP) analytes as outlined in the Code of Federal Regulations (CFR) 40 CFR 261.24. A drum

sample would use the following example naming conventions: TP-1001-DR-001 (drum sample #1 from within test pit TP-1001).

Required equipment and materials include the following:

- Level B PPE including supplied-air respirator
- Nitrile gloves or equivalent
- One 70-gallon over-pack vessel.
- Polyethylene sheeting.
- Non-sparking drum/bung wrench.
- Non-Classified Waste labels.
- Whirl-Pak® bags, or equivalent.
- PID with 10.6 eV lamp.
- PID calibration gas and regulator.
- Coolers, ice, and freezer bags.
- Laboratory-supplied sample containers specified in Table A-V and sample labels.
- Chain-of-custody forms, custody seals, and shipping forms.
- Camera and/or video recorder.
- Field logbook.
- Pen or marker with indelible ink.

6.2.12 Equipment Decontamination

The down-hole equipment will be steam cleaned before startup of field operations and after each boring using a high-pressure, high temperature, hot water cleaner. Similarly, the excavator will be steam cleaned before startup of field operations and after each test pit. The potable water used will come from a source free of contamination. One sample of potable water will be analyzed for VOCs to verify water quality. In the event that the potable water source is changed, a sample will be collected and analyzed for VOCs from the new source.

Non-dedicated sampling or monitoring equipment that comes in contact with Site soil or groundwater will be decontaminated prior to and immediately after use at each location. Water level indicators and sampling equipment will be cleaned by the following procedure:

- wash with soapy (Alconox®, or equivalent) water solution;
- spray de-ionized water on the outside surfaces; and,
- wipe outside surface with paper towel.

Pumps used for monitoring well development and sampling will be decontaminated prior to use and between each location according to the following procedures:

- wash outside of pump with soapy (Alconox®, or equivalent) water solution;
- pump soapy (Alconox®, or equivalent) water solution through the pump for a minimum of 2 minutes;
- pump de-ionized water through the pump for a minimum of 5 minutes;
- rinse outside of pump with de-ionized water; and

- The pump will be wrapped in inert material (i.e., polyethylene sheeting or aluminum foil) for storage or transport.

Tubing will be dedicated to each monitoring well during purging and sampling activities and will be disposed of after sampling of each well is completed.

Disposable nitrile gloves will be worn during sampling and decontamination activities and changed, at a minimum, between locations to prevent cross-contamination.

Required equipment and materials include the following:

- Decontamination pad and high-pressure sprayer for large equipment.
- Potable water.
- Alconox® (or equivalent) detergent.
- Spray bottles.
- Paper towels.
- Polyethylene sheeting and/or aluminum foil
- 55-gallon DOT approved drums decontamination water.
- Distilled or deionized water.
- Nitrile gloves.

6.2.13 Investigation-Derived Waste

Soil cuttings generated from soil boring advancement and well construction activities will be collected, containerized, and stored in 55-gallon drums labeled with Non-Classified Waste labels and placed on a secondary containment pallet, or equivalent device, in a secured area of the Site. Results from soil sampling may be used to characterize the stored materials and determine appropriate methods for disposal. If required by the disposal facility, additional waste profile samples may be collected from the containerized materials prior to disposal.

Water generated from development, sampling, and decontamination activities will be collected, containerized, and stored in 55-gallon drums labeled with Non-Classified Waste labels and placed on a secondary containment pallet, or equivalent device, in a secured area of the Site. Results from groundwater sampling may be used to characterize the stored materials and determine appropriate methods for disposal. If required by the disposal facility, additional waste profile samples may be collected from the containerized materials prior to disposal.

Analytical results of investigation-derived waste will be evaluated and Haley & Aldrich will coordinate with the RACER for transport to, and disposal at, a MDNR-approved waste-handling facility. Haley & Aldrich will coordinate with MDNR to obtain a hazardous waste generator number for the site which would be required for transport and disposal offsite for any wastes determined to be hazardous.

Disposable materials generated during field activities (i.e., bailers, disposable bladders, gloves, paper towels, etc.) will be collected and contained for proper disposal as municipal solid waste.

Required equipment and materials include the following:

- Nitrile gloves or equivalent.
- 55-gallon drums.
- Secondary containment pallet, or equivalent
- Non-Classified Waste labels.
- Bailer.
- Garbage bags.
- Laboratory-supplied containers specified in Table A-V and sample labels.
- Chain-of-custody forms, custody seals, and shipping forms.
- Coolers, ice, and freezer bags.
- Field logbook or boring log forms.
- Pen or marker with indelible ink.

6.3 Sample Handling and Custody

To ensure samples are identified correctly and remain representative of the sampled media, the sample documentation and custody procedures outlined in this section will be adhered to during the sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. Field Staff will be responsible for ensuring proper documentation and custody procedures are initiated at the time of sample collection, and individual samples can be tracked from the time of sample collection until custody of the samples is transferred to the laboratory. The laboratory will be responsible for maintaining sample custody and documentation from the time the laboratory receives the samples until final sample disposal.

6.3.1 Sample Containers and Preservation

Each sample container will be obtained from the laboratory specifically for the site investigation activities through submittal of a laboratory task order form. The laboratory will be responsible for cleaning and preparing the containers, as well as adding or providing the appropriate preservatives. Methods of sample preservation are intended to: 1) retard biological action, 2) retard hydrolysis, and 3) reduce sorption effects. The sample preservatives are listed in Table A-V.

In addition, the collected samples will be thermally preserved by being kept in a refrigerator or iced cooler to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory. Care will be taken during sample collection to verify preservatives have been added to containers and the appropriate containers have been supplied. Samples collected during subfreezing temperatures will be protected from freezing.

Containers suspected of improper cleaning or preparation will be discarded. Prior to use, the containers will be stored in a clean, dry environment (such as the Haley & Aldrich or subcontractor's offices) to prevent exposure to fuels, solvents, and other contaminants.

Samples will be analyzed within the holding times specified in Table A-V.

6.3.2 Sample Labels and Designation

Sample containers will be labeled immediately before sample collection using indelible ink. At a minimum, the containers will be labeled with the following information:

- Site name.
- Sample designation.
- Type of preservative added.
- Date.
- Time.
- Initials of sampler.
- Analysis required.

Additional information, as applicable, will also be included on the label.

The sample designation naming convention will provide each sample with a unique sample name through collection, analysis, data reduction, and validation. The sample name will be placed on each sample container label prior to sample collection. Each sample will be named according to the following sample naming convention:

- Groundwater Monitoring Well Samples: MW-1001-GW-001 (groundwater sample #1 from monitoring well MW-1001).
- Test Pit Soil and Groundwater Samples: TP-1001-SO-001 (soil sample #1 from within test pit TP-1001) and TP-1001-GW-001 (groundwater sample #1 from within test pit TP-1001).

Unique dates and times recorded for each sample will also be used to differentiate samples. Duplicate samples will follow the same naming convention with a unique sample number such that they are submitted blind to the laboratory (i.e., the laboratory cannot tell that the sample is a field duplicate). Notes will be kept in the field log book and/or sampling record to identify which samples are primary and field duplicate pairs.

6.3.3 Sample Packaging and Shipment

Samples will be immediately placed in a hard plastic cooler. Environmental samples will be maintained on sufficient wet ice to cool the samples to 4° ± 2°C. Ice will be double-bagged using Ziplock bags. Sufficient packing material will be placed in each cooler to mitigate the potential for sample bottles to shift and become damaged or broken. Trip blanks will be included in each cooler containing samples for VOC analysis. Temperature blanks will be included in each cooler containing cooled samples.

The original completed chain-of-custody form will be placed in a waterproof plastic bag inside one of the submitted coolers or relinquished directly to laboratory personnel. The lid will be secured by taping around the cooler. A custody seal will be placed between layers of tape securing the cooler. The cooler will be shipped by overnight carrier to the laboratory or transported to the laboratory by laboratory courier.

6.3.4 Sample Records and Custody

Records of sampling methods will be maintained throughout each sampling activity. The records will document the location and time of sample collection, instrument calibration information, QA/QC information, and changes in sampling plans or protocol.

Custody is one of several factors in establishing the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity.

A sample or evidence file is under a person's custody if:

- The item is in actual possession of the person.
- The item is in the view of the person after being in actual possession of the person.
- The item was in actual physical possession but is locked to prevent tampering.
- The item is in a designated and identified secure area.

Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files are discussed in Section 5.4.4.

6.3.4.1 ***Field Record and Custody Procedures***

The Field Team Leader will be responsible for ensuring security and maintaining control of field documentation until transferred to the project files controlled by the Haley & Aldrich PM.

Field logbooks will provide the means of recording data collection activities. Entries will be described in as much detail as possible so that another person could reconstruct a particular activity. Field logbooks will be bound field survey books or notebooks with consecutively numbered pages, and will be stored in the document control center when not in use. Each logbook will be identified by the project name.

Entries in the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of the field team members present, level of personal protective equipment used, and the signature of the person making the entry will be recorded. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook. Measurements taken, samples collected, corrective actions, and modifications of the Revised Workplan will be recorded in the field log book, if not recorded on sample collection records. Whenever a sample is collected or a measurement is taken, a detailed description of the sample location will be recorded, if not recorded on sample collection records. Photographs taken of a sample location will also be noted. Equipment used to make measurements will be identified, along with the date, time, and results of calibration. Calibration will be documented using calibration log forms. Entries will be made in indelible ink, signed, and dated; no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, initialed, and dated by Field Staff.

Sample custody and documentation procedures will begin at the time samples are collected. After a sample is collected, Field Staff will immediately begin chain-of-custody documentation.

An example chain-of-custody form is included in Appendix C. The chain-of-custody form is used to record the following information, where appropriate:

Sample identification.
- Date and time of sample collection.
- Sample matrix.
- Analyses and specific methods required.
- Number and type of sample containers.
- Laboratory.
- Project identification.
- Project number.
- Contact information.
- Turn-around time.
- Level of QC package.
- Special instructions.
- Method of shipment and bill of lading number.
- Signatures of persons relinquishing and receiving sample custody.

The chain-of-custody form will consist of, at minimum, duplicate copies. The original copy of the form will accompany the samples to the laboratory and one duplicate copy will be kept in the project files maintained by the Haley & Aldrich PM.

Each chain-of-custody form will be completed properly in the field prior to final packaging of coolers. Entries will be made using indelible ink. Errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and initialing and dating the change. Unused portions of the chain-of-custody form will be crossed out and initialed.

The chain-of-custody form will be signed (as relinquished) by Field Staff at the time of shipment or delivery and will be countersigned (as received) by laboratory personnel. To detect tampering of the samples during transportation to the laboratory, a custody seal will be placed across the opening of each cooler and signed by Field Staff. Commercial carriers are not required to sign off on the custody form provided the custody form is sealed inside the sample cooler and the custody seals remain intact. The shipping tracking number and bill of lading will serve as evidence of custody transfer between Field Staff and carrier, and the carrier and laboratory. Field Staff will retain and file copies of the chain-of-custody record and bill of lading after the samples are shipped.

6.3.4.2 ***Laboratory Receipt and Custody***

Upon arrival at the laboratory, the Laboratory Sample Custodian will check the integrity of each shipping container by verifying the custody seal is not broken.

Each cooler will be opened and examined for evidence of proper cooling and the internal temperature will be recorded. Individual sample containers will be inspected for breakage, damage, leakage, inverted septa, inappropriate caps or bottles, air bubbles in VOC samples, and incomplete sample labels. Contents of each shipping container will be verified against the chain-of-custody form. Problems observed will be documented on the sample custody form and

communicated to the Haley & Aldrich PM immediately so appropriate corrective action can be determined and implemented. The original completed chain-of-custody form will be returned with the laboratory data package.

The following information will be included on the laboratory sample receipt or chain-of-custody form:

- Internal cooler temperature.
- Condition of samples.
- Preservation of samples.
- Condition of custody seal(s).
- "Received by" and "relinquished by" signatures.
- Sample identification.

After the sample receipt information is checked and recorded, sample analysis information will be entered into the Laboratory Information Management System (LIMS), or equivalent system. Each sample will be provided a unique laboratory identification number. The unique identification number and analytical tests requested on the chain-of-custody records will be entered into the LIMS. The laboratory will follow internal standard operating procedures (SOPs), which are available for review upon request, for sample log-in, storage, tracking, and control.

After completion of sample log-in, samples will be stored in secure, limited access areas in an environment that maintains required temperature preservation noted in Table A-V. According to Table A-V, environmental samples for most analyses are required to be maintained at a temperature of 4° ± 2°C. The temperature of refrigerators or freezers used to store samples will be monitored by the laboratory according to internal SOPs. Samples not requiring temperature preservation (metals) may be stored at room temperature.

Sample custody will be maintained within the secure laboratory facility until the samples are disposed. The laboratory will be responsible for sample disposal, which will be conducted in accordance with applicable local, state, and federal regulations.

6.4 Analytical Methods

Analytical data to satisfy the site investigation DQOs require environmental laboratory analysis. The required turnaround time for delivery of final analytical reports and electronic EDDs will be 10 business days from receipt of each sample delivery group, unless otherwise determined and communicated with the laboratory.

The environmental laboratory will conduct the analyses specified in Table A-III. The analytical methods selected are intended to support the site investigation DQOs and data end use, and the associated MRLs or method detection limits (MDLs), as achievable based on specific field, sample, and laboratory conditions, are intended to meet levels appropriate for the site investigation DQOs. The selected analytical methods will be from approved sources and have known accuracy and precision.

The following criteria for reporting laboratory analytical data will apply for each sample:

- Target analytes not detected above the MDL will be reported as less than the quantitation limit (QL). The QL is the MRL corrected for the dilution factor for a sample.
- Target analytes detected between the MDL and QL will be reported as quantified and qualified with a flag to indicate the data are estimated. Qualification protocols are described in Section 8.1.2 of this QAPP.
- Target analytes detected at or above the QL will be reported as quantified.
- Analytical results will be reported in standard units representing mass of analyte within a known volume of environmental media. Results of aqueous matrix sample organic and metals analyses will be reported in microgram(s) per liter (ug/L) and results of the remaining inorganic analyses will be reported in milligram(s) per liter (mg/L). Results of solid matrix sample analyses will be reported in microgram(s) per kilogram (mg/kg) of dry weight sample. Results of TCLP analyses will be reported in mg/L.

Sample results will not be corrected for analytes found in laboratory blanks. However, sample results may be qualified as "not detected" based on laboratory, field, or trip blank contamination.

If analytical problems arise, the laboratory will follow method and internal laboratory corrective action procedures.

6.5 Quality Control

QC parameters, samples, and evaluations, including QC samples prepared in the field and the laboratory, which will be used to evaluate analytical data in terms of DQI criteria are described in this section. The specific laboratory QC procedures are detailed in laboratory SOPs. Tables A-I, A-II, and A-III summarize the site investigation data quality criteria. Procedures to address QC data outside of the criteria are outlined in Section 8. of this QAPP.

6.5.1 Field Elements of Quality Control

Field blanks, equipment blanks, trip blanks, and field duplicate samples will be used to assess sample collection techniques and environmental conditions during sample collection and transport. These field elements of QC are summarized in Table A-II and discussed in the following paragraphs.

6.5.1.1 *Field Blanks*

Field blanks will be used to assess potential effects on accuracy caused by sampling activities. One field blank sample will be collected per 20 investigative samples of each matrix. Field blanks are prepared by routing distilled or deionized water from the same source used to collect equipment blanks into sample bottles from the same lot or source as those used for sample collection. Samples collected immediately before and immediately after field blank collection will be noted.

Field blanks should not contain parameter of interest at concentrations greater than two times the MRL. If a field blank exceeds this criterion, the source of the contamination will be investigated for future work and appropriate corrective action instituted. Corrective action procedures are

described in Section 7.1.3. If the concentration in an associated investigative samples is less than five times (or ten times for common laboratory contaminants such as methylene chloride, chloroform, and acetone) the result in the associated field blank, the result for the investigative sample may be affected by contamination and will be qualified, as specified in Section 8.1.2.

6.5.1.2 ***Equipment Blanks***

Equipment blanks will be used to assess potential effects on accuracy caused by sampling activities. One equipment blank sample will be collected per 20 investigative samples of each matrix using non-dedicated sampling equipment. Equipment blanks will be prepared by routing distilled or deionized water through non-dedicated sampling equipment after field sample collection, equipment decontamination, and collecting the rinsate in sample containers. Samples collected immediately prior to and following equipment blank collection with the non-dedicated equipment used for equipment blank collection will be noted.

Equipment blanks should not contain parameter of interest at concentrations greater than two times the MRL. If an equipment blank exceeds this criterion, the source of the contamination will be investigated for future work and appropriate corrective action instituted. Corrective action procedures are described in Section 7.1.3. If the concentration in an associated investigative samples is less than five times (or ten times for common laboratory contaminants such as methylene chloride, chloroform, and acetone) the result in the associated equipment blank, the result for the investigative sample may be affected by contamination and will be qualified, as specified in Section 8.1.2.

6.5.1.3 ***Trip Blanks***

Trip blanks will be analyzed for VOCs to assess potential cross-contamination effects on accuracy that may occur from sample containers, transit, and storage. Trip blanks will be provided by the laboratory and will consist of 40-mL glass vials filled with acidified reagent-grade water and then sealed with a cap with a polytetrafluoroethylene septum. Trip blanks will accompany VOC sample containers from the laboratory to the field and back to the laboratory. One set of trip blank samples will be placed in the VOC sample cooler at the start of each day of sampling and remain in the cooler throughout the day. The trip blanks will be transported with the samples to the laboratory.

Trip blanks should not contain target VOC concentration greater than the applicable MRL. If a trip blank exceeds this criterion, the source of the contamination will be investigated and corrective action taken in accordance with Section 7.1.3. If a target VOC concentration in an associated investigative sample is less than five times (or ten times for common laboratory contaminants such as methylene chloride, chloroform, and acetone) the result in the associated trip blank, the result for the investigative sample may be affected by contamination and will be qualified, as specified in Section 8.1.2.

6.5.1.4 ***Field Duplicates***

Field duplicates will be used to assess variability in sample media and the combined sampling and analytical precision; therefore, the results are anticipated to exhibit more variability than that of laboratory duplicates, which measure only laboratory precision. One field duplicate will be collected per 10 investigative samples of the same matrix. Duplicate samples will be labeled, as

specified in Section 6.3.2, for blind submittal to the laboratory. Precision will be evaluated by calculating the RPD between the field duplicate sample pairs for each analyte detected at or above the QL. The RPD will not be calculated when both duplicate sample results for a field duplicate sample pair are reported as less than the QL, or if one sample is below the QL and both samples agree within two QL increments. Although the RPD will be calculated between field duplicate samples, the results will not be used as a basis for qualifying, accepting, or rejecting data. The RPD and actual results will be evaluated qualitatively to assess precision of field sample collection procedures.

Water sample field duplicates should have an RPD less than or equal to 25 percent when both the sample and duplicate are greater than or equal to five times the QL; or less than or equal to 50 percent when the sample and/or duplicate is less than five times the QL but greater than the detection limit. Soil sample field duplicates should have an RPD less than or equal to 50 percent when both the sample and duplicate are greater than or equal to five times the QL; or less than or equal to 100 percent when the sample and/or duplicate is less than five times the QL but greater than the detection limit. If these criteria are exceeded, then corrective action, such, as described in Section 7.1.3, will be taken. Both the primary and duplicate sample data will be reported and used for site characterization.

6.5.2 Laboratory Elements of Quality Control

The laboratory will, at a minimum, analyze internal QC samples and conduct QC evaluations at the frequency specified by the analytical method, laboratory SOPs, and this QAPP. Method-specific QC procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are provided in the laboratory SOPs. The QC parameters and evaluations that will be used to assess laboratory data quality are summarized in Table A-I and discussed in the following paragraphs.

6.5.2.1 *Sample Preservation*

Sample preservation is designed to retain the initial condition of the collected sample by retarding biological action, retarding hydrolysis, and/or reducing sorption effects. The preservative, pH, and temperature of each sample will be compared to the sample preservation specified in Tables A-I and A-V to assess the representativeness of the sample.

6.5.2.2 *Sample Holding Time*

Sample holding time reflects the length of time that a sample or sample extract remains representative of environmental conditions. For methods that do not require sample preparation (e.g., extraction), one holding time (the length of time from sample collection to analysis) will be evaluated. For methods that require sample preparation prior to analysis, two holding times will be evaluated: 1) the length of time from sample collection until sample preparation and 2) the length of time from sample preparation to sample analysis. The sample holding times will be compared to holding times specified by the respective analytical method, which are listed in Table A-I.

6.5.2.3 ***Initial Calibration***
Initial calibration establishes the dynamic range of an instrument, establishes calibration curves or RFs for analyte quantitation, and demonstrates instrument sensitivity. Criteria for initial calibration are instrument- and analytical method-specific. Initial calibration results will be compared to investigation acceptance criteria specified in Table A-I.

6.5.2.4 ***Method Blanks***
Method blanks will be used to monitor laboratory preparation and analytical systems for interferences and contamination from glassware, reagents, sample manipulations, and general laboratory environment. The method blank is an analyte-free matrix (reagent-grade water) to which each reagent will be added in the same volume or proportion as used in sample processing. Method blanks will be taken through the entire sample preparation/extraction and analytical process. Method blanks will be prepared and analyzed with each analytical or preparation batch of environmental samples up to a maximum of 20 samples of a similar matrix. A method blank should be prepared and analyzed before analysis of the associated environmental samples. If the result for a single method blank is greater than the MRL, the source of contamination should be sought and, if feasible, corrected. The associated samples should be reanalyzed if sufficient sample volume remains. If reanalysis is not possible, the laboratory should flag the associated data and note the deviation in the case narrative.

Analytical data will not be corrected for the presence of analytes in blanks. The method blank results will be compared to investigation acceptance criteria specified in Table A-I.

6.5.2.5 ***ICBs and CCBs***
ICBs and CCBs will be analyzed with each sample batch for ICP and graphite furnace atomic absorption (GFAA) methods to determine whether metals are introduced into samples during preparation by the laboratory. The criteria used to evaluate method blanks are also used to evaluate the ICBs and CCBs and associated sample data (Table A-I).

6.5.2.6 ***LCS/LCSDs***
LCS/LCSDs will be used to measure laboratory accuracy and precision in the absence of matrix interference. LCS/LCSDs are prepared in the laboratory and consist of samples of a known matrix (reagent-grade water) spiked with known quantities of specific target analytes at a level less than or equal to the midpoint of the calibration curve for each analyte (the midpoint is defined as the median point in the curve, not the middle of the range). These samples are taken throughout the entire sample preparation and analytical process. LCS/LCSDs will be prepared and analyzed with each analytical or preparation batch of environmental samples up to a maximum of 20 samples of a similar matrix. If more than one LCS/LCSD is analyzed in an analytical batch, results from each LCS/LCSD analyzed will be reported. The %R and RPD of each LCS/LCSD analyte will be calculated and compared to investigation acceptance criteria specified in Table A-I.

6.5.2.7 ***ICVs and CCVs***
ICV and CCV samples are mid-range calibration standards that will be analyzed during each analytical batch before batch samples and after a specific number of samples, respectively, to assure calibration accuracy for each analyte. Calibration standards are known concentrations of

the analytes of interest that are analyzed to determine the response of the analytical system. The %D or %R for each ICV and CCV will be calculated and compared to investigation acceptance criteria specified in Table A-I in an effort to ensure the instrument is retaining the initial calibration.

6.5.2.8 ***Surrogate Spikes***

Surrogate spikes will be used to assess the accuracy of analytical instrument performance for each organic analysis and determine if there may be matrix interferences present. Surrogates are organic compounds chemically similar to target analytes, but not normally found in field samples. Surrogates will be added to each blank, standard, field sample, and QC sample before performing an organic analysis according to laboratory SOPs. The %R of each surrogate spike will be calculated and compared to investigation acceptance criteria specified in Table A-I.

6.5.2.9 ***Internal Standards.***

Internal standards are compounds that behave similarly to target analytes during analysis and are used to assess accuracy for gas chromatography/mass spectrometry (GC/MS) analysis. Internal standards will be prepared and added to each initial calibration standard, ICV, CCV, field sample, and QC sample prior to analysis. Retention times and extracted ion current profile (EICP) areas of internal standards added to samples will be compared to investigation acceptance criteria specified in Table A-I.

6.5.2.10 ***MS/MSDs***

Matrix spikes measure matrix-specific method performance and will be used to assess accuracy and precision. Unlike LCS/LCSDs, MS/MSD samples will be used to assess the influence of the sample media (media interference) on sample analysis. Samples for MS/MSD analysis will be collected from each sample media. A minimum of one MS/MSD sample pair will be analyzed with every batch of up to 20 samples. Each MS/MSD sample will be spiked with compounds specified by the laboratory SOPs prior to sample extraction or analysis at a concentration less than or equal to the midpoint of the calibration curve for each analyte. The sample selected for MS/MSD analyses will be designated on the chain-of-custody form and extra sample volumes will be collected, as necessary, to provide sufficient sample volume for MS/MSD analysis.

MS/MSD %R results will be used to assess the long-term accuracy of a method and the presence or absence of a matrix interference. MS/MSD RPD results will be used to assess the precision of the sampling technique and analytical method. MS/MSD results will be compared to investigation acceptance criteria specified in Table A-I. If the %R or the RPD between the MS and MSD is outside the limits, calculations should be checked and the data may be qualified, as specified in Section 6.1.2. Sample results will not be qualified based solely on MS/MSD results.

6.5.2.11 ***Field Duplicate Samples***

Field duplicate samples will be used to assess both sampling and analytical precision. The purpose of submitting samples "blind" to the laboratory is to assess the precision of the laboratory analytical system. Precision will be evaluated by calculating the RPD between each primary and duplicate sample.

Although the RPD will be calculated between field duplicate samples, the results will not be used as a basis for qualifying, accepting, or rejecting data. The RPD and actual results will be evaluated qualitatively as additional evidence to support data comparability and quality. Water sample field duplicates should have an RPD less than or equal to 25 percent when both the sample and duplicate are greater than or equal to five times the QL; or less than or equal to 50 percent when the sample or duplicate is less than five times the QL but greater than the MDL. Soil sample field duplicates should have an RPD less than or equal to 50 percent when both the sample and duplicate are greater than or equal to five times the QL; or less than or equal to 100 percent when the sample or duplicate is less than five times the QL but greater than the MDL. Both the primary and duplicate sample results will be used for site characterization.

6.5.2.12 ***Post-Digestion Spikes***

To determine the accuracy of ICP and GFAA analyses, at least one sample in each analytical batch is spiked with the target analytes after the preparation procedure to create a post-digestion spike. The post-digestion spike is performed only on batches of samples prepared for dissolved metals or if the sample turbidity is less than 1 NTU. Post-digestion spike recoveries will be compared to investigation acceptance criteria specified in Table A-I.

6.5.2.13 ***Laboratory Duplicates***

To determine the precision of ICP and GFAA analyses, two separate aliquots of the same sample are analyzed. Duplicate analyses are performed only for samples analyzed for dissolved metals or samples with turbidity less than 1 NTU. Laboratory duplicate RPDs will be compared to investigation acceptance criteria established in Table A-I.

6.5.2.14 ***Interference Check Standards***

An ICP interference check standard verifies the laboratory inter-element and background correction factors. Interference check standard recoveries will be compared to investigation acceptance criteria specified in Table A-I.

6.5.2.15 ***Serial Dilutions***

To determine precision of metal analyses, one sample in the preparation batch is reanalyzed at a five-fold dilution. The %D is calculated between the parent sample analysis and the diluted analysis. The %D criteria will be compared to the investigation acceptance criteria specified in Table A-I.

6.5.3 Laboratory Internal Quality Control Checks

The laboratory will conduct internal QC checks to evaluate whether sampling procedures and laboratory analytical method performance are within acceptable limits of precision and accuracy.

The general objectives of the internal laboratory QC program are to:

- Ensure procedures are documented, including changes in administrative and/or technical procedures.
- Ensure analytical procedures are validated and conducted according to method guidelines and laboratory SOPs.
- Monitor the performance of the laboratory using a systematic inspection program.
- Ensure data are properly reported and archived.

The laboratory will conduct internal QC checks for analytical methods in accordance with their Quality Assurance Manual (QAM) and internal SOPs, the individual method requirements, and this QAPP. The QAM for the TestAmerica Nashville laboratory is provided in Appendix A. The laboratory will notify the Haley & Aldrich PM in writing before making significant changes resulting from corrective actions to this QAPP or analytical methodology.

Laboratory QC consists of two distinct components, a laboratory component and a matrix component. The laboratory component measures the performance of the laboratory analytical process during sample analyses, while the matrix component measures the effects of a specific media on the method performance. The criteria against which the QC data will be evaluated are listed in Table A-I along with corrective actions for instrument calibrations or QC sample data out of compliance.

6.5.4 Laboratory Quantitation Limits

The following quantitation limits will be used to ensure proper instrument sensitivity.

6.5.4.1 *Method Detection Limits*

The MDL is an empirically derived value used to estimate the lowest concentration a method can detect in a matrix-free environment. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence the analyte concentration is greater than zero. The laboratory will, at a minimum, perform MDL studies during initial method setup, annually, or whenever the basic chemistry of a procedure is changed. MDLs will be method-specific and include cleanup method used. MDLs will be established for each target analyte in an interference-free matrix using the procedures in 40 CFR, Part 136, Appendix B, or an equivalent statistical approach. Representative MDLs for this project are presented in Table A-III of this QAPP.

6.5.4.2 *Method Reporting Limits*

The MRL, the lowest concentration reliably achieved within limits of precision and accuracy (that is, the lowest point in the calibration curve) during routine operating conditions, is based on the MDL for each analyte. Laboratory-specific MRLs for each method included in this QAPP will be compared to the investigation objectives in an effort to ensure data usability goals are met. Representative MRLs for this project are presented in Table A-III of this QAPP.

6.5.5 Laboratory QC Batches

The frequencies of instrument calibration and QC sample analysis for analytical methods are batch controlled. Sample data for the investigation will be associated with preparation batch QC samples that were extracted or prepared concurrently with the site samples and analyzed in the same analytical batch (analyzed on the same instrument relative to the primary sample results). The identity of each preparation or analytical batch will be unambiguously reported with the analyses so a reviewer can identify the QC samples and the associated environmental samples.

6.5.5.1 ***Preparation Batch***

A preparation batch is a group of 20 or fewer environmental samples of the same matrix that are extracted or prepared within the same time period (concurrently) or in limited continuous sequential time periods with the same lot of reagents. Keeping batches "open" for more than two hours will not be accepted; samples and their associated QC samples (method blank, LCS/LCSD, and MS/MSD) will be prepared in a continuous process. Each preparation batch will be analyzed sequentially on a single instrument (as practicable).

6.5.5.2 ***Analytical Batch***

An analytical batch is a group of 20 or fewer environmental samples analyzed together within the same analytical run sequence as defined by the method calibration criteria, or in continuous sequential time periods. Samples in each analytical batch will be of similar matrix, will be treated in a similar manner, and will use the same reagents.

6.6 Equipment/Instrumentation Testing, Inspection, and Maintenance

A preventive maintenance program will be in place to promote the timely and effective completion of a measurement effort. The preventive maintenance program is designed to minimize downtime of crucial sampling and/or analytical equipment due to unexpected component failure. In implementing this program, efforts will be focused in three primary areas: 1) establishment of maintenance responsibilities, 2) establishment of maintenance schedules for major and/or critical instrumentation and apparatus, and 3) establishment of an adequate inventory of critical spare parts and equipment.

6.6.1 Field Equipment

Field equipment scheduled for site investigation use will be uniquely identified; and records of service, calibration, and use during site investigation activities will be maintained in the field logbook. Equipment failure will be minimized by inspecting field equipment to ensure it is operational and by performing appropriate preventive maintenance activities. Field sampling equipment and associated support equipment will be inspected prior to collecting each sample and necessary repairs will be made prior to decontaminating and reusing the equipment. Routine daily maintenance procedures of field equipment to be conducted in the field will include:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment and measurement systems.
- Storage of equipment sheltered from the elements.
- Daily inspections of sampling equipment and measurement systems for possible problems (e.g., damage or weak batteries).
- Instrument calibration checks, as described in Section 6.7.1 of this QAPP.
- Charging of equipment battery packs when not in use.

Field equipment maintenance will be documented in the applicable field logbooks. Specific equipment to be inspected/tested includes:

- Multiparameter water quality meter.
- Flow-through cell.

- pH/temperature/specific conductance meter.
- Bladder pump or other submersible pump.
- Electronic water level indicator.
- PID.
- Handheld GPS device.
- Digital camera.

Spare parts and supplies will be stored in the field to minimize downtime. These items include, but are not limited to, the following:

- Appropriately sized batteries.
- Extra sample containers and preservatives.
- Extra sample coolers, packing material, and ice.
- Sufficient supply of decontamination solutions (Alconox®).
- Distilled or deionized water.
- Twin-line Teflon®-lined polyethylene tubing.
- Teflon® tape.
- Additional supply of health and safety equipment (i.e., safety glasses, gloves, etc.).
- Additional equipment, as necessary, for field tasks.

6.6.2 Laboratory Instrumentation

Preventive maintenance of laboratory equipment and instrumentation is essential to ensure the quality of the analytical data produced. The objective of preventive maintenance is to ensure instrument operation appropriate for both task-specific and method DQOs. The laboratory will follow a routine preventive maintenance program to minimize the occurrence of instrument failure and other system malfunctions and will have designated individuals who conduct routine scheduled maintenance and required support activity for each instrument system. The laboratory maintains its own schedule and procedures for preventative maintenance of laboratory equipment, which are documented in the laboratory-specific QAM.

6.7 Instrument/Equipment Calibration Procedures and Frequency

General programmatic requirements for the calibration of instruments are established in the USEPA document *A Compendium of Superfund Field Operations Methods*, (USEPA, 1987), and in manufacturer specifications. As an activity that affects data quality, instrument calibration must be performed in accordance with the formal written procedures specified by the USEPA guidance and by the applicable manufacturer operations manual. It is also necessary for instruments to be calibrated, operated, and maintained within manufacturer specifications by trained personnel.

6.7.1 Field Instrument Calibration

Field instruments will be inspected and calibrated before transport to the site. At a minimum, each instrument will be inspected and the calibration checked following manufacturer guidance prior to use. Field instrument calibration and maintenance will be conducted in accordance with

the equipment-specific manufacturer SOPs provided with the equipment to be used in the field. An example equipment calibration record is included in Appendix C. The following critical spare parts and equipment should be maintained in the field or will be available to field personnel on short order:

- Calibration standards.
- Appropriately sized batteries for equipment.

To ensure the quality of sampling equipment and instruments used during site investigation activities, the following QC tasks will be conducted by the Haley & Aldrich Field Team Leader:

- Select and control the equipment inventories.
- Ensure personnel possess proper training for field equipment operation and maintenance.
- Ensure on-site equipment is functioning and has been calibrated prior to use in the field.
- Ensure calibration will take place prior to sampling.
- Ensure instrumentation will be cleaned, decontaminated, checked for damage, and repaired, if needed.
- Ensure field calibration activities will be noted in the field logbook or individual Equipment Calibration Records that will include the following:
    - Calibrator's name.
    - Instrument name, model, and serial number.
    - Date/time of calibration.
    - Standard(s) used.
    - Lot number and expiration date of each standard.
    - Temperature (if it influences the measurement).
    - Results of calibration.
    - Corrective actions taken.

6.7.2 Laboratory Instrument Calibration

Instrument calibration is necessary to ensure an analytical system is operating correctly and functioning at the proper sensitivity to meet the required MRLs. Calibration establishes the dynamic range of an instrument, establishes RFs to be used for quantitation, and demonstrates instrument sensitivity. Criteria for calibration are specific to the instrument and analytical method.

Detailed calibration procedures, calibration frequency, and acceptance criteria are specified in the laboratory analytical method SOPs, which are available upon request. The laboratory will be responsible for proper calibration and maintenance of laboratory analytical equipment.

Calibration activities performed will be documented in the analytical data package (Section 5.4.3) and will be available for review during internal and external laboratory audits.

6.7.2.1 ***Standard/Reagent Preparation***

The laboratory will use primary reference standards obtained from the National Institute of Standards and Technology, USEPA Cooperative Research and Development Agreement vendors, American Association of Laboratory Accreditation vendors, or other reliable commercial sources. When standards are received at the laboratory, the date received, supplier, lot number, purity, concentration, and expiration date will be recorded in a standards logbook. Vendor certifications for the standards will be retained in the files (standards logbook) and made available upon request.

Standards will be obtained in pure, stock, or working standard form. Dilutions will be made from the vendor standards. Records regarding standards will unambiguously trace standard preparation, use in calibration, expiration dates, and quantitation of sample results. Standards will be given a standard identification number, and the following information will be recorded in the appropriate file (standards logbook): the source of the standard, the initial concentration of the standard, the final concentration of the standard, the volume of the standard that was diluted, the solvent and the source/lot number of the solvent used for standard preparation, the expiration date of the standard, and the initials of the preparer.

After preparation and before routine use, the identity and concentration of the standards will be verified. Verification procedures include a check for chromatographic purity (if applicable) and verification of the concentration by comparing the standard response to a prepared standard of the same analyte obtained from a different source. Reagent purity will be assessed by analyzing an aliquot of the reagent lot using the analytical method in which it will be used; for example, every lot of laboratory grade water is analyzed for undesirable contaminants prior to use in the laboratory. Standards will be routinely checked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentration), and will be discarded if deterioration is suspected or the expiration date has passed. Expiration dates will be taken from vendor recommendations, analytical methods, or internal research.

6.7.2.2 ***Instrument Calibration***

Criteria for calibration are specific to the instrument and the analytical method. Each instrument will be calibrated according to manufacturer guidelines using standard solutions appropriate to the type of instrument and the linear range established for the method. Target analytes will be present in both initial and continuing calibrations, which must meet the acceptance criteria specified in the analytical method and summarized in Table A-I. Instrument calibration will proceed from the lowest to the highest calibration standard and the lowest calibration standard concentration will be at or near the MRL for each target analyte.

Multipoint calibrations will contain the minimum number of calibration points specified in the analytical method with each point used for the calibration being contiguous. If more than the minimum number of standards are analyzed for the initial calibration, each standard analyzed will be included in the initial calibration. The only exception is the exclusion of a standard from the calibration that has been statistically determined to be an outlier, providing the requirement for the minimum number and MRL standard criteria are met.

Either calibration curves or RFs will be used to determine analyte concentrations. When using RFs to determine analyte concentrations, the average RF from the initial calibration will be used. The CCV will not be used to update the RFs from the initial calibration. In addition, the concentration used for the CCV will be at or below the concentration of the mid-point of the calibration curve.

Instrument calibration information will be documented and include, at a minimum, the equipment calibrated, reference standards used for calibration, calibration techniques, corrective actions, acceptable performance tolerances, frequency of calibration, and calibration documentation format. The laboratory will maintain records of standard preparation and instrument calibration. Calibration records will include daily checks using standards prepared independently of the calibration standards, and instrument response will be evaluated against established criteria. The analysis logbook maintained for each analytical instrument will include, at a minimum, the date and time of calibration, initials of the person performing instrument calibration, and calibrator reference number and concentration.

6.8 Inspection/Acceptance Requirements of Supplies and Consumables

Only supplies and consumables of adequate quality to sustain confidence in sample collection, processing, and laboratory analyses will be used for the investigation. Where no independent assurance of the quality of outside supplies is available, procedures to ensure the quality of the purchased materials are consistent with the overall investigation technical and quality criteria will be established. Purchased supplies and consumables will not be used until they have been inspected, calibrated, or otherwise verified to ensure compliance with standard specifications relevant to each calibration or test performed for the investigation. Records of supplies and consumables used for the investigation will be maintained.

6.8.1 Inspection and Acceptance Testing of Supplies and Consumables

Inspection or acceptance testing will be documented, including the procedures followed, individuals responsible, evaluation frequency, and handling and storage conditions. The established procedures must enable project personnel to verify critical supplies and consumables meet relevant investigation quality objectives prior to use. Supplies and consumables used during sample collection and processing will be inspected on an as-received basis. In the analytical laboratory, each analyst verifying the quality of reagents/standards must be qualified to perform the associated instrumental analysis so the analyst can calibrate the instrument, use the data system to set up sequences, perform calculations, and interpret data.

6.8.2 Documentation and Tracking of Supplies and Consumables

Records for purchase and receipt of supplies and consumables for sample collection and processing activities will be maintained. Return of damaged or inappropriate materials to the suppliers will be documented.

Documented procedures shall exist at the laboratory for the purchase, receipt, handling/storage, and tracking of supplies and consumables used for technical operations. The established procedures must enable personnel to ensure supplies and consumables have been tested, have not

expired, and meet acceptance criteria. Laboratory personnel performing reagent/standard preparation must have demonstrated proficiency in understanding the dilutions, preparation, and documentation required after training with a qualified person.

6.9 Data Management

The individuals responsible for data management for site investigation activities include personnel involved with identifying, reporting, and documenting activities affecting data quality. In general, the qualifications of the individuals associated with data management activities will be commensurate with the level of expertise necessary to ensure the intended level of evaluation.

This section outlines the documentation requirements for completion of site investigation activities. Field, laboratory, calculation, and report documents will be stored in a project-specific file, as described in Section 5.4.4, which will provide a traceable record for data management activities.

6.9.1 Field Data

Daily field activities will be documented in the site field logbooks and forms. Types of information to be entered in the field logbook include the arrival and departure times for the day, description of data collection activities, field measurements, instrument calibration details, field screening results, problems or difficulties that arise and the solutions achieved, other investigation-related activities or observations, general weather conditions, and notes regarding site visitors. Well Boring Logs and Well Installation Logs will be used to document borehole drilling and well completion. Well development information will be recorded on individual Monitoring Well Development Forms (Revised Workplan Appendix C). Groundwater purging, parameter stabilization, and sample collection information will be recorded on individual Groundwater Sample Records (Revised Workplan Appendix C). Field equipment calibration information will be recorded in the logbook or on individual equipment calibration records (QAPP Appendix C).

The Haley & Aldrich Field Team Leader will be responsible for management of field data, which will be stored in a secured area until transferred to the Haley & Aldrich PM for incorporation into the main project files. The field data recorded in the field logbooks and forms will be reviewed by the Haley & Aldrich Quality Assurance Officer or designee to verify representativeness based on existing site conditions and site knowledge and compliance of data collection activities with procedures documented in this QAPP.

Deviations from investigation activities proposed in this QAPP will be documented on a Field Change Request (FCR) form. This form provides a description of the originally intended task, the reason that task cannot be completed as planned, and the proposed solution. The FCR form is to be completed by the Haley & Aldrich Field Team Leader and approved by the Haley & Aldrich PM or, when appropriate, the Onsite Safety Coordinator (OSC) prior to implementation of the change. A copy of a blank FCR form is included in Appendix C.

6.9.2 Analytical Data

The laboratory will maintain a project file incorporating the LIMS data, hardcopy raw data, and laboratory logbooks. The project file will include, but is not limited to, the formulas used for data reduction, computer programs, data transfers (electronic or manual), data review protocol, raw data files, etc. Data acquired electronically will be transferred and manipulated electronically to reduce errors inherent in manual data manipulation. Data entered, transferred, or calculated manually will be spot checked for accuracy by someone who did not perform the original entries or calculations.

Analytical results generated by the laboratory will be transmitted to the Haley & Aldrich Project Chemist in the form of EDDs via email or compact disc to be accompanied by hard copies or PDF copies of the analytical reports. The analytical data will be reported in a format organized to facilitate data verification. Computer-acquired data will also be stored on magnetic tape, disks, or other media that can be accessed using industry-standard hardware and software for data processing, retrieval, or reporting. The laboratory will maintain data collected for the Site for a minimum of ten years. The Haley & Aldrich Project Chemist is responsible for managing and maintaining deliverables received from the laboratory until the data verification, validation, and data quality reports are completed, at which point the laboratory deliverables will become part of the main project files controlled by the Haley & Aldrich PM.

EDDs will be used to enter analytical results into the database to reduce transcription errors. Data verification and validation will be performed, as described in Section 6. of this QAPP. The resulting validated data will then be available to the appropriate project team members for review and inclusion in reports.

6.9.3 Data Reduction

Data reduction involves the process of generating qualitative and quantitative site information through observations, field procedures, analytical measurements, and calculations. Specific QC measures developed to ensure accuracy throughout the data reduction process are described throughout this QAPP.

6.9.3.1 *Field Data*

Field data obtained from direct-read instruments (e.g., stabilization parameters) will be used as reported from the instruments, while other data (e.g., water level elevations) require data reduction of field measurements.

A legible record of each calculation will be prepared on standard engineering paper or in a computer spreadsheet. Each calculation will be checked by an individual with sufficient qualifications. Both the originator and reviewer will initial the calculation sheet, and the original sheet will be placed in the project files. Data transformation of units will be performed within the spreadsheet database, where possible, to minimize transcriptional error. The number of significant figures will remain unchanged regardless of data transformation: results will not be rounded or truncated.

6.9.3.2 ***Analytical Data***

The laboratory will reduce analytical data in accordance with the analytical methods and laboratory SOPs.

6.9.4 Data Tabulation

Selected geologic, hydrogeologic, engineering, and chemical-specific data will be summarized in tables and figures. Data entered into tables and figures will be independently reviewed against the original forms and reports to ensure consistency in the values and units. Data summaries and text will be clearly presented in a logical progression.

6.9.5 Project Records

Reports will be reviewed prior to transmittal to ensure consistency with the site investigation objectives and appropriateness of interpretations, conclusions, and recommendations. Reviews will be conducted, at a minimum, by the Haley & Aldrich PM and Quality Assurance Officer.

Documents and records related to the site investigation will be retained for a minimum of ten years.

7. ASSESSMENT AND OVERSIGHT

This section discusses QA assessment activities, corrective actions, and reports to management associated with site investigation activities.

7.1 Assessment and Response Actions

Technical systems and performance audits may be performed as independent assessments of sample collection and analysis procedures. Audit results will be used to evaluate the ability of the laboratory to 1) produce data that fulfill investigation objectives, 2) comply with QC criteria presented in this QAPP, and 3) identify areas requiring corrective action. A systems audit is a qualitative review of the overall sampling or measurement system, while a performance audit is a quantitative assessment of a measurement system including both internal and external audits. If required, Haley & Aldrich personnel will conduct internal audits. External audits are the responsibility of federal and state regulatory agencies. Data verification and validation is also a quantitative check of the analytical process, where documentation and calculations are evaluated and verified. Data verification is discussed in Section 6.1.2.

7.1.1 Field Performance

Oversight of field procedures will be the direct responsibility of the Haley & Aldrich Field Team Leader, who will review each element of the Revised Workplan and this QAPP in an effort to ensure the investigation objectives are met. In addition to an initial review, the sampling procedures will be reviewed as the fieldwork progresses so necessary modifications are made. Field system audits may be conducted by internal (Haley & Aldrich) or external (MDNR) auditors to independently assess compliance with field procedures specified in this QAPP.

7.1.1.1 ***Internal Field System Audits***

The Haley & Aldrich PM (or designee) may conduct internal audits of field activities, such as sampling and field measurements, if deemed necessary. These audits will verify established procedures are being followed. An internal field audit will include examination of field measurement records; instrument calibration records; and sample collection, handling, and documentation. Findings of an internal audit will be summarized by the Haley & Aldrich PM (or designee). Follow-up audits may be conducted to correct deficiencies and verify QA procedures are maintained throughout the program.

7.1.1.2 ***External Field System Audits***

Audits of field sample collection, handling, and documentation procedures used during the investigation activities may be conducted by MDNR auditors. The purpose of the audits will be to document the quality of field procedures and verify field procedures are conducted, as described in this QAPP. External field audits may be conducted randomly during field activities. Audits may or may not be announced and are performed at the discretion of MDNR.

7.1.2 Laboratory Performance

In-house audits of laboratory systems and performance will be a regular part of the laboratory QA program. External audits may be conducted by Haley & Aldrich or MDNR.

7.1.2.1 ***Internal Laboratory System Audits***

The laboratory quality assurance (Lab QA) Manager performing analytical testing services for the investigation activities may perform periodic internal systems audits to evaluate laboratory operations and QC procedures in accordance with the laboratory QAM. These audits are intended to serve two purposes: 1) to ensure the laboratory is complying with procedures defined in the laboratory QAM, SOPs, and contract; and 2) to determine sample flow or analytical problems. Internal audits performed by the participating laboratory during the period of investigation sample analyses may be requested by the Haley & Aldrich PM, as necessary, to review associated QA/QC issues relevant to the investigation.

7.1.2.2 ***External Laboratory System Audits***

An audit of laboratory procedures used during the course of investigation sample analysis activities may be conducted by and at the discretion of RACER or MDNR.

The following general areas may be evaluated during an external laboratory audit:

- Sample custody procedures.
- Calibration procedures and documentation.
- Completeness of data forms, notebooks, and other reporting requirements.
- Data review and verification procedures.
- Data storage, filing, and record keeping procedures.
- QC procedures, tolerances, and documentation.
- Operating conditions of facilities and equipment.
- Training and maintenance activity documentation.
- Systems and operations overview.
- Security of laboratory automated systems.

7.1.3 Corrective Action

A corrective action program will be implemented to promptly address conditions that have a potential for compromising data quality. The underlying causes and the full extent of the condition negatively impacting data quality will be determined and corrected in order to prevent recurrence. Haley and Aldrich project staff are responsible for bringing potential nonconformance issues to the attention of the Haley & Aldrich PM for evaluation of appropriate corrective actions. If a nonconformance is determined to exist that cannot be resolved within the parameters of this QAPP or the Revised Workplan, a Corrective Action Request will be initiated. Corrective Action Requests may also be initiated as a result of surveillance inspections or quality audits.

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data verification, and data assessment. Proposed and implemented corrective actions will be documented in the regular QA reports to management, as specified in Section 7.2. Corrective action will only be implemented after approval by the Haley & Aldrich PM (or designee). If immediate corrective action is required, approvals secured by telephone from the Haley & Aldrich PM should be documented in writing.

For each incidence of noncompliance, a formal corrective action program will be established and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Haley & Aldrich PM, who will notify the RACER Cleanup Manager and the MDNR RPM, as appropriate. Implementation of corrective action will be confirmed in writing through the same channels.

Nonconformance with the established QC procedures in this QAPP will be identified and corrected in accordance with this QAPP. The Haley & Aldrich PM (or designee) will issue a nonconformance report for each nonconformance condition.

7.1.3.1 ***Field Corrective Action***

During field activities, Haley & Aldrich Field Staff will be responsible for documenting and reporting suspected technical and QA non-conformances or deficiencies. The non-conformances and/or deficiencies will be documented in the field logbook and reported to the Haley & Aldrich PM. If the problem is associated with field measurements or sampling equipment, the field staff will take appropriate steps to correct the problem. Typical field corrective actions include the following:

- Ensuring instruments are adjusted properly for ambient conditions, such as temperature.
- Checking, recharging, or replacing batteries.
- Recalibrating instruments.
- Replacing instruments used to measure field parameters.
- Stopping work (if necessary) until the problem is corrected.

If a non-conformance or problem requires a major adjustment to the field procedures outlined in this QAPP (e.g., changing sampling methodology or sampling schedule), the Haley & Aldrich PM will be responsible for initiating corrective actions and notifying the RACER Cleanup Manager and the MDNR RPM. The Haley & Aldrich PM will be responsible for:

- Evaluating the reported nonconformance.
- Controlling additional work on nonconforming items.
- Determining the appropriate corrective actions in conjunction with RACER.
- Maintaining a log of non-conformances and corrective actions.
- Approving changes verbally or in writing prior to field implementation, if feasible. If deemed unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of departure from established program practices.
- Ensuring explanation of non-conformances and corrective actions is included in the investigation progress reports.
- Ensuring additional work dependent on the nonconforming activity is not performed until the appropriate corrective actions are completed.
- Reporting changes to affected parties, including the RACER Cleanup Manager.

Corrective action in the field may be initiated when the sample network or rationale is changed (i.e., quantity of samples modified, sampling locations added/moved, etc.), or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions.

In general, any member of the Haley & Aldrich Field Team may identify the need for corrective action. The field staff, in consultation with the Haley & Aldrich PM, will recommend a corrective action. The RACER Cleanup Manager and MDNR RPM will be consulted as appropriate to address the proposed corrective measure to be implemented by Haley & Aldrich Field Staff. It will be the responsibility of the Haley & Aldrich Field Team Leader and the Haley & Aldrich PM to ensure the corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (i.e., additional samples) using existing and approved procedures in this QAPP, corrective action approved by the Haley & Aldrich PM will be documented. If corrective actions keep investigation QA objectives from being achieved (i.e., fewer samples/analytical fractions are achievable than anticipated), it will be necessary for each level of project management (including the Haley & Aldrich PM, RACER Cleanup Manager, and the MDNR RPM) to concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to inability to implement approved methods. The Haley & Aldrich PM will identify deficiencies and recommend corrective action to the Haley & Aldrich Field Team Leader. The Haley & Aldrich Field Team Leader and Haley & Aldrich Field Staff will implement corrective actions. Corrective action will be documented in investigation reports.

Corrective actions will be implemented and documented in the field logbook. Corrective actions will not be initiated by Haley & Aldrich Field Staff without prior communication of findings through the proper channels. If corrective actions are insufficient, the Haley & Aldrich PM, RACER Cleanup Manager, and the MDNR RPM may suspend fieldwork.

7.1.3.2 ***Laboratory Corrective Action***

Corrective actions are required whenever unreliable analytical results prevent the QC criteria from being met, as specified by the analytical method, the laboratory SOPs, or this QAPP. The SOPs specify the majority of the conditions during or after analysis that automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, or automatic reinjection/reanalysis when certain QC criteria are not met. Furthermore, a number of conditions (i.e., broken sample containers, multiple phases, low/high pH readings, and potentially high concentration samples) may be identified during sample log-in or just prior to analysis. The corrective action taken depends on the analysis and the nonconformance. A summary of corrective actions that will be undertaken for problems associated with specific laboratory analyses is provided in Table A-I.

Corrective action will also be undertaken if one of the following occurs:

- Blanks consistently contain target analytes above acceptance levels.
- Undesirable trends are detected in spike recoveries.
- Spike recoveries are outside the QC limits.
- RPDs between duplicate analyses are consistently outside QC limits.
- There are unusual changes in MRLs.
- Deficiencies are detected during QA audits.
- Inquiries concerning data quality are received from the Haley & Aldrich Project Chemist.

A member of the laboratory technical staff will identify the need for corrective action. The analyst who reviews the sample preparation or extraction procedures, and performs the instrument calibration and analysis will handle corrective actions at the bench level (primarily). If the problem persists or its cause cannot be identified, the matter will be referred to the department supervisor or QA department for further investigation. The Lab QA Manager, in consultation with members of the technical staff, will approve the required corrective action to be implemented by designated members of the laboratory technical staff. The Lab QA Manager will also ensure implementation and documentation of the corrective action. If the nonconformance causes investigation objectives not to be achieved, it will be necessary to inform the Haley & Aldrich PM, who must concur with the corrective action. Once resolved, full documentation of the corrective action procedure will be filed with the Lab QA department. If corrective action does not rectify the situation, the laboratory will contact the Haley & Aldrich PM prior to release of the data. A summary of the corrective actions will be included in the data reports submitted to Haley & Aldrich.

7.1.3.3 ***Corrective Action During Data Verification and Data Assessment***

The need for corrective action may be identified during the data verification or data assessment process. Potential types of corrective action may include resampling by Haley & Aldrich Field Staff or reanalysis of samples by the laboratory.

As previously stated in Section 5.2.4, percent completeness will be considered when determining whether the data quality meets the objectives for the investigation. If completeness objectives are not met for individual parameters, the Haley & Aldrich PM will review reasons for the invalid data with the Haley & Aldrich Technical Leader. The corrective actions that will be taken are dependent upon how critical the data are to the DQOs, the ability to mobilize Haley & Aldrich Field Staff, whether the samples are still within holding time criteria, and the reasons for the incomplete data (e.g., holding time exceeded). An evaluation will also be conducted if a sample does not generate data for a parameter category (e.g., VOCs). Such a data gap could result from sample container breakage or sample loss during analysis. If Haley & Aldrich determines the missing results are critical to accomplishing investigation objectives, additional sampling will be conducted to obtain the missing data. The Haley & Aldrich PM will be responsible for approving implementation of a corrective action, including resampling, documenting the corrective action, and notifying the RACER Cleanup Manager for authorization.

7.2 Reports to Management

Deliverables associated with the investigation will contain separate QA sections in which data quality information collected during specific tasks is summarized. Deliverables include reports that summarize the sampling program findings. Submission of these reports is the responsibility of the Haley & Aldrich PM. Quality assurance sections will identify QA samples collected and the corresponding primary samples and will report precision, accuracy, representativeness, comparability, completeness, sensitivity, and traceability of the data as well as the results of performance and system audits, and corrective action needed or taken during the investigation. In addition, whenever necessary, updates on training provided and changes in key personnel will be reported. Anticipated field or laboratory problems for upcoming activities that could affect data quality will be reported with proposed solutions. Furthermore, detailed

references to QAPP modifications will also be highlighted. To the extent possible, assessment of the investigation should also be performed on the basis of available QC data and overall results in relation to originally targeted objectives.

8. DATA VALIDATION AND USABILITY

The data review, verification, validation, and reconciliation procedures to be conducted during the investigation are described in this section.

8.1 Data Review, Verification, and Validation

The field and laboratory procedures described in the Revised Workplan and this QAPP will be reviewed to assess whether these activities were performed in a manner appropriate for accomplishing the investigation objectives. This assessment will include a review of the field and analytical results followed by data verification and data validation.

"Data verification" is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. "Data validation" refers to an analyte-specific and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set.

The laboratory will perform data review/verification on the laboratory data and will add laboratory-specific data qualifiers. The Haley & Aldrich Project Chemist will direct data verification and validation of the laboratory data to determine whether the data have been generated in accordance with the procedures identified in this QAPP. Data verification/validation involves identifying the technical usability of the data for making decisions pertaining to satisfying the investigation objectives and adding appropriate qualifiers to the data. The data review, verification, and validation methods and criteria are discussed in the following subsections.

8.1.1 Data Review

Prior to data verification and validation, the field and analytical data will be reviewed by Haley & Aldrich, and the laboratory, respectively.

8.1.1.1 *Field Data Review*

Prior to use, field data will be reviewed by the Haley & Aldrich Technical Leader or Haley & Aldrich Project Quality Assurance Officer or designee. The data will be reviewed to assess whether the procedures specified in this QAPP were followed, including sample location, collection, and handling; field equipment calibration; analytical methods; and data reduction. Also, the data review will be conducted to identify inconsistencies or anomalous values. Inconsistencies will be resolved immediately, if possible, by seeking clarification from the Haley & Aldrich Field Staff responsible for data collection. The information contained in the field logbook, sampling forms, and chain-of-custody records will be included in the review process, where applicable. Change or correction to the field documentation will also be reviewed. A narrative will be prepared that describes deviations from the procedures, explains qualifications regarding the data quality, and describes significant problem identified during the review process.

8.1.1.2 ***Analytical Data Review***

Prior to the release of data to Haley & Aldrich, the laboratory will perform in-house data review under the direction of the laboratory project manager (Lab PM) and/or the Lab QA Manager and will prepare and retain full analytical and QC documentation. In general, the laboratory data review will be conducted, as described in the following paragraphs.

The bench analyst will conduct the initial data review based on established protocols specified in laboratory SOPs, analytical methods, and this QAPP. At a minimum, this review will include the following assessments:

- Sample preparation procedures and documentation in relation to DQIs.
- Sample analysis procedures and documentation in relation to DQIs.
- Analytical results in relation to DQIs.
- QC sample results in relation to DQIs.
- Compliance with laboratory SOPs.
- Completeness of documentation.

The DQI acceptance criteria and the corrective action summaries are provided in Tables A-I and A-II.

When an analysis of a QC sample indicates the analysis of a batch of samples is not in control, the analyst will immediately bring the matter to the attention of the appropriate designated laboratory QC staff (Lab QA Manager, Lab PM, Section Leader, etc.). This individual will determine whether the analysis can proceed, if selected samples should be rerun, or if specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria will be documented. The Haley & Aldrich PM, or designee will be notified as soon as possible to determine the appropriate corrective action for out-of-control events resulting in unacceptable data.

After this review is complete, the analyst will sign the applicable control documentation associated with the analytical batch and forward to the appropriate reviewer. This reviewer (department manager, Lab QA Manager, etc.) will be responsible for review and approval of the analytical control documentation associated with each analytical batch, as well as corrective action explanations provided by the analyst. This individual will also be responsible for determining whether the analytical data meet QC criteria established by the analytical methods and by this QAPP and for identifying QC problems that require further resolution. A permanent record of corrective actions will be maintained in the laboratory files.

The Lab PM will provide the final review and approval of the analytical data that have been approved by the analyst and other designated reviewer. The Lab PM will also be responsible for reviewing final data reports for proper format and reporting consistency prior to release of the reports to the Haley & Aldrich PM. This review will include confirmation of the following, at a minimum:

- Inclusion of data qualifiers, with appropriate references and narrative on the quality of results.
- Satisfaction of QAPP requirements.

8.1.2 Data Verification

To determine whether investigation DQOs have been met, the number, location, and type of samples and measurements collected will be compared against this QAPP and an Haley & Aldrich or a third party data validator will perform data verification on the analytical data. The objective of the data verification is to provide a data review that verifies the precision, accuracy, representativeness, comparability, completeness, sensitivity, and traceability of the laboratory results.

Although Contract Laboratory Program methods will not be used for sample analysis, data verification will be performed in general accordance with applicable portions of the *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA, 2008) and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Review* (USEPA, 2004) (USEPA CLP National Functional Guidelines).

Data verification will be performed in a three-tiered approach modeled on the *USEPA Region 9 Draft Superfund Data Evaluation/Validation Guidance* (USEPA, 2001b). For the investigation, 100 percent of the soil and groundwater analytical data will be verified, with 80 percent of the data verified through a Tier 1 evaluation and 20 percent of the data verified through a Tier 2 evaluation. The Haley & Aldrich Project Chemist will select the samples for tiered evaluation.

Data verification will result in accepting, rejecting, and/or qualifying data on the basis of the tiered evaluations and the acceptance criteria of the evaluations defined in Tables A-I and A-II. Data will be qualified based on the procedures outlined in the USEPA CLP National Functional Guidelines for the applicable data evaluations. Potential data qualifiers are listed in Table A-VI. Data qualifiers will be added to the project database. Upon completion of data verification, the data validator will prepare a Data Validation Report.

8.1.3 Data Validation

The Haley & Aldrich Project Chemist will coordinate the data validation with support from appropriate members of the project team. The objective of the data validation is to assess whether the field and analytical data are of sufficient quality to support the investigation DQOs. Factors that will be considered during this evaluation include, but are not limited to, the following:

- Were samples collected using the methodologies included in this QAPP and the Revised Workplan?
- Were proposed analyses performed in accordance with this QAPP and laboratory SOPs?
- Were samples obtained from each proposed sampling location?
- Were field and laboratory data verified in accordance with the verification protocols, including the project-specific QC objectives specified in this QAPP?
- Which data sets were found to be unusable qualified “R” based on the data verification/validation results?
- What effects do qualified data have on the ability to implement the investigation?

- Can valid conclusions be drawn for each specific task?
- Were issues requiring corrective action fully resolved?

Results of the data validation process, impacts on the investigation DQOs, and recommendations for corrective action will be documented in QA sections of investigation submittals.

8.2 Reconciliation with User Requirements

The Haley & Aldrich PM, PQAO, and Technical Leader will determine whether field and analytical data or data sets meet the requirements necessary for decision making. The results of measurements will be compared to the DQO requirements set forth in the Revised Workplan and this QAPP. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. The DQOs will be considered satisfied if the data are sufficient (based on the quality and completeness of the data) for the investigation.

Data not meeting data user needs (if any) will be identified and appropriately noted in the project database so the decision-makers are aware of the data limitations.

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TABLES

TABLE A-I
LABORATORY QUALITY CONTROL SUMMARY
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Analytical Method	Parameter	DQI	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW8260B	Volatile Organic Compounds (VOCs)	Accuracy	Tune	At beginning of each 12 hour analytical shift	Meet 4-bromofluorobenzene mass intensity criteria	• Retune instrument •Repeat standard analysis.
		Accuracy	Initial Calibration	• Prior to analysis • As required	• Consists of minimum of 5 points. • RSD ≤ 15% or $r^2 \geq 0.990$ for target analytes	• Evaluate system • Repeat calibration
		Accuracy	ICV (from second source)	Once, immediately following the initial calibration	%D ± 25% for target analytes	• Evaluate system • Repeat calibration.
		Accuracy	CCV	At beginning of each 12 hour analytical shift	• RF ≥ 0.10 for chloromethane; 1,1-dichloromethane; and bromoform • RF ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane • %D ≤ 30% for CCCs and target analytes	• Evaluate system/standard • Re-analyze calibration check standard • Repeat initial calibration • Repeat sample analysis to last acceptable CCV
		Accuracy	Method Blank	• 1 per analytical batch ≤20 samples • Following each CCV	< MRL	• Locate and eliminate source of contamination • Reanalyze method blank • Flag affected target analyte results in affected samples
		Accuracy	Surrogate Spike	Every sample, standard, method blank, LCS, and MS/MSD	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	• Evaluate data and reanalyze sample unless obvious matrix interference is present • Flag affected analyte results in affected samples.
		Accuracy	MS	1 per analytical batch of ≤ 20 samples	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	• Evaluate data and reanalyze sample unless obvious matrix interference is present • Flag affected analyte results in affected samples
		Accuracy and Precision	MSD	1 per analytical batch of ≤ 20 samples	%R and/or RPD within laboratory generated control limits (refer to limits reported in laboratory analytical report).	• Evaluate data and reanalyze sample unless obvious matrix interference is present • Flag affected analyte results in affected samples.
		Accuracy	LCS	1 per analytical batch of ≤ 20 samples	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	• Reanalyze sample • Flag affected analyte results in affected samples
		Accuracy	IS	Every sample, standard, method blank, LCS, and MS/MSD	• RT +/-30 seconds of RT of most current CCV IS RT • EICP area 50% to 200% of most current CCV IS EICP area	• Dilute sample and reanalyze data • Flag affected data • Evaluate and correct system • Reanalyze sample
		Representativeness	Holding Time	Every Sample	Analysis within 14 days of collection	Flag affected analyte results in affected samples
		Representativeness	Sample Preservation	Every Sample	• 0 to 6 degrees Celsius • For liquids: pH<2	• Analyze within 14 days • Flag affected analyte results in affected samples

TABLE A-I
LABORATORY QUALITY CONTROL SUMMARY
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Analytical Method	Parameter	DQI	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW8270	Semi-Volatile Organic Compounds (SVOCs): • 2,4-Dinitrotoluene • Hexachlorobenzene • Hexachlorobutadiene • Hexachloroethane • Nitrobenzene • Pentachlorophenol • 2,4,5-Trichlorophenol • 2,4,6-Trichlorophenol	Accuracy	Tune the Instrument (using a decafluorotriphenyl-phosine standard)	At beginning of each 12 hour analytical shift	• Must meet the ion abundance criteria specified in the method. • Degradation of DDT ≤ 20% • Benzidine tailing ≤ 3.0 • PCP tailing ≤ 5.0	• Retune instrument •Repeat standard analysis.
		Accuracy	Initial Calibration	• Prior to analysis • As required • At least annually	• Consists of minimum of 5 points. • RSD ≤ 15% or $r^2 \geq 0.990$	• Evaluate system • Repeat calibration
		Accuracy	ICV (from second source)	Once, immediately following the initial calibration	%D ± 25% for target analytes	• Evaluate system • Repeat calibration.
		Accuracy	CCV	At beginning of each 12 hour analytical shift	• RF ≥ 0.05 for SPCCs • RF ≤ 30% for CCCs • %D ± 20% for target analytes	• Evaluate system/standard • Re-analyze calibration check standard • Repeat initial calibration • Repeat sample analysis to last acceptable CCV
		Accuracy	IS	Every sample, standard, method blank, LCS, and MS/MSD	• RT within 0.06 relative retention time units of most current CCV IS RT • EICP area 50% to 200% of most current CCV IS EICP area	• Dilute sample and reanalyze data • Flag affected data • Evaluate and correct system • Reanalyze sample
		Accuracy	Method Blank	• 1 per analytical batch ≤20 samples	< MRL	• Locate and eliminate source of contamination • Reextract/Reanalyze method blank and associated samples • Flag affected target analyte results in affected samples
		Accuracy	Surrogate Spike	Every sample, standard, method blank, LCS, and MS/MSD	• %R within the laboratory generated control limits (refer to limits reported in laboratory analytical report). • One surrogate per fraction may be out if %R > 10%	• Evaluate system • Reanalyze sample • Evaluate data and reanalyze sample unless obvious matrix interference is present • Flag affected data
		Accuracy	MS	1 per analytical batch of ≤ 20 samples	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	Flag affected analyte results in affected samples
		Accuracy and Precision	MSD	1 per preparatoin batch of ≤ 20 samples	%R and/or RPD within laboratory generated control limits (refer to limits reported in laboratory analytical report).	Flag affected analyte results in affected samples
		Accuracy	LCS (blank spike)	1 per preparation batch of ≤ 20 samples	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	Flag affected analyte results in affected samples
		Representativeness	Holding Time	Every Sample	• For liquids: extraction within 7 days of collection • For solids: extraction within 14 days of collection • Analysis within 40 days of extraction	Flag affected analyte results in affected samples
		Representativeness	Sample Preservation	Every Sample	0 to 6 degrees Celsius	• Analyze within 14 days • Flag affected analyte results in affected samples

TABLE A-I
LABORATORY QUALITY CONTROL SUMMARY
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Analytical Method	Parameter	DQI	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-6010B	Metals: Arsenic Barium Cadmium Chromium Lead Selenium Silver	Accuracy	Initial Calibration	• Prior to analysis • As required • At least daily	$r^2 \geq 0.998$	• Evaluate system • Repeat calibration
		Accuracy	Independent Calibration Verification	Following each calibration	Results ± 10% of true values	•Terminate analysis • Recalibrate
		Accuracy	IS	Every sample, standard, method blank, LCS, and MS/MSD	%R: 70%-130%	• Reanalyze data • Flag affected data • Evaluate and correct system
		Accuracy	ICS	Daily after calibration, prior to sample collection	• Results ± 20% of true values • Non-interfering elements <MRL unless proven contaminant is vendor standard	•Terminate analysis • Recalibrate • Reanalyze affected samples back to last acceptable ICS
		Accuracy	ICV	After calibration, prio to sample analysis	• Results ± 10% from calibration standard	Identify and correct problem
		Accuracy	CCV	• Every 10 samples in analytical batch • At end of analytical sequence	• Results ± 10% from calibration standard	• Re-analyze CCV • Discontinue sample analysis • Identify and correct problem • Recalibrate • Reanalyze affected samples back to the last accetable CCV
		Accuracy	Reagent Blank (ICB and/or CCB)	• At beginning of analytical sequence • Every 10 samples in analytical batch • At end of analytical sequence	< MRL	• Re-analyze reagent blank • Discontinue sample analysis • Identify and correct problem • Reanalyze affected samples back to the last accetable CCV
		Accuracy	Method Blank	• 5% of routine samples • Each batch preparation	< MRL	• Evaluate system • Reprepare and reanalyze analytical batch, as appropriate • Flag affected target analyte results in affected samples
		Accuracy	MS	• 5% of routine samples • Each batch preparation	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	• If the LCS is acceptable, flag the data to indicate matrix interference • If the LCS is not acceptable, reprepare and reanalyze the sample batch
		Accuracy and Precision	MSD	• 5% of routine samples • Each batch preparation	%R and/or RPD within laboratory generated control limits (refer to limits reported in laboratory analytical report).	Flag affected analyte results in affected samples
		Accuracy	MRL Check Standard	Daily	%R: 70%-130%	• Reanalyze sample • Flag affected analyte results in affected samples
		Accuracy	Post Digestion Spike	Each batch of digested samples	• Results ± 20% of true values	• Reanalyze sample • Flag affected analyte results in affected samples
		Accuracy	LCS	• 5% of routine samples • Each batch preparation	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	• Reanalyze LCS once • Reprepare and reanalyze LCS and affected samples • Flag affected analyte results in affected samples
		Precision	Serial Dilution	5% of routine samples	If result is >50 times the MDL then the percent difference with the original must be less than or equal to 10	Flag affected analyte results in affected samples

TABLE A-I
LABORATORY QUALITY CONTROL SUMMARY
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Analytical Method	Parameter	DQI	QC Element	Frequency	Acceptance Criteria	Corrective Action
		Representativeness	Holding Time	Every Sample	Analysis within 180 days of collection	Flag affected analyte results in affected samples
		Representativeness	Sample Collection	Every Sample	pH <2	Flag affected analyte results in affected samples
SW-7470A	Metals: Mercury	Accuracy	Initial Calibration	• Daily • Prior to analysis • As needed	$r^2 \geq 0.995$	• Evaluate system • Repeat calibration
		Accuracy	ICV	• Immediately following calibration • Prior to analysis	%R: 80%-120%	• Re-analyze ICV • Discontinue sample analysis • Identify and correct problem • Recalibrate • Reanalyze affected samples back to the last accetable CCV
		Accuracy	CCV	• Immediately following calibration • Every 10 samples in analytical batch • At end of analytical sequence	%R: 80%-120%	• Re-analyze CCV • Discontinue sample analysis • Identify and correct problem • Recalibrate • Reanalyze affected samples back to the last accetable CCV
		Accuracy	Calibration Blank	• Immediately following calibration • Every 10 samples in analytical batch • At end of analytical sequence	< MRL	• Re-analyze reagent blank • Discontinue sample analysis • Identify and correct problem • Reanalyze affected samples back to the last accetable CCV
		Accuracy	LCS (blank spike)	1 per 20 samples	%R within the laboratory generated control limits (refer to limits reported in laboratory analytical report).	• Reanalyze LCS once • Reprepare and reanalyze LCS and affected samples • Flag affected analyte results in affected samples
		Representativeness	Holding Time	Every Sample	Analysis within 28 days of collection	Flag affected analyte results in affected samples
		Representativeness	Sample Collection	Every Sample	pH <2	Flag affected analyte results in affected samples

% - Percent
%D - Percent difference or drift
%R - Percent recovery
CCB - Continuing calibration blank
CCC - Calibration Check Compound
CCV - Continuing calibratino verification standard
DQI - Data quality indicator
EICP - Extracted ion current profile
ICB - Initial calibration blank
ICS - Interference check standard
ICV - Initial calibration verification standard
IS - Internal standard
LCS - Laboratory control standard
LCSD - Laboratory control standard duplicate
MDL - Method detection limit
MS - Matrix spike
MSD - Matrix spike duplicate
QC - Quality control
r - Correlation coefficient
r^2 - coefficient of determination
RF - Response factor
RPD - Relative percent difference
RT - Retention time

TABLE A-II
FIELD SAMPLE QUALITY CONTROL SUMMARY
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Quality Control Element	Data Quality Indicator	Frequency	Analysis	Acceptance Criteria	Corrective Action
Field Blank	Accuracy	1 per 20 field samples of each sample matrix	Contaminants of concern (VOCs, SVOCs, etc.) monitored in field samples	< 2x Method reporting limit	• Evaluate contribution by de-ionized water, ambient air, and sample containers • Re-evaluate source of de-ionized water and sample containers • Flag affected analyte results in affected samples
Equipment Blank	Accuracy	1 per 20 field samples of each sample matrix using non-dedicated equipment. [a]	Contaminants of concern (VOCs, SVOCs, etc.) analyzed in field samples collected with non-dedicated equipment.	< 2x Method reporting limit	• Re-evaluate equipment decontamination procedures • Flag affected analyte results in affected samples
Trip Blank	Accuracy	1 set per shipment container containing VOC samples.	VOCs	< Method reporting limit	• Re-analyze trip blank. • Re-evaluate sample handling and shipping procedures • Flag affected analyte results in affected samples
Field Duplicate Samples	Precision	1 per 10 field samples of each sample matrix.	Contaminants of concern (VOCs, SVOCs, etc.) monitored in field samples	For liquid samples: RPD: ≤25% or ≤ 50%[b]	• Re-evaluate sample collection procedures

[a] = Non-dedicated equipment anticipated to be low-flow pump used for collecting groundwater samples.

[b] = Groundwater field duplicate results should have a relative percent difference (RPD) less than or equal to 25 percent when both the sample and duplicate results are greater than or equal to five times the reporting limit; or less than or equal to 50 percent when the sample and/or duplicate result is less than five times the reporting limit but greater than the detection limit.

VOCs = Volatile organic compounds

TABLE A-III
PARAMETER LIST, ANALYTICAL METHODS, AND TARGET QUANTITATION LIMITS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

		Analytical Method		Detection Limits Limits[1]			
				Water		Soil	
				Lab RL	Target MDL	Lab RL	Target MDL
	CAS #	Water	Soil	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
TCL Volatile Organic Compounds (VOC)							
Acetone	67-64-1	SW8260	SW8260	50	25	50.0	25
Benzene	71-43-2	SW8260	SW8260	1	0.27	2.0	1.1
Bromochloromethane	74-97-5	SW8260	SW8260	1	0.44	2.0	0.78
Bromodichloromethane	75-27-4	SW8260	SW8260	1	0.37	2.0	0.46
Bromoform	75-25-2	SW8260	SW8260	1	0.22	2.0	0.65
Bromomethane	74-83-9	SW8260	SW8260	1	0.47	2.0	0.88
2-Butanone	78-93-3	SW8260	SW8260	50	1.7	50.0	7.1
Carbon disulfide	75-15-0	SW8260	SW8260	1	0.29	5.0	0.67
Carbon tetrachloride	56-23-5	SW8260	SW8260	1	0.27	2.0	0.67
Chlorobenzene	108-90-7	SW8260	SW8260	1	0.38	2.0	0.72
Chloroethane	75-00-3	SW8260	SW8260	1	0.41	5.0	1
Chloroform	67-66-3	SW8260	SW8260	1	0.47	2.0	0.48
Chloromethane	74-87-3	SW8260	SW8260	1	0.2	2.0	1.1
Cyclohexane	110-82-7	SW8260	SW8260	5	0.2	10.0	0.57
Dibromochloromethane	124-48-1	SW8260	SW8260	1	0.3	2.0	0.64
1,2-Dibromo-3-chloropropane	96-12-8	SW8260	SW8260	5	0.2	5.0	1.5
1,2-Dibromoethane	106-93-4	SW8260	SW8260	1	0.34	2.0	0.67
1,2-Dichlorobenzene	95-50-1	SW8260	SW8260	1	0.2	2.0	0.67
1,3-Dichlorobenzene	541-73-1	SW8260	SW8260	1	0.49	2.0	1.5
1,4-Dichlorobenzene	106-46-7	SW8260	SW8260	1	0.25	2.0	0.72
Dichlorodifluoromethane	75-71-8	SW8260	SW8260	1	0.14	2.0	1.4
1,1-Dichloroethane	75-34-3	SW8260	SW8260	1	0.32	2.0	0.67
1,2-Dichloroethane	107-06-2	SW8260	SW8260	1	0.38	2.0	0.51
1,1-Dichloroethene	75-35-4	SW8260	SW8260	1	0.36	2.0	0.67
cis-1,2-Dichloroethene	156-59-2	SW8260	SW8260	1	0.38	2.0	0.67
trans-1,2-Dichloroethene	156-60-5	SW8260	SW8260	1	0.36	2.0	0.62
1,2-Dichloropropane	78-87-5	SW8260	SW8260	1	0.33	2.0	0.67
cis-1,3-Dichloropropene	10061-01-5	SW8260	SW8260	1	0.19	2.0	0.35
trans-1,3-Dichloropropene	10061-02-6	SW8260	SW8260	1	0.16	2.0	0.55
Ethylbenzene	100-41-4	SW8260	SW8260	1	0.32	2.0	0.98
2-Hexanone	561-78-6	SW8260	SW8260	50	2.2	50.0	8.5
Isopropylbenzene	98-82-8	SW8260	SW8260	1	0.24	2.0	0.67
Mehtyl acetate	79-20-9	SW8260	SW8260	10	0.28	10.0	1.6
Methylene chloride	75-09-02	SW8260	SW8260	5	0.15	10.0	1.6
Methylcyclohexane	108-87-2	SW8260	SW8260	5	0.21	10.0	3.3
4-Methly-2-pentanone	108-10-1	SW8260	SW8260	10	1.6	50.0	3.4
Methyl tert-butyl ether	1634-04-4	SW8260	SW8260	1	0.32	2.0	0.67
Propyl benzene,n-	103-65-1	SW8260	SW8260	1	0.22	2.0	0.86
Styrene	100-42-5	SW8260	SW8260	1	0.22	2.0	0.74
1,1,2,2-Tetrachloroethane	79-34-5	SW8260	SW8260	1	0.25	2.0	0.89
Tetrachloroethene	127-18-4	SW8260	SW8260	1	0.22	2.0	0.67
Tetrahydrofuran	109-99-9	SW8260	SW8260	20	3.3	20.0	8.4
Toluene	108-88-3	SW8260	SW8260	1	0.33	2.0	0.89
1,2,4-Trichlorobenzene	120-82-1	SW8260	SW8260	1	0.24	2.0	0.67
1,1,1-Trichloroethane	71-55-6	SW8260	SW8260	1	0.35	2.0	0.85
1,1,2-Trichloroethane	79-00-5	SW8260	SW8260	1	0.38	5.0	1.19
Trichloroethene	79-01-6	SW8260	SW8260	1	0.37	2.0	1
Trichlorofluoromethane	75-69-4	SW8260	SW8260	1	0.3	2.0	0.67
1,1,2-Trichloro-1,2,2-trifluoroetha	76-13-1	SW8260	SW8260	1	0.26	2.0	0.76
Vinyl Chloride	75-01-4	SW8260	SW8260	1	0.36	2.0	1.01
Xylenes (total)	1330-20-7	SW8260	SW8260	3	0.87	5.0	1.9

TABLE A-III
PARAMETER LIST, ANALYTICAL METHODS, AND TARGET QUANTITATION LIMITS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

		Analytical Method		Detection Limits Limits[1]			
				Water		Soil	
				Lab RL	Target MDL	Lab RL	Target MDL
	CAS #	Water	Soil	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
TCL Semi-Volatile Organic Compounds (SVOC)							
Acenapthene	83-32-9	SW8270	SW8270	2.000	0.5	330.0	14
Acenaphthylene	208-96-8	SW8270	SW8270	2.000	0.4	330.0	20
Acetophenone	98-86-2	SW8270	SW8270	10.000	8	330.0	35
Anthracene	120-12-7	SW8270	SW8270	2.000	0.2	330.0	9
Atrazine	1912-24-9	SW8270	SW8270	10.000	9.8	330.0	73
Benzaldehyde	100-52-7	SW8270	SW8270	10.000	8.4	1670.0	297
Benzo(a)anthracene	56-55-3	SW8270	SW8270	2.000	0.7	330.0	11
Benzo(b)fluoranthene	205-99-2	SW8270	SW8270	2.000	0.7	330.0	38
Benoz(k)fluorathene	207-08-9	SW8270	SW8270	2.000	0.8	330.0	37
Benzo(g,h,I)perylene	191-24-2	SW8270	SW8270	2.000	0.5	330.0	9
Benzo(a)pyrene	50-32-8	SW8270	SW8270	2.000	0.6	330.0	8
1,1-Biphenyl	92-52-4	SW8270	SW8270	10.000	8.2	330.0	104
4-Bromophenylphenyl ether	101-55-3	SW8270	SW8270	10.000	3	330.0	150
Butyl benzyl phthalate	85-68-7	SW8270	SW8270	10.000	3.7	330.0	125
di-n-Butyl phthalate	87-74-2	SW8270	SW8270	10.000	3.2	330.0	141
Caprolactam	105-60-2	SW8270	SW8270	10.000	2.8	330.0	102
Carbazole	86-74-8	SW8270	SW8270	10.000	0.4	330.0	16
4-Chloroaniline	106-47-8	SW8270	SW8270	10.000	4.8	330.0	103
bis(2-Chloroethoxy)methane	111-91-1	SW8270	SW8270	10.000	2.6	330.0	128
bis(2-Chloroethyl)ether	111-44-4	SW8270	SW8270	10.000	4.1	330.0	151
bis(2-Chloroisopropyl)ether	108-60-1	SW8270	SW8270	10.000	3.5	330.0	158
4-Chloro-3-methylphenol	59-50-7	SW8270	SW8270	10.000	2.8	330.0	142
2-Chloronaphthalene	91-58-7	SW8270	SW8270	10.000	2.9	330.0	150
2-Chlorophenol	95-57-8	SW8270	SW8270	10.000	2.4	330.0	149
4-Chlorophenyl phenyl ether	7005-72-3	SW8270	SW8270	10.000	2.8	330.0	148
Chrysene	218-01-9	SW8270	SW8270	2.000	0.5	330.0	31
Dibenz(a,h)anthracene	53-70-3	SW8270	SW8270	2.000	0.6	330.0	15
Dibenzofuran	132-64-9	SW8270	SW8270	10.000	0.7	330.0	14
3,3-Dichlorobenzidine	91-94-1	SW8270	SW8270	10.000	6.4	660.0	48
2,4-Dichlorophenol	120-83-2	SW8270	SW8270	10.000	2.3	330.0	131
Diethylphthalate	84-66-2	SW8270	SW8270	10.000	2.8	330.0	148
2,4-Dimethylphenol	105-67-9	SW8270	SW8270	10.000	2.6	330.0	137
Dimethylphthalate	121-11-3	SW8270	SW8270	10.000	2.7	330.0	157
4,6-Dinitro-2-methylphenol	534-52-1	SW8270	SW8270	25.000	3.3	830.0	112
2,4-Dinitrophenol	51-28-5	SW8270	SW8270	25.000	3.1	830.0	99
2,4-Dinitrotoluene	121-14-2	SW8270	SW8270	10.000	3	330.0	140
2,6-Dinitrotoluene	606-20-2	SW8270	SW8270	10.000	3	330.0	150
bis(2-Ethylhexyl)phthalate	117-81-7	SW8270	SW8270	10.000	3.3	330.0	126
Fluoranthene	206-44-0	SW8270	SW8270	2.000	0.7	330.0	11
Fluorene	86-73-7	SW8270	SW8270	2.000	0.7	330.0	20
Hexachlorobenzene	118-74-1	SW8270	SW8270	10.000	2.7	330.0	153
Hexachlorobutadiene	87-68-3	SW8270	SW8270	10.000	2.7	330.0	174
Hexachlorocyclopentadiene	77-47-4	SW8270	SW8270	10.000	1.9	330.0	101
Hexachloroethane	67-72-1	SW8270	SW8270	10.000	2.4	330.0	150
Indeno(1,2,3-cd)pyrene	193-39-5	SW8270	SW8270	2.000	0.5	330.0	31
Isophorone	78-59-1	SW8270	SW8270	10.000	2.8	330.0	135
2-Methylnaphthalene	91-57-6	SW8270	SW8270	2.000	0.6	330.0	21
2-Methylphenol	95-48-7	SW8270	SW8270	10.000	2.6	330.0	189
3/4-Methylphenol	106-44-5	SW8270	SW8270	10.000	2.3	330.0	166
Naphthalene	91-20-3	SW8270	SW8270	2.000	0.5	330.0	14
2-Nitroaniline	88-74-4	SW8270	SW8270	25.000	2.3	830.0	121

TABLE A-III
PARAMETER LIST, ANALYTICAL METHODS, AND TARGET QUANTITATION LIMITS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

	CAS #	Analytical Method		Detection Limits Limits[1]			
				Water		Soil	
				Lab RL	Target MDL	Lab RL	Target MDL
		Water	Soil	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
TCL Semi-Volatile Organic Compounds (SVOC) (continued)							
3-Nitroaniline	99-09-2	SW8270	SW8270	25.000	2.9	830.0	273
4-Nitroaniline	100-01-6	SW8270	SW8270	25.000	3.4	830.0	252
Nitrobenzene	98-95-3	SW8270	SW8270	10.000	2.5	330.0	159
2-Nitrophenol	88-75-5	SW8270	SW8270	10.000	3	330.0	196
4-Nitrophenol	100-02-7	SW8270	SW8270	25.000	5.3	830.0	153
N-Nitroso-di-n-propylamine	621-64-7	SW8270	SW8270	10.000	2.7	330.0	152
N-Nitrosodiphenylamine (dipheny	86-30-6	SW8270	SW8270	10.000	4	330.0	183
di-n-Octyl phthalate	117-84-0	SW8270	SW8270	10.000	3.7	330.0	135
Pentachlorophenol	87-86-5	SW8270	SW8270	25.000	2.6	830.0	123
Phenanthrene	85-01-8	SW8270	SW8270	2.000	0.7	330.0	10
Phenol	108-95-2	SW8270	SW8270	10.000	1.7	330.0	131
Pyrene	129-00-0	SW8270	SW8270	2.000	0.6	330.0	23
2,4,5-Trichlorophenol	95-95-4	SW8270	SW8270	25.000	2.7	830.0	148
2,4,6-Trichlorophenol	88-06-2	SW8270	SW8270	10.000	3	330.0	149
TCL Polychlorinated Biphenyls (PCB)							
Aroclor 1016	12674-11-2	SW8082	SW8082	0.5	0.132	33	21
Aroclor 1221	11104-28-2	SW8082	SW8082	0.5	0.186	33	11
Aroclor 1232	11141-16-5	SW8082	SW8082	0.5	0.215	33	16
Aroclor 1242	53469-21-9	SW8082	SW8082	0.5	0.188	33	26
Aroclor 1248	12672-29-6	SW8082	SW8082	0.5	0.141	33	30
Aroclor 1254	11097-69-1	SW8082	SW8082	0.5	0.111	33	11
Aroclor 1260	11096-82-5	SW8082	SW8082	0.5	0.2	33	28
Glycols							
Ethylene glycol	107-21-1	SW8015	SW8015	10 mg/l	.5 mg/l	10 mg/kg	1.4 mg/kg
TAL Metals (ICP and CVAA)							
Antimony	7440-36-0	SW6010	SW6010	10	5.9	10000	800
Arsenic	7440-38-2	SW6010	SW6010	10	4	1000	700
Barium	7440-39-3	SW6010	SW6010	10	6	2000	700
Beryllium	7440-41-7	SW6010	SW6010	4	1	1000	100
Cadmium	7440-43-9	SW6010	SW6010	1	0.6	1000	200
Chromium	7440-47-3	SW6010	SW6010	5	1	1000	200
Cobalt	7440-48-4	SW6010	SW6010	20	2	1000	300
Copper	7440-50-8	SW6010	SW6010	10	3	2000	500
Lead	7439-92-1	SW6010	SW6010	5	2.9	1000	600
Manganese	7439-96-5	SW6010	SW6010	15	1.5	1000	200
Mercury	7439-97-6	SW6010	SW6010	0.2	0.1	100	7.7
Nickel	7440-02-0	SW6010	SW6010	10	2	1000	400
Selenium	7782-49-2	SW6010	SW6010	10	3.9	2000	600
Silver	7740-22-4	SW6010	SW6010	5	2	1000	200
Thallium	7440-28-0	SW6010	SW6010	10	8.4	2000	900
Vanadium	7440-62-2	SW6010	SW6010	20	7	10000	900
Zinc	7440-66-6	SW6010	SW6010	50	8	10000	500
Cyanide (total)	57-12-5	SW6010	SW6010	5	3	2000	1800

TABLE A-III
PARAMETER LIST, ANALYTICAL METHODS, AND TARGET QUANTITATION LIMITS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

	CAS #	Analytical Method		Detection Limits Limits[1]			
				Water		Soil	
				Lab RL	Target MDL	Lab RL	Target MDL
		Water	Soil	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
TAL Metals (ICPMS)							
Antimony	7440-36-0	SW6020	SW6020	2	0.07		
Arsenic	7440-38-2	SW6020	SW6020	2	0.06		
Barium	7440-39-3	SW6020	SW6020	2	0.07		
Beryllium	7440-41-7	SW6020	SW6020	2	0.08		
Cadmium	7440-43-9	SW6020	SW6020	1	0.03		
Chromium	7440-47-3	SW6020	SW6020	2	0.3		
Cobalt	7440-48-4	SW6020	SW6020	2	0.2		
Copper	7440-50-8	SW6020	SW6020	5	0.3		
Lead	7439-92-1	SW6020	SW6020	2	0.09		
Manganese	7439-96-5	SW6020	SW6020	5	0.2		
Nickel	7440-02-0	SW6020	SW6020	5	0.09		
Selenium	7782-49-2	SW6020	SW6020	2	0.07		
Silver	7740-22-4	SW6020	SW6020	2	0.3		
Thallium	7440-28-0	SW6020	SW6020	2	0.05		
Vanadium	7440-62-2	SW6020	SW6020	4	0.2		
Zinc	7440-66-6	SW6020	SW6020	50	0.9		

Notes:

1. Please note that target these quantitation limits are presented for guidance only. Actual quantitation limits are highly matrix dependent and may be elevated due to matrix effects, QA/QC problems, and high concentrations of target and non-target analytes.
Lab MDL - Laboratory Method Detection Limit
PQL - Target Practical Quantitation Limit
2. TAL Metals aluminum, calcium, iron, magnesium, potassium and sodium will not be analyzed due to the low risk associated with these parameters.
3. TCL VOC and TCL SVOC analysis excludes dioxins, pesticides, and herbicides.

TABLE A-IV
DATA REPORTING REQUIREMENTS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Data Type	Analysis Type	Data Reporting Requirement	Report Format
Soil	Description	Location, depth, date, and time. Soil classification, color, moisture content, plasticity, consistency, impacts.	Project-specific field form or logbook.
Soil	Unconfined Compressive Strength	Location, depth, date, and time. Pocket penetrometer measurements.	Project-specific field form or logbook.
Soil	Standard Penetration Test	Location, depth, date, and time. Number of blow counts.	Project-specific field form or logbook.
Well Construction Details	Documentation	Location, date, and time installed. Type and amount of screen, riser, filter pack, seal, and completion materials. Top-of-casing, ground surface, total depth, and screened interval elevations. Amount of water added during drilling and installation.	Project-specific field form or logbook. State of Missouri Well Certification Form.
Test Pit Details	Documentation	Location, date, and time installed. Nature of material/soil, soil/backfill horizons, water level, visual staining, stratification, dimensions. Sample locations described and depicted on test pit sketch.	Project-specific field form or logbook.
Surveying	Horizontal and Vertical Survey	Specified in Section 6.2.6 of this Quality Assurance Project Plan.	Project-specific field form or logbook. Electronic data deliverable.
Water Level Measurements	Depth Measurements	Location, date, and time of measurement. Depth to water and total depth measurements from top of casing.	Project-specific field form or logbook.
Hydraulic Conductivity	In-Situ Permeability	Location, date, and time of measurement. Depth below water measurements.	Project-specific field form or logbook. Data logger file.
Screening Data: Soil Borehole and Test Pits	Volatile Organic Vapors	Location, date, and time sample collected. Location, date, and time sample analyzed. Initial and continuing calibration data. Volatile Organic Vapor data.	Project-specific field form or logbook.

TABLE A-IV
DATA REPORTING REQUIREMENTS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Data Type	Analysis Type	Data Reporting Requirement	Report Format
Screening Data: Groundwater	pH	Location, date, and time sample collected. Initial and continuing calibration data. pH data.	Project-specific field form or logbook.
	Specific Conductance	Location, date, and time sample collected. Initial and continuing calibration data. Specific Conductance data.	Project-specific field form or logbook.
	Temperature	Location, date, and time sample collected. Temperature data.	Project-specific field form or logbook.
	Oxidation-Reduction Potential	Location, date, and time sample collected. Initial and continuing calibration data. Oxidation-Reduction Potential data.	Project-specific field form or logbook.
	Dissolved Oxygen	Location, date, and time sample collected. Initial and continuing calibration data. Dissolved oxygen data.	Project-specific field form or logbook.
	Turbidity	Location, date, and time sample collected. Initial and continuing calibration data. Turbidity data.	Project-specific field form or logbook.
Definitive Organic or Inorganic Data	Specified Laboratory Methods	Specified in Section 6.4 of this Quality Assurance Project Plan.	Electronic data deliverable and hard copy or portable document format copy of data report.

TABLE A-V
SAMPLE CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Analysis [1]	*Sample Containers* [2]	*Preservation*	*Maximum Holding Time from Sample Collection* [3]	*Volume of Sample*	*Shipping*	*Normal Packaging*
Soil						
Volatile Organic Compounds	Three 5g EnCore Sampler ™ per analysis[4] (or equivalent)	Iced, </= 4 +/- 2 C	48 hours for extraction 14 days after extraction for analysis	Fill completely	Overnight or hand deliver	Bubble Pack or Foam Chips
Semi Volatile Organic Compounds and Polychlorinated biphenyls	One 8-ounce glass jar per analysis	Iced, </= 4 +/- 2 C	14 days for extraction 40 days after	Fill to shoulder of jar	Overnight or hand deliver	Bubble Pack or Foam Chips
Target Analyte List Metals	One 4-ounce glass jar per analysis	Iced, </= 4 +/- 2 C	180 days (mercury 28 days) for analysis	Fill to shoulder of jar	Overnight or hand deliver	Bubble Pack or Foam Chips
Total Cyanide	One 4-ounce glass jar	Iced, </= 4 +/- 2 C	14 days for analysis	Fill to shoulder of jar	Overnight or hand deliver	Bubble Pack or Foam Chips
Chromium VI	One 4-ounce glass jar	Iced, </= 4 +/- 2 C	24 hours for analysis	Fill to shoulder of jar	Overnight or hand deliver	Bubble Pack or Foam Chips
Groundwater						
Volatile Organic Compounds	Three 40-mL teflon-lined septum vials per analysis	HCL to pH <2 Iced, </= 4 +/- 2 C	14 days for analysis	Fill completely, no air bubbles	Overnight or hand deliver	Foam Liner or Bubble Pack
Semi Volatile Organic Compounds and Polychlorinated biphenyls	Two 1-liter amber glass bottles per analysis	Iced, </= 4 +/- 2 C	7 days for extraction 40 days after extraction for analysis	Fill to neck of bottle	Overnight or hand deliver	Bubble Pack or Foam Chips
Target Analyte List Metals	One 1-liter plastic bottle	HNO_3 to pH <2, Iced, </= 4 +/- 2 C	180 days (mercury 28 days) for analysis	Fill to neck of bottle	Overnight or hand deliver	Bubble Pack or Foam Chips
Total Cyanide	One 500-ml plastic bottle	NaOH to pH>12 Iced, </= 4 +/- 2 C	14 days for analysis	Fill to neck of bottle	Overnight or hand deliver	Bubble Pack or Foam Chips
Chromium VI	One 250-ml plastic bottle	Iced, </= 4 +/- 2 C	24 hours for analysis	Fill to neck of bottle	Overnight or hand deliver	Bubble Pack or Foam Chips

[1] Analyses-sample containers, preservation, shipping and packaging requirement are applicable to TCL/TAL parameter groups.

[2] Multiple analyses for a soil sample may not require additional containers for each parameter; confirm volume requirements with the laboratory.

[3] The technical holding times are based on time elapsed from sample collection.

[4] If VOCs are the only parameter analyzed, one 4-ounce plastic container will be collected for dry weight determination.

TABLE A-VI
DATA QUALIFIERS
RACER TRUST - FORMER LEEDS ASSEMBLY PLANT - NORTHERN PARCEL
KANSAS CITY, MISSOURI

Qualifier	Description
U	The analyte was analyzed for, but not detected at a level greater than or equal to the level of the adjusted sample quantitation limit for sample and method.
J	The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the sample quantitation limit).
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected at a level greater than or equal to the adjusted sample quantitation limit. However, the reported adjusted sample quantitation limit is approximate and may be inaccurate or imprecise.
R	The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample. The data are rejected and may not be usable due to quality control deficiencies.

APPENDIX A

Laboratory Quality Assurance Manual

Quality Assurance Manual

TestAmerica Nashville

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Nashville, TN 37204
Phone: 615-726-0177/ 800-765-0980
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www.testamericainc.com

Effective Date of Revision 20: April 6, 2010

Vision, Mission & Core Values

Vision

TestAmerica will be the industry leader for environmental testing and data deliverables.

Mission Statement

TestAmerica is committed to providing exceptional client service, highest quality legally defensible data, and the most comprehensive range of capabilities in the environmental testing industry.

Core Values

Integrity: We adhere to the highest moral and ethical principles in all that we do.

Client Service: We ensure our clients' satisfaction and success.

Performance: We set challenging goals, hold one another accountable, and reward results.

Technical Excellence: We continually invest in new technologies to provide exceptional data quality and credibility.

Teamwork: We help each other succeed through a cooperative team effort, in an atmosphere of civility and respect.

People: We invest in the long term professional development and success of our employees.

Growth: We manage our business for profitable growth.

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Quality Assurance Manual

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Effective Date of Revision 20: April 6, 2010

Approval Signatures

Laboratory Director – Johnny A. Mitchell — Date: 3.23.10

Quality Assurance Manager - Eric S. Smith — Date: 3-23-10

Technical Director – Michael H. Dunn — Date: 3-23-10

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REFERENCED CORPORATE SOPs AND POLICIES

SOP/Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Internal Auditing
CA-Q-S-005	Calibration Curves (General)
CA-Q-S-008	Management Systems Review
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-002	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
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 Nashville'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 (2005). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 6. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

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

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- EPA SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)*, Third Edition, September 1986, Final Update 1, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IIIB, June 2005, and Final Update IV, January 2008.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- USEPA Contract Laboratory Program, *Statement of Work for Inorganics & Organics Analysis, Multi-Media, Multi-Concentration,* SOM and ISM, current revisions.
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th and 21st Edition.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *US Department of Energy* Order 414.1 C, *Quality Assurance,* June 17, 2005.
- *U.S. Department of Energy*, *Quality Systems for Analytical Services*, Revision 2.4, October 28, 2008.
- U.S. Department of Defense, *Quality Systems Manual for Environmental Laboratories*, Final Version 3, January 2006.
- U.S. Department of Defense, *Air Force Center for Environmental Excellence Quality Assurance Project Plan (QAPP),* Version 4.0.02, May 2006.

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by TestAmerica Nashville 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 Nashville analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters. The QA 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, air, 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 the Control Limits Manual. 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 Nashville 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 abides by the requested criteria following review and acceptance of the requirements by the Laboratory Director, the Technical Director, and the Quality Assurance Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director, the Technical 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

This manual is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of TestAmerica Nashville's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager reviews the changes in the normal course of business and incorporate changes into revised sections of the document. The updates are reviewed by the QA Manager, Laboratory Director, Technical Director, relevant operational staff and Corporate Quality Assurance (if a change is made to the Corporate template) and then incorporated into the document in periodic updates. The QAM is based on a Corporate QAM

Template that is prepared and reviewed annually by the Corporate Quality Department. Necessary changes are coordinated by the Corporate Quality Department and distributed electronically to each laboratory for inclusion in the laboratory specific QA Manuals.

Policies in the QAM that require immediate attention are addressed through the use of a Laboratory 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. 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.

Laboratory-specific QAM changes are approved and documented through the Management of Change process. (Refer to SOP NV08-161, Management of Change System.)

3.4.2 Control

Copyright information pertaining to this QA Manual is located on the Cover Page of this manual. The procedure for control of distribution of the QA manual is incorporated by reference to laboratory SOP NV08-152: Document Control.

Figure 3-1.

Laboratory QA/QC Policy Memorandum # _____

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

_____	_____
Technical Director Approval Date	Quality Assurance Approval Date
_____	
Laboratory Director Approval Date	

1. **Purpose**

2. **Procedure**

3. **Documentation**

4. **Attachments**

5. **References/Cross References**

SECTION 4

ORGANIZATION AND MANAGEMENT
(NELAC 5.4.1)

4.1 OVERVIEW

TestAmerica Nashville is a local operating unit of TestAmerica Laboratories, Inc. This Quality Assurance Manual (QAM) is applicable to the TestAmerica Nashville laboratory only.

TestAmerica Nashville
2960 Foster Creighton Drive
Nashville, TN 37204

EPA ID: TN00032

The organizational structure, responsibilities, and authorities of the corporate staff of TestAmerica Laboratories, Inc are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, General Managers, VP of Client and Technical Services, Corporate Director of Technical Services, Legal and Contracts Director, National Accounts Director, Ethics and Compliance Directors, Director of Quality and Client Advocacy, Corporate Quality Directors, Corporate Quality Assurance, etc.). The laboratory operational and support staff work under direction of the Laboratory Director. The organizational structure for Corporate is presented in Figure 4-1 and the laboratory's organization chart can be found in Appendix 2.

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. When necessary, more extensive job descriptions may be maintained by laboratory management.

4.2.1 Quality Assurance Program

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

4.2.2 Laboratory Director

TestAmerica Nashville'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 General Manager. 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 is (are) 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. Once all corrective actions have been made, with the approval of the Quality Manager, the Laboratory Director has the responsibility to resume suspended/restricted work.
- 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, the Technical Director, and the Operations Manager(s) as direct reports.

4.2.3 Quality Assurance 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 the Techical 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.
- Maintains records of all ethics-related training, including the type and proof of attendance.
- Maintains, improves, and evaluates 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.
- Evaluation of the thoroughness and effectiveness of training.
- Monitoring standards of performance in quality control and quality assurance to ensure that systems are in place to produce the level of quality as defined in this document.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Reviews a percentage of all final data reports for internal consistency, including Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, calculations, format, holding time, sensibility and completeness of the project file contents.
- Reviews of external audit reports and data validation requests.
- Follows up with audits to ensure client QAPP requirements are met.
- Ensuring communication with 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.

4.2.4 Technical Director

The Technical Director reports directly to the Laboratory Director. He/she is accountable for all analyses and analysts with respect to ISO 17025. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development

programs for existing analysts and second- and third-generation instrumentation. Specific responsibilities include, but are not limited to:

- Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, manual integration, and instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc.
- Works with operations managers and department supervisors to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with operations managers, department supervisors and QA Manager.

4.2.5 Analytical Operations Manager(s)

The Analytical Operations Managers manage and direct the analytical production sections of the laboratory. For Ohio VAP, this position is known as a Department Operations Manager. He/She

reports directly to the Laboratory Director. He/She assists the Technical Director in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Technical Director and QA Manager and in compliance with regulatory requirements.
- Ensures that scheduled instrument maintenance is completed.
- Is responsible for efficient utilization of supplies.
- Constantly monitors and modifies the processing of samples through the departments.
- Develops, reviews, and provides comment on technical SOPs.
- Works with department supervisors to ensure departmental compliance with the quality system.

4.2.6 Hazardous Waste Coordinator

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

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

4.2.7 Department Supervisors

Department supervisors report to the Operations Managers. 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 8.3), 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 CAR issues, the timely and accurate completion of performance evaluation samples and MDLs, for his/her department.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Report all non-conformance conditions to the QA Manager, Technical Director, Operations Managers, and/or Laboratory Director.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He/she 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.

4.2.8 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader or department 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 department supervisor, the Technical Director, and the QA Manager. These improvements, if approved, are 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.

4.2.9 Environmental Health & Safety (EH&S) Manager

The EH&S Manager reports to the Laboratory Director and ensures that systems are maintained for the safe operation of the laboratory. For Ohio VAP, this is position is the Health & Safety Manager/Coordinator. The EH&S Manager 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.

4.2.10 Sample Control Manager

The Sample Control Manager reports to the Project Management Operations Manager. The responsibilities are outlined below:

- Direct the logging of incoming samples into the LIMS.
- Ensure the verification of data entry from login.

4.2.11 Project Management Operations Manager

The Project Management (PM) Operations Manager reports to the Laboratory Director and serves as the interface between the laboratory's analytical 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 PM team.
- Technical liaison for the PM team.
- Human resource management of the PM team.
- Responsible to ensure that clients receive the proper sampling supplies.
- Coordinating status meetings with departmental supervisors.
- 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 department supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample progress/status.
- 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).

4.2.12 Project Managers

The Project Management team consists of Project Managers who report to the Project Management Operations Manager. The Project Managers are responsible to:

- Monitor analytical and QA project requirements for a specified project
- Ensure that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notify laboratory personnel of incoming projects and sample delivery schedules.
- Be accountable to clients for communicating sample progress/status.
- Ensure that clients receive the proper sampling supplies.
- Coordinate subcontract work
- Inform clients of project related problems, resolving service issues, and coordinating technical issues with the laboratory staff.
- Provide assistance to clients regarding resolution of problems concerning COC.

- Monitor the status of all projects in-house to ensure timely delivery of reports.
- Perform review of projects for completeness and compliance to client needs prior to release to client.
- Generate final laboratory reports and has signature authority (where approved).

4.2.13 Purchasing / Facilities Maintenance Manager

The Purchasing / Facilities Maintenance Manager reports to the Laboratory Director. He/She is responsible for:

- Coordinating facility maintenance, and
- Oversight of purchasing and receiving of supplies.

4.2.14 Shipping Manager / Sample Archiving and Disposal

The Shipping Manager reports to the Laboratory Director. He/She is responsible for ensuring the timely and correct shipment of sample containers, including proper preservatives and instructions, to clients. He/She maintains accurate records of sample container shipments. In addition, he/she:

- Supervises the organized storage and appropriate climate control of samples.
- Supervises the disposal of samples in accordance with the Waste Disposal SOP, the Hazardous Waste Contingency Plan in the Chemical Hygiene/Safety Manual, and the U. S. Department of Agriculture requirements.

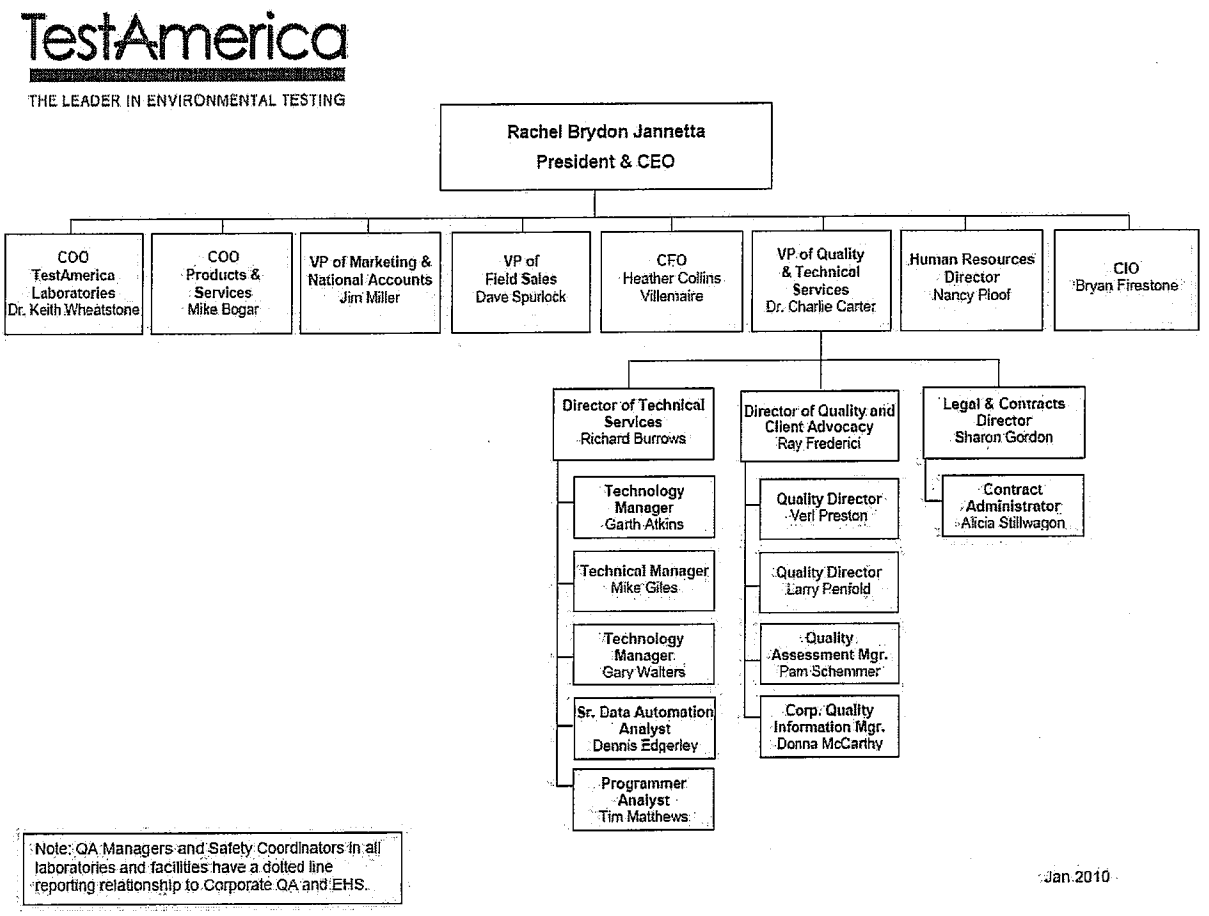
4.3 DEPUTIES

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

Key Personnel	Primary Deputy	Support Deputy
Laboratory Director	Technical Director	QA Manager PM Operations Manager
QA Manager	Laboratory Director	Technical Director
Technical Director	Laboratory Director	QA Manager Operations Managers
EHS Manager	Human Resources	Laboratory Director

Figure 4-1.

Corporate Organization Chart



SECTION 5

QUALITY SYSTEM
(NELAC 5.4.2)

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

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

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

5.2 ETHICS AND DATA INTEGRITY

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

- An Ethics Policy (Corporate Policy No. CA-L-P-001) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A training program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CA-L-S-001)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-L-S-001).
- An effective external and internal monitoring system that includes procedures for internal audits (Section 16).

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

5.3 QUALITY SYSTEM SUPPORTING DOCUMENTATION

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

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

5.3.1 Order of Precedence

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

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

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

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

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

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

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

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 is considered valid if it is adequate for its intended use. Data usability is 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 must be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

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

5.4.7 Sensitivity

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

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory prepares a Control Limits Manual containing tables that summarize the precision and accuracy acceptability limits for analyses performed at TestAmerica Nashville. The Control Limits Manual is considered to be part of the QA Manual and therefore carries the same revision number as the QA Manual. Letter suffixes are added to the revision number if it becomes necessary to update the Control Limits Manual during the course of the year prior to a QA Manual update. This summary includes an effective date, is updated each time new limits are generated and is distributed in the same manner as the QA Manual to the analytical departments. It also is available on the laboratory server. 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 Nashville has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are 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. TestAmerica Nashville 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 Technical Director and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory. (See SOP Archiving / SA08-194.) 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 is to be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

As the QC limits are calculated, QC charts are generated showing warning and control limits for the purpose of evaluating trends. The QA Manager evaluates these to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 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 in the lab:

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

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the company intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedures for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in the following lab SOPs: Document Control of Internal Technical Forms, Work Instructions, Information Sheets / NV08-152, Archiving of Technical and Quality Department Paper Records / NV 08-194, and Organization of Quality Department Documents / NV08-220.

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

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports. 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 document name and number, the number of pages of the item, the effective date, revision number and the laboratory's name. The QA department is responsible for the maintenance of the system and maintains the items in the QA Office.

Controlled documents are authorized by the QA Department and other management. In order to develop a new document, a manager submits a paper or electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain the official document on file. The official document is provided as needed to those using it. Controlled documents are available at all locations where the operational activity described in the document is performed (this 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.

Handwritten edits to controlled documents are not allowed, except by QA staff. Necessary changes to controlled documents must be brought to the attention of the QA department by using the appropriate notification and amendment procedures for controlled documents.

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

Quality System Policies and Procedures are reviewed at a minimum of every two years except for drinking water SOPs which are reviewed every year 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

For changes to the QA Manual, refer to SOP Document Control / NV08-152. 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 QA server.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure (SOP) and SOP Document Control / NV08-152. The QA Department has a complete file of all current and previous versions, showing changes, of each SOP. Additionally, there are controlled notebooks of current SOPs in the lab. These are updated by the QA department. There is a table of contents. Electronic versions of current, previous, and in-transition SOPs are maintained on a QA hard drive that is backed up weekly. Current, unchangeable versions are stored on the QA server/SOPs.

Changes to facilities, the QA Manual, certifications, personnel, safety/health, capabilities are documented in the Management of Change log as prescribed in Section 14.

Forms, worksheets, work instructions and information are organized by department in the QA office. There is a table of contents. Electronic versions are kept on a hard drive in the QA department; hard copies are kept in QA files. The procedure for the care of these documents is in SOP Document Control / NV08-152.

Reference books, regulations, and other external protocols are listed, with location, in the QA office. This list is updated as needed.

Logbooks and preparation worksheets are initialized and stored in an archiving system described in SOP NV08-194 for easy tracking and retrieval.

Certification correspondence, audit reports and responses, control charts, MDLs, training files, subcontractor credentials, and PT studies are stored by date in the QA office in appropriate files. These documents are not uniquely identified.

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 Nashville 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 (method detection and reporting limits), 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 must 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 same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel must 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. Project Managers contact the appropriate laboratory management or corporate personnel if any of the details are unknown, differ from what standard payment policy and insurance coverage includes, or if the task appears to fall outside the Project Manager's job responsibilities.

For complex or large projects, the proposed contract is given to the Director of National Accounts, who decides 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 Project Management Operations Manager
- Laboratory and/or Corporate Technical 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 Director of National Accounts, 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 fulfills the review requirements.

The Legal & Contracts Director maintains copies of all signed contracts.

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 is distributed to and maintained by the appropriate sales/marketing personnel. A copy of the contract and formal quote is filed with the laboratory PM and the Lab Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps correspondence records (i. e., e-mail) and a phone log of conversations with the client. These records are archived by the laboratory facility for a minimum of five years.

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 Nashville 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 requirements.

PMs are the primary client contact and they ensure resources are available to meet project requirements. Although PMs 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 production meetings. Such changes are updated to the project notes and are introduced to the managers/supervisors at these

meetings. The laboratory staff is then introduced to the modified requirements via the individual laboratory operations managers/department supervisors. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

TestAmerica strongly encourages client visits to the laboratory and formal/informal information sharing sessions 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 TestAmerica laboratory network. The phrase "work sharing" refers to internal transfers of samples between TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to 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 must 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 is placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work is identified in the final report, as is non-NELAC accredited work where required.

Project Managers (PMs), Customer Service Managers (CSM), or Regional Account Executives (RAE) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory advises the client of a subcontract or work sharing arrangement in writing, and approval from the client (Figure 8-1) is 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 (RAE) or Customer Service Manager (CSM)) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) are selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica. A listing of all approved subcontracting laboratories 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 TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client has approved sending the samples to that laboratory. The client must provide written acknowledgement that the samples can be sent to that facility. This written acknowledgement is to be provided using the form in Figure 8-1. 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 as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide written acknowledgement that the samples can be sent to that facility. This written acknowledgement is to be provided using the form in Figure 8-1.

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) by lab management and forwarded to Corporate Contracts for formal contracting with the laboratory. Corporate Contracts adds the lab to the approved subcontractor list on the intranet site along with the associate documentation and notifies the finance group for JD Edwards.

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

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

- Complaints must be investigated. Documentation of the complaint, investigation and corrective action is maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report (Form No. CW-F-WI-009).
- Information is updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing are retained on the intranet listing. The lab QA Manager notifies all TestAmerica laboratories and Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification is posted on the intranet

site and e-mailed to all Lab Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which reflect 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 (or RAE or CSM, etc) responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it is current and scope-inclusive. The information is documented on a Subcontracted Sample Form (Figure 8-2) and the form is retained in the project folder. For TestAmerica laboratories, certifications can be viewed on the company's Total Assess Database.

The Shipping 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 TestAmerica.

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

Non-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 laboratory's EDD (i. e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

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

8.4 CONTINGENCY PLANNING

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs. In the event this provision is utilized, the PM must verify certifications and notify the laboratory QA Manager of this event.

The comprehensive subcontractor approval process, as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures must then be initiated within 30 calendar days of subcontracting.

Figure 8-1.

Client-Approved Subcontractor Form

Client Information:

Client Name & Account Number:_____

Client Contact: _____

Client Address: _____

_____

Project Information: (Please choose all applicable.)

- ❖ **Certification required:** □ **State** □ **NELAC** □ **A2LA** □ **AIHA**

  □ **Method**_____□ **Target compound**_____□ **Other**_____

- ❖ **Required Turn around time (method provisional)**_____

Subcontractor's Information:

Subcontractor's Name: _____

Subcontractor's Contact: _____

Subcontractor's Email: _____

Subcontractor's Address: _____

_____

Subcontractor's Phone Number: _____

Analytical Test/Compound/Method to be subcontracted: _____

_____

□ **I, the client, have designated this subcontractor for my project(s).**

□ **TestAmerica – Nashville has designated this subcontractor for my project(s).**

Certification Statement:

I hereby give ***TestAmerica Nashville*** permission to use the above noted subcontractor for the above noted testing procedures/methods. I realize that the above subcontractor will be held liable for the validity of the above mentioned testing procedures/methods. All subcontractors must meet the requirements as spelled out in project information and will follow all analytical holding times and turn around times for analytical reports. The subcontract laboratory, and not TestAmerica, will be held liable for liquidated damages for delays in subcontracted analytical reports and/or electronic data deliverables.

_____

Client Signature **Date**

Figure 8-2.

Subcontracted Sample Form

Date/Time: _____

Subcontracted Laboratory Information:

- Subcontractor's Name: _____
- Subcontractor Point of Contact: _____
- Subcontractor's Address: _____
- Subcontractor's Phone: _____
- Analyte/Method: _____
- Certified for State of Origin: _____
- NELAC Accredited: Yes_____No_____
- A2LA (or ISO 17025) Accredited: Yes_____No_____
- AIHA Accredited: Yes_____No_____
- CLP-like Required: Yes_____No_____
  (Full doc required)
- Requested Sample Due Date: _____
  (Must be put on COC)

Project Manager: _____

Laboratory Sample # Range: _____
(Only of Subcontracted Samples)

Laboratory Project Number (Billing Control #): _____

All subcontracted samples are to be sent via bonded carrier and Priority Overnight. Please attach tracking number below and maintain these records in the project files.

PM Signature_____**Date**_____

SECTION 9

PURCHASING SERVICES AND SUPPLIES
(NELAC 5.4.6)

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors are 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 TestAmerica's Corporate Controlled Purchases Procedure, CW-F-S-007.

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

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 by the manufacturer or according to laboratory procedure. Pyrex (or equivalent) glass is used where possible. For safety purposes, thick-wall glassware is used where available.

9.2.1 Glassware Cleaning

The proper technique for cleaning glassware depends upon the intended use of the glassware being cleaned. The goal is to remove all substances from the glassware that might interfere with the analysis. Water-soluble substances can be removed with tap water followed with multiple rinses with reagent water. In some instances, detergent may be required. Detergent washings are followed by rinses with analyte-free water. Specific guidelines can be found in Table 9-1.

9.2.2 Glassware Storage

Once cleaned, glassware is capped, inverted or covered for storage in a designated cabinet, away from bulk chemicals or reagents.

9.3 REAGENTS, STANDARDS & SUPPLIES

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

9.3.1 Purchasing

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

The analyst provides the item number, item description, package size, and the quantity needed to his/her department supervisor. Any substitution of items requires the approval of the Technical Director, QA Manager, or Lab Director, using a Supply Item Substitution Approval Form as described in SOP Standards Control / NV08-214. Completed Supply Item Substitution forms are filed with the Purchasing Manager. The department supervisors and the Purchasing Manager place the orders. See SOP Purchasing / NV08-232 for further details.

9.3.2 Receiving

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

9.3.3 Specifications

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 or the SOP Standards Control / NV08-214. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals unless noted otherwise by the manufacturer or by the reference source method. Chemicals must not be used past the manufacturer's or SOP's expiration date unless 'verified'.

- An expiration date cannot 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 by the department supervisor.

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 500 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 specific conductivity of less than 10 microohm-cm at 25°C. An in-line resistivity meter check is performed and recorded daily, and the conductivity is checked and recorded weekly. If the water's conductivity is greater than the specified limit, the Technical Director must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

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

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

Purchased 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.

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

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions. Table 9-2 details general 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 department supervisor makes a supply request to the Technical Director and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed, and purchasing places the order.

Upon receipt of a new or used piece of equipment, it is assigned a short name (such as HP-20) added to the equipment list (described in Section 21) that is maintained by the QA Department, and IT must be notified so that it can be linked to the server for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (see Section 20). For software, its operation must be deemed reliable. Evidence of instrument verification must be retained at the instrument and in the QA Department. Software certificates supplied by the vendors are filed with the 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 preventive maintenance is discussed in Section 21. The need for service is determined by analysts and/or Department Managers/Supervisors. The service providers who perform the services are approved by the Department Managers/Supervisors/Technical Director.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Finance documents on Vendor Selection (SOP No. CW-F-S-018) and Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated expenses 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 are 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 works through the appropriate channels to gather the information required to clearly identify the problem and contacts 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 are summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a master 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), available on the intranet site. New vendors to be used for technical purchases must also undergo vendor evaluation as described in laboratory SOP Purchasing, NV08-232.

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 Corporate QA Department and/or the Corporate Technology Director are consulted with vendor and product selection that have an impact on quality.

Table 9-1.

Laboratory Glassware Cleaning Procedures

Analysis/Parameter	**Cleaning Procedure** (in specified order)
Extractable Organics (including Pesticides and Herbicides)	13, 1, 2, 3, 4, 5 or 7, (6 or 8 optional), 14, 15
Purgeable Organics	7, 11
Trace Metals	1, 2, 3, 4, 10, 4, 9, 3, 4
Teflon™ Microwave Vessels	3, 9, 4
Nutrients (except P) and other Wet Chemistry	1, 2, 4, 9, 4
Minerals, Demand, CN and Phenols	1, 2, 4
Residues	1, 2, 4, 12
Phosphorus	9, 1, 2 (Alconox™), 4

Key to laboratory glassware cleaning procedures:

1 Remove all labels.
2 Wash with hot tap water, a brush to scrub inside glassware and stopcocks and other small pieces, if possible, using a suitable laboratory-grade detergent:
Organics – Liquinox™, Alconox™ or equivalent,
Inorganic Anions – Liquinox™ or equivalent,
Inorganic Cations – Liquinox™, Acationox™, Micro or equivalent.
3 Rinse thoroughly with hot tap water.
4 Rinse thoroughly with deionized water.
5 Rinse thoroughly with pesticide-grade acetone.
6 Rinse thoroughly with pesticide-grade methylene chloride.
7 Rinse thoroughly with pesticide-grade methanol.
8 Rinse thoroughly with pesticide-grade hexane.
9 Rinse or soak with 1:1 HCl.
10 Rinse or soak with 10% HNO_3.
11 Bake at 105°C for 3-4 hours (Note: Class A volumetric glassware must not be baked.)
12 Bake crucibles at 105°C or 180°C for 1 hour (prior to use as per method).
13 After use, rinse with solvent used.
14 Store inverted or capped with suitable material or container stopper.
15 Rinse with solvent used in analysis as the last step prior to use.

Table 9-2.

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 must not be stored with bases.
Standards for metals analysis	Stored at room temperature in the standards cabinet or a drawer near the instrument in the metals department.
Standards for extractable organics	Stored in freezers at temperatures below 0°C in the department (except DRO department standards which are stored refrigerated at <4 ± 2°C.
Standards for volatile organics	Neat standards are stored at room temperature in the standard cabinet in the department. Stock solutions and working solutions are stored in the freezer (-10 to -20°C).
Bulk Dry Chemicals	Stored at room temperature in the reagent storage area of the primary analytical department.
Working Solutions Containing Organic Compounds	Stored in the departmentas per method recommendation/ requirement. They are generally stored refrigerated at 4± 2°C.
Working Solutions Containing Only Inorganics	Stored at room temperature in the department; refrigeration is optional.
Flammable Solvents	Stored in solvent cabinets at room temperature in the organic extraction laboratory.
Non-Flammable Solvents	Stored separately from the flammable solvents in cabinets at room temperature in the organic extraction laboratory.

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

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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 Nashville 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. Special services are also available and provided upon request. These services include:

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

10.3 CLIENT COMMUNICATION

Project managers are the primary communication link to the clients. The lab informs its clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management maintains ongoing client communication throughout the entire client project.

The Technical Director is available to discuss any technical questions or concerns that the client may have.

10.4 REPORTING

The laboratory works 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 Nashville participates in the American Council of Independent Laboratories (ACIL) Seal of Excellence program. This program includes the submission of a survey to laboratory clients. The clients send their responses directly to ACIL.

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 Nashville believes that effective client complaint handling processes have important business and strategic value. Listening to and documenting client concerns captures "client knowledge" that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory stands behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g, communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints, with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

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

The process of complaint resolution and documentation utilizes the procedures outlined in Section 13 (Corrective Actions) and is documented in the Project Information and Problem Electronic (PIPE) non-conformance database or in a Corrective Action Report (CAR).

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 are those where the immediate issue that resulted in the complaint cannot be altered, but reoccurrences may be addressed. Non-correctable complaints are reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery

- Process Improvement

Complaints related to analytical reports are generally investigated by a Project Manager. These types of complaints may include, but are not limited to: report content and/or format, potential errors, turnaround time, bottle order shipping errors, and compliance with project requirements. The investigation may include discussions with the analyst, QA Manager, Laboratory Director, or Technical director, and is documented in a Customer Non-conformance Report (Figure 11-1) in the PIPE database.

Complaints related to quality systems, accreditation issues, and audit findings are investigated by the QA Manager. These complaints are documented in the CAR database.

The laboratory informs the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

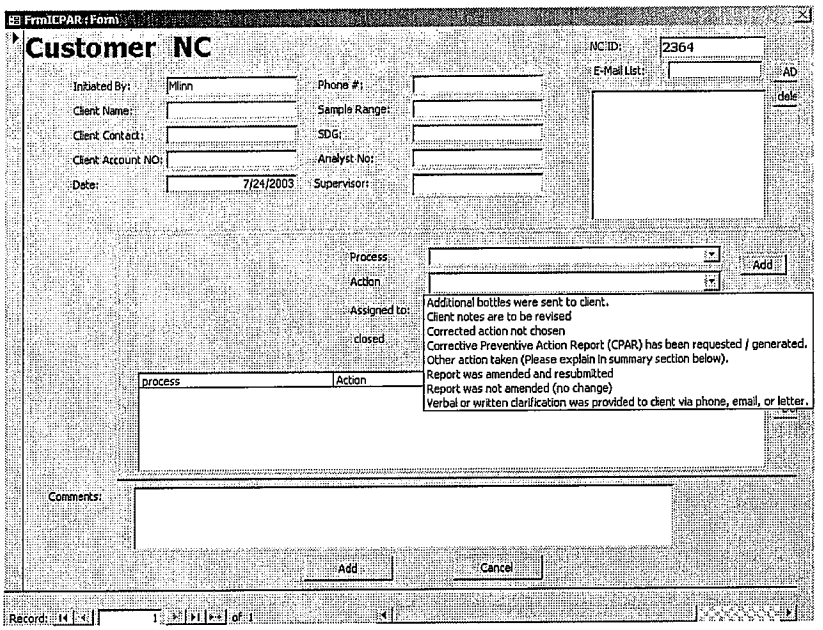
11.3 INTERNAL COMPLAINTS

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. The procedures that must be followed regarding corrective action generation are outlined in Section 13. In addition, corporate management, Sales and Marketing, and Information Technology (IT) may initiate a complaint by contacting the laboratory management staff or through the corrective action system described in Section 13.

11.4 MANAGEMENT REVIEW

The number and nature of client complaints are reported by the QA Manager to the laboratory and Corporate QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions are part of the Annual Management Review (Section 17)

Figure 11-1 **Customer Non-Conformance Report**



Process Drop-down Menu
Add compounds to the report if possible
Add Facility ID Number to Analytical Report
Alter Reporting Limits
Bottle Order did not arrive or arrived late
Bottle Order received incomplete/incorrect
Change Project Name
Change Project Number
Change Sample Collection Date/Time
Change Sample ID
Change Sampler Name
Change Test Method Reported if possible
Client did not receive email version of data
Client did not receive the fax/hardcopy data
Client Notes/Special Instructions were not followed
COC requested analysis not reported
Compound missing for QC section of Analytical Report (See below)
Correct units not used in report
Detailed case narrative required
Hardcopy data vs. EDD does not agree
Incorrect pricing applied to invoice (test:_____)
Other ANALYTICAL (See Comments)
Other NON-ANALYTICAL (See Comments
Remove compounds not requested from report
Report analytical values to MDL
Report limits not achieved
Unprofessional attitude by Lab Personnel
Verify analysis (outside historical bounds)
Verify sample matrix type (solid vs. liquid)

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 resolution. The supervisor may elect to discuss it with the Technical Director or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the 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. [Note: For Ohio VAP, the laboratory must not deviate from approved SOPs or the QA Manual.]

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 Technical 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.

On a monthly basis, the laboratory management team reviews the non-conformance corrective actions to determine if any trends are present. If trends are found, such as repeated occurrences, further corrective action is taken to eliminate the reoccurrences as outline in Section 13.

12.2 RESPONSIBILITIES AND AUTHORITIES

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CA-L-S-001), outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or

violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances the Laboratory Director, the Technical Director, a Department Supervisor, or the QA Manager may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client must 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 and in LIMS, 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 management within 24 hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Department Supervisors. 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), the Director of Quality & Client Advocacy, and Corporate Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, Ethics and Compliance Officers, Corporate Quality, Chief Operating Officer, General Managers and the Corporate Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

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.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CA-L-S-001) distinguishes between situations when it would be appropriate for the laboratory QA Manager and Laboratory Director (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 ECOs 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 TestAmerica's Corporate 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 Senior Management team evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process is 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 must be respected, and the problem and the required corrective and preventive action must be stated in writing and presented to the Laboratory Director.

The Laboratory Director must arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting must be held to confirm that there is a problem, that suspension/restriction of the method is required and must be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases a formal group meeting 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 also initiates 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 are 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 holds all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i. e., Project Management, Log-in, etc...). Clients are NOT generally notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager determines if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Director, QA Manager, Department Supervisor) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Director of Client Services and Sales and Marketing are notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The Laboratory Director, with the approval of the QA Manager, has the responsibility to authorize the resumption of work or the elimination of any restrictions after all corrective action is complete. 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 Reports (NCR) and Corrective Action Reports (CAR).

13.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for 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).

13.2.1 Non-Conformance Report (NCR) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP (See Figure 13-1 for an example Analysis Non-conformance Report.)
- QC outside of limits (non matrix related)
- Isolated reporting / calculation errors
- Client complaints (See Figure 11-1 for an example Client Non-conformance Report.)
- Sample receipt non-conformances (See Figure 13-2 for an example Sample Non-conformance Report.)

13.2.2 Corrective Action Report (CAR) - is used to document (see Figure 13-3 for an example) the following types of corrective actions:

- Questionable trends that are found in the monthly review of NCRs.
- Issues found while reviewing NCRs that warrant further investigation.
- Internal and external audit findings
- Failed or unacceptable PT results.

- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Health and safety violations

13.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Root Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

13.3.1 Root Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCR or CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for root cause. Table 13-1 provides some general guidelines on determining responsibility for assessment.
- Root Cause Analysis is an investigative process aimed at identifying the basic or causal factor(s) that underlies variation in performance or the occurrence of a documented non-conformance event. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, an immediate response is often directed at a symptom and not the cause.
- Systematically analyze and document the Root Cause(s) behind the issue. Attempt to identify Root Cause that, when corrected, potentially will lead to dramatic improvements in performance by eliminating entire classes of problems.
- Identify and review each issue associated with the event and ask why this event occurred. Brainstorm the root cause(s) of problems by asking why events occurred or conditions existed. Look at technique, processes, or other systems outside of the normal/obvious indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation. If there are sub issues, repeat the process for all issues associated with the non-conformance event.
- The root cause analysis step is the key to the corrective action process, as a long term corrective action cannot be determined until the root cause is determined.
- If the root cause is not readily obvious, the Department Supervisor, Operations Manager, Technical Director, Lab Director, or QA Manager (or QA designee) is consulted.

13.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory must identify potential corrective actions. The action(s) most likely to address root causes, eliminate the problem, and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions must be to a degree appropriate to the magnitude of the problem identified through the root cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory must document and implement the changes. The NCR or CAR is used for this documentation.

13.3.3 Monitoring of the Corrective Actions

- The Department Manager/Supervisor and QA Manager are responsible to ensure that the corrective action taken was effective.
- All Corrective action follow up is documented in the CAR database and ineffective actions are re-evaluated until acceptable resolution is achieved. Department Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCR and CAR is entered into a database for tracking purposes, and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- The QA Manager reviews monthly NCRs and CARs 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 laboratory QA Manager indicating the nature of the out-of-control situation and problems encountered in solving the situation.

13.3.4 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and are 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. (Refer to Section 16.1.4 Special Audits.)
- 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.

13.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 12 for information regarding the control of non-conforming work). The documentation of these procedures is through the use of an NCR or CAR.

Table 13-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to the analytical methods or specific method SOPs.

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 must be treated if associated QC measurements are unacceptable. Specific procedures are included in method SOPs, 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 monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples are reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data must be reported with an appropriate data qualifier and/or the deficiency must be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCR and appropriate corrective action (e. g., reanalysis) is taken and documented.

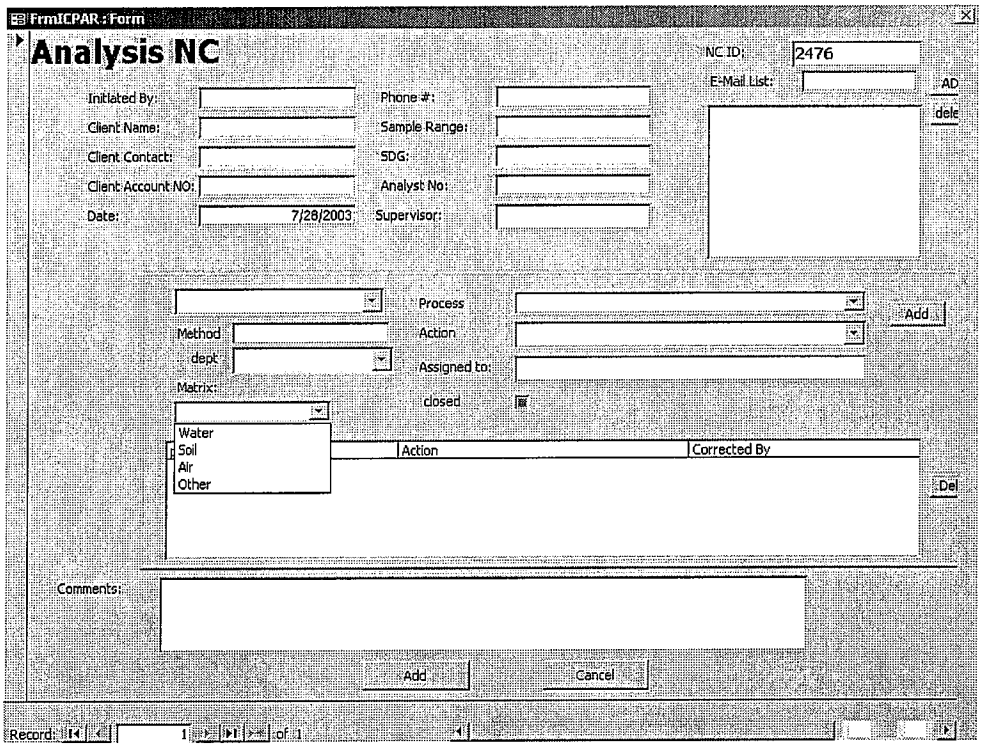
13.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake must 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 must 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.

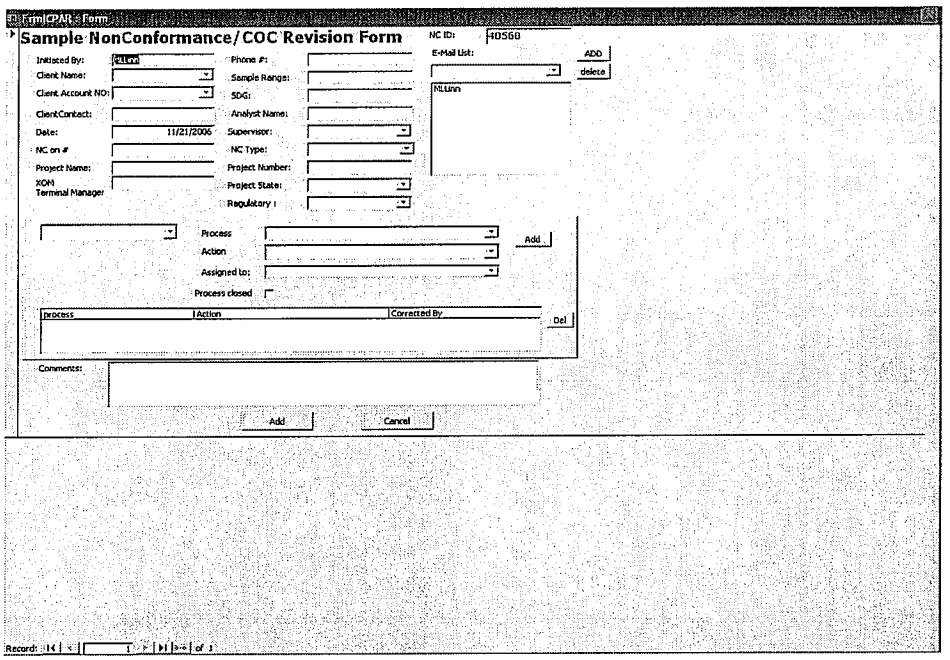
When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) must also be documented.

Figure 13-1. Analysis Non-Conformance Report



First Drop-down Menu	PEST
CCV	HPLC
Ext. Blank	QC HOLD
Final Review Log-in	INORGANICS
Final Review Sample	**Process Drop-down Menu**
INST. Blank	(Describe in text)
LCS	**Action Drop-down Menu**
Log-in	Corrected action not chosen
MS/MSD	Corrective and Preventive Action Report Generated
Non Analysis	Incorrect Extraction/Extract Volumes Entered into LIMS
Other	Metals MS/MSD out. Post-digestion Spike Analyzed.
Sample Issues	Pesticide Breakdown Criteria Failed
Surrogate	Re-analyze
Dept. Drop-down Menu	Re-analyze – Out of Holding Time
BNA	Re-analyze Insufficient Sample
BTX	Re-analyze – NO (Comments needed in LIMS)
DRO	Re-analyze – NO (Comments needed in LIMS)
HALL	Re-extract – Insufficient Sample
METALS	Re-extract – Out of Holding Time
MISC	Re-extract
PREP	Sample Dilutions Did Not Confirm Original Analysis
TPH PREP	Worklist Taken Back to "Not Entered" Due to Data Entry, Unload or Analysis Error
VOA	

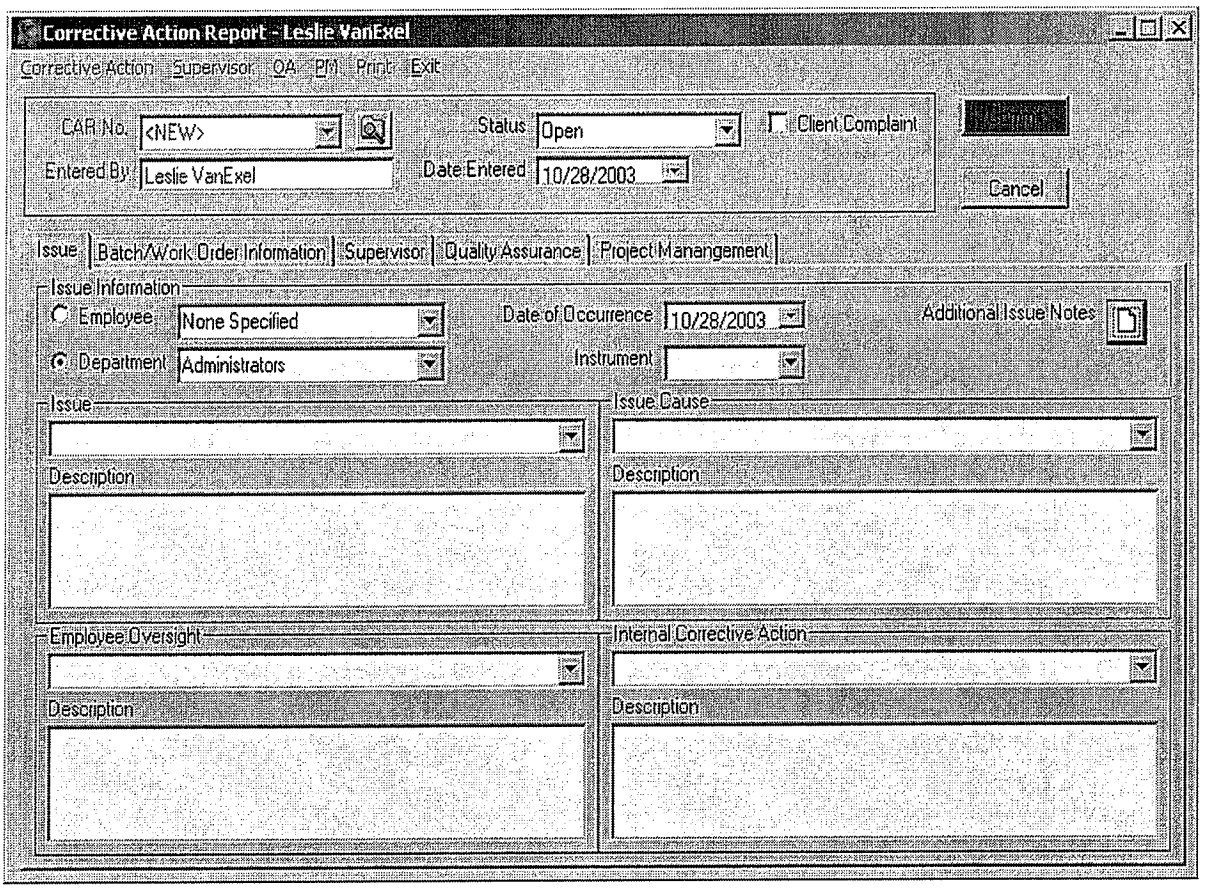
Figure 13-2. Sample Non-conformance Report

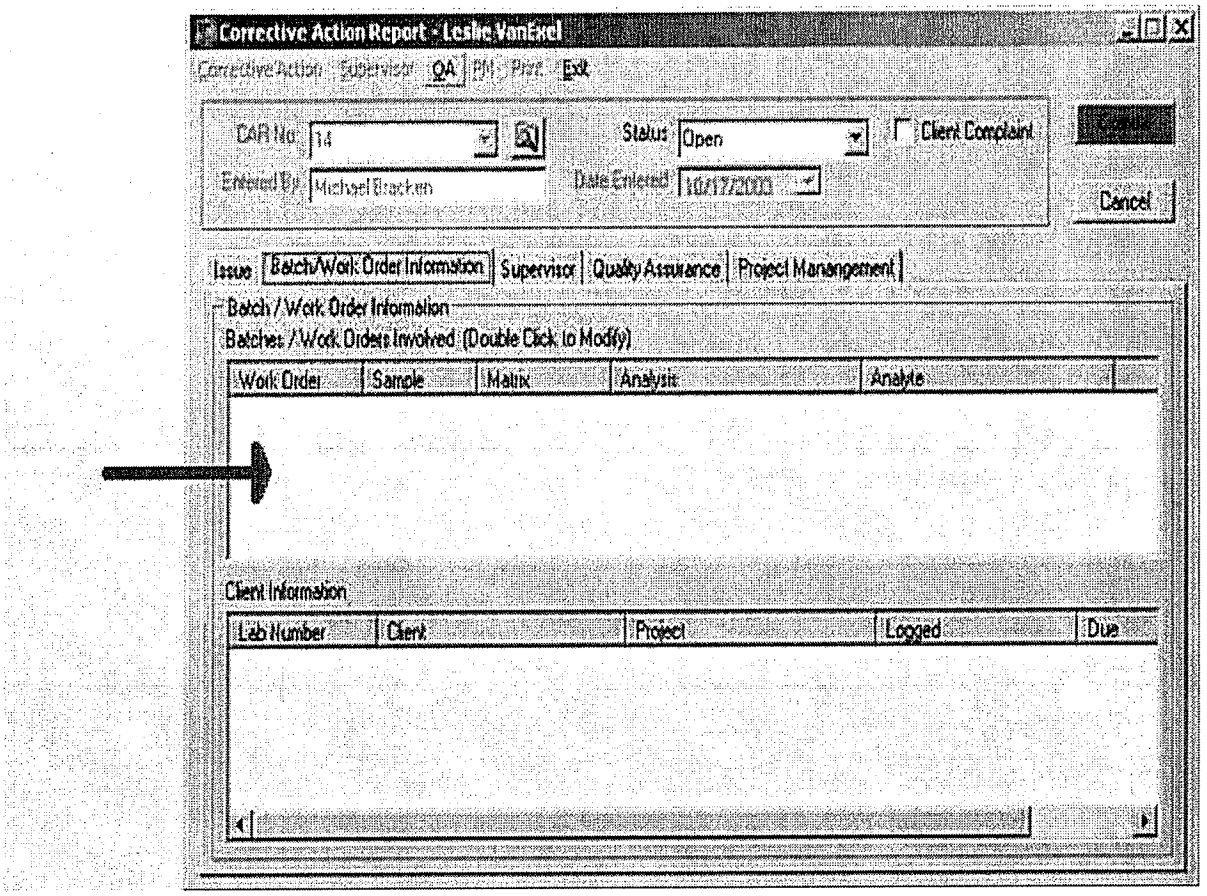


Process Drop-down Menu	Action Drop-down Menu
Change Project Name	Account Number Provided in Comments
Change Project Number	Analysis cancelled per client request
Change Sample Collection Date/Time	Analytical Method Number provided in Comments
Change Sample ID	Cancelled Analysis
Change TAT to RUSH TAT per client request	Changed TAT per client request
Change TAT to Standard TAT per client request	Chromatograms have been requested
Change/Verify Method	Clarifications of special Instructions/COC provided by client
Changed Report Units – per client notes	Client Notified
Changed Report Units – per client request	Client Notified and Cancelled Analysis
Client cancelled sample analysis after analysis performed	COC sent in by client (via fax or e-mail)
Client reimbursement requested	Compounds removed as requested
COC is unclear-please clarify	Corrected action not chosen
Containers submitted-no analysis requested on COC	Data Qualifier added/removed as requested
Correct units not used in report/LIMS	Do Not Run
Dioxin/Furans List/Method?	Documentation Level: ½
Documentation Level?	Documentation Level: 3 (Full Doc minus Raw Data)
EDB Method?	Documentation Level: 4 (Full Doc plus Raw Data)
EnCore Prep Date Incorrectly Entered in LIMS	Documentation Level: CLP Methods
Fedex Delivery Failure	EDB Method: 504.1
HERB List?	EDB Method: 524/6210
Hold sample(s) per client/PM request	EDB Method: 601
Improper Bottle Used for Analysis	EDB Method: 624
Metals List?	EDB Method: 8011
Need List of Compounds?	EDB Method: 8021
Need MA MCP/CAM Checklist Provided	EDB Method: 8260
No Analysis Requested?	Herb List: Appendix IX
No COC-Please FAX	Herb List: Long
Oil & Grease Method?	Herb List: Other
Other NC/Process: See Comment Section Below	Herb List: Short

Out of Holding Time-List Analysis	Letter has been sent to NC per state cert. requirement
PO#	List provided by client
Provide Chromatograms per client request	MA MCP/CAM Checklist Provided by Project Management
Purchase Order Number Not provided	Metals List: 8 RCRA Metals
Remove compounds not requested	Metals List: CPL/TAL
Remove compounds requested on COC	Metals List: Other
Remove or add data qualifier flags	Metals List: Priority Pollutant List
Retag for additional analysis (Sample already completed)	Need List of Compounds in Comments
Sample Containers Broken in Shipment	New Analysis added per Client Request
Sample Containers Missing from Cooler-checked twice	No
Sample mislabeled	
Samples missing that are listed on the COC	
Samples submitted with Expired Holding Time	
Saturday Delivery Marked? Yes or No	Oil & Grease Method: 9070A/9070B/1664
Service Order Number not provided	Proceed with analysis and note in comment section of rpt
Special Instructions unclear-please clarify	Process Completed
Subcontract Samples?	Purchase Order Number provided in Comment Section
TCLP?	Resampling Request Form completed w/ documentation
Temperature outside Method Allowance-Run or Do Not Run?	Run
TPH Method?	Run Method 9071B HEM (soil)
Trip Blank not located in sample cooler	Sample held as requested
Update Demographics in Database-State, Matrix, Date, etc.	Sample Placed on Hold
Verify analysis/method/compound requested	Samples subcontracted to client approved subcontractor
Write letter to NC State for Nonconformance issue	Samples retagged; New SDB in Comment Section below
Wrong Preservation Used	Service Order Number provided in Comment Section
	Void NC
	Yes

Figure 13-3. **Corrective Action Report**




Corrective Action Report - Leslie VanExel
Corrective Action
Supervisor
QA
PM
Print
Exit
CAR No
14
Status
Open
Client Complaint
Entered By
Michael Bracken
Date Entered
Cancel
Issue
Batch/Work Order Information
Supervisor
Quality Assurance
Project Management
Batch / Work Order Information
Batches / Work Orders Involved (Double Click to Modify)
Work Order
Sample
Matrix
Analysis
Analyte
Client Information
Lab Number
Client
Project
Logged
Due

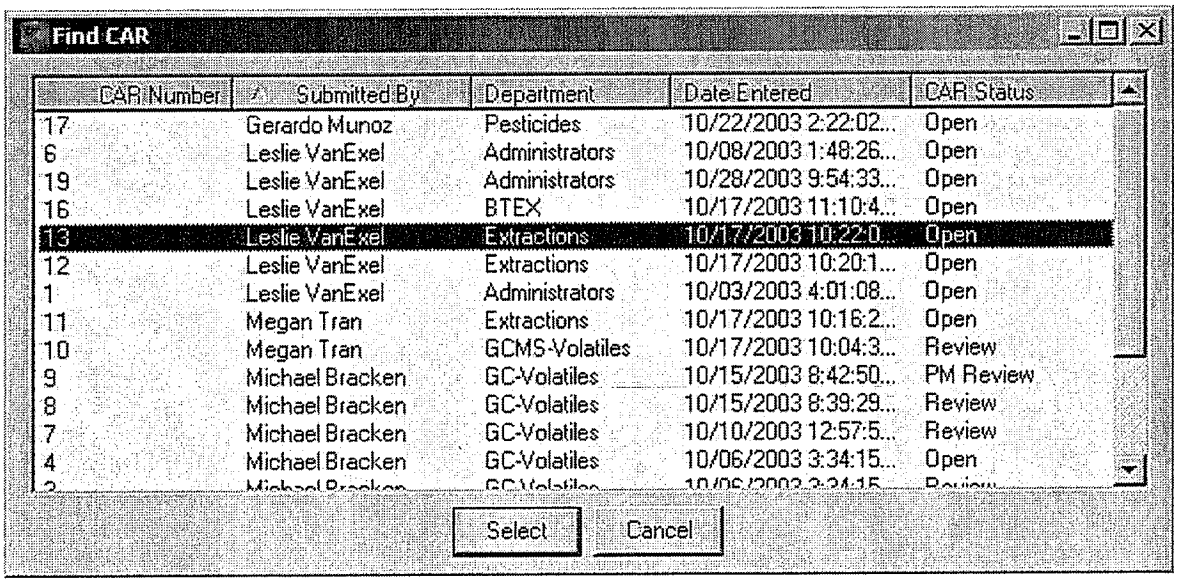

Find CAR
CAR Number
Submitted By
Department
Date Entered
CAR Status
17 Gerardo Munoz Pesticides 10/22/2003 2:22:02... Open
6 Leslie VanExel Administrators 10/08/2003 1:48:26... Open
19 Leslie VanExel Administrators 10/28/2003 9:54:33... Open
16 Leslie VanExel BTEX 10/17/2003 11:10:4... Open
13 Leslie VanExel Extractions 10/17/2003 10:22:0... Open
12 Leslie VanExel Extractions 10/17/2003 10:20:1... Open
1 Leslie VanExel Administrators 10/03/2003 4:01:08... Open
11 Megan Tran Extractions 10/17/2003 10:16:2... Open
10 Megan Tran GCMS-Volatiles 10/17/2003 10:04:3... Review
9 Michael Bracken GC-Volatiles 10/15/2003 8:42:50... PM Review
8 Michael Bracken GC-Volatiles 10/15/2003 8:39:29... Review
7 Michael Bracken GC-Volatiles 10/10/2003 12:57:5... Review
4 Michael Bracken GC-Volatiles 10/06/2003 3:34:15... Open
Select
Cancel

Table 13-1. Example – General Corrective Action Procedures

(For Ohio VAP, see Ohio specific SOPs)

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	Instrument response < MDL.	Prepare another blank. If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst, Department Supervisor)*	Correlation coefficient $r \geq 0.995$ ($r^2 \geq 0.99$) or standard concentration value. % Recovery within acceptance range. See details in method SOP.	Reanalyze standards. If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Department 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 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 the Control Limits Manual	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 the Control Limits Manual	Batch must be re-prepared and re-analyzed. If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Laboratory Control Sample Duplicate (LCSD) *(Analyst, Data Reviewer)*	% Recovery within limits specified in the Control Limits Manual	Batch must be re-prepared and re-analyzed. If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates in environmental samples *(Analyst, Data Reviewer)*	% Recovery within limits of method or within three standard deviations of the historical mean.	Individual sample must be repeated. Place comment in LIMS.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Surrogates in batch QC samples *(Analyst, Data Reviewer)*	Within limits of method or within three standard deviations of the historical mean.	Individual sample must be repeated. Place comment in LIMS. The batch may require repreparation and/or analysis if the QC sample calls into question the acceptability of the samples. If the surrogate % recovery exceeds the upper control limit AND any associated client samples in the batch are non-detect for target compounds, the data is acceptable to report. If the surrogate % recovery exceeds the upper control limit AND any associated client samples are greater than the RL, re-prep and re-analyze affected QC and client samples in the batch.
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 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.
Internal / External Audits *(QA Manager, Department Supervisor, Operations Manager, Technical Director, Laboratory Director)*	Defined in Quality System documentation such as SOPs, QAM, etc.	Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department 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.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Client Complaints *(Project Managers, Lab Director, Sales and Marketing)*		Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report must 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, 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.
Health and Safety Violation (Health & Safety Officer, Lab Director, Department Supervisor)	Environmental Health and Safety (EHS) Manual.	Non-conformance is investigated and corrected through CAR system.

Note:
1. Except as noted below for certain compounds, the method blank must be below the detection limit. Concentrations up to five times the reporting limit are allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates **provided** they appear in similar levels in the reagent blank and samples. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction is not performed. For benzene and ethylene dibromide (EDB) and other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit. For Ohio VAP, the method blank must be below the reporting limit for all analytes that are a contaminant of concern for the project site.

SECTION 14

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 Nashville's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and 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 QA 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 reviews, 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 must 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 provides 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: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes. This process is discussed in further detail in SOP 08-161, Management of Change.

SECTION 15

CONTROL OF RECORDS
(NELAC 5.4.12)

TestAmerica Nashville 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. See SOP Archiving / SA08-194 for the archiving procedures.

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) department in a database, which is backed up as part of the regular network backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by the QA Department.

Table 15-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Respones - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits, Disposal Records	7 years
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	7 Years (HR Personnel Files must be maintained indefinitely)
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 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 at the Security Archives data storage facility. All records are 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. Records are maintained on-site at the laboratory for at least one 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 otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention is 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.

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 15-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to whom to contact for authorization prior to destroying the data.

Table 15-2. Special Record Retention Requirements

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

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

15.1.2 All records are held secure and in confidence. Records maintained at the laboratory are located in the Data Archive Room. Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Logs are maintained in 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. Also reference SOP Electronic Lab Data Archiving / NV08-171.

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 must be readily understood through the documentation. This includes inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with the project folder. An electronic copy is stored on the server. The chain of custody indicates 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 LIMS maintains an audit trail of data verification steps.

- 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). See SOP Electronic Lab Data Archiving / NV08-171. At a minimum, a data folder includes: benchsheet, prep sheets (where applicable), sample data, and associated QC data. Analytical data is stored by department and sequentially by date analyzed. Run logs are maintained for each instrument or method; a copy of each day's run long or instrument sequence is stored with the data to aid in reconstructing an analytical sequence. 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. Each folder containing a batch of data is labeled, at a minimum, with the date analyzed and the benchsheet or sequence number.

- Changes to hardcopy records must follow the procedures outlined in Sections 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. Prior to the destruction of any of the hard copy information that was scanned, the scanning process must 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.

- 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 must contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records must include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing 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 must follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

15.2.4 The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code;
- date of analysis; time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods, ID codes, volumes, weights, instrument printouts, meter readings, 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 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 Nashville has a record management system (a.k.a document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. 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. Bench sheets are filed sequentially in folders. 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. Access to the data is limited to data storage facility and TestAmerica employees.

15.5.6 Transfer of Ownership

15.5.6.1 In the event that the laboratory transfers ownership or goes out of business, TestAmerica Nashville must ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements must 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 must revert to the control of the corporate headquarters. If the entire company cease to exist, as much notice as possible must 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 destroyed after 10 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.

SECTION 16

AUDITS
(NELAC 5.4.13)

16.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors have the sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Audits, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are shown in Table 16-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 16-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems	QA Department or Designee	All areas of the laboratory annually
QA Technical Audits - Evaluate raw data versus final reports - Analyst integrity - Data authenticity	QA Department or Designee	All methods within a 2-year period, with at least 15% of methods every quarter
SOP Method Compliance	Technical Director and QA Department	- All SOPs within a 2-year period - All new analysts or new analyst/methods within 3 months of IDOC
Special	QA Department or Designee	Surveillance or spot checks performed as needed
Performance Testing	Analysts with QA oversight	Two successful per year for each NELAC field of testing or as dictated by regulatory requirements

16.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, the laboratory's Data Integrity and Ethics Policies, NELAC quality systems, ISO 17025:2005, A2LA, AIHA, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is

assessed. The audit is divided into modules for each operating or support area of the lab, and each module is comprehensive for a given area. The area audits may be done on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

16.1.2 QA Technical Audits

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

16.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs must be assessed by the Technical Director and QA department at least every two years. The work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products must be performed within 3 months of completing the documented training.

16.1.4 Special Audits

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

16.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: drinking water, nonpotable water, soil and industrial hygiene.

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

- 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 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 obtains the COC information from the documentation provided with the PTs, with review by QA or other designated staff.

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

- PT samples do 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 is the same as with routine environmental samples.

- Instructions are allowed to 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 would be allowed where described in the SOP.

- No special reviews are performed by operations 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.

16.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory department 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.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

16.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business

information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers must not be obscured from the information. Additional information regarding CBI can be found in within the 2003 NELAC standards.

16.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and database (refer to Section 13). The laboratory's corrective action responses for both types of audits (internal and external) are completed within a predetermined timeframe. When the corrective action has not yet been completed within that predefined response timeframe, a completion date must set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Supervisor where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan are forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory must take timely corrective action, and must notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 17

MANAGEMENT REVIEWS
(NELAC 5.4.14)

17.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report is prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director for review and comments. The final report is also submitted to the Technical Director and lab Operation Managers as well as the appropriate Corporate Quality Director. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Corporate Senior Management Team and General Managers by Corporate QA.

17.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Director, QA Manager, Operations Managers) 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. It also provides a platform for defining quality goals & objectives.

This management systems review (Corporate SOP CA-Q-S-008 & Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review keeps 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 (summarizing items, such as SOPs, CARs, MDLs, audits (internal and external), proficiency testing results, certifications, and training 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 laboratory senior management meetings. Issues that may be raised from these meetings include:

  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.
- Review of the ACIL seal of excellence program performance.
- 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 Corporate 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 must 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.

TestAmerica's Chief Operating Officer, VP of Client and Technical Services, General Managers, and Corporate Quality Directors receive a monthly report compiled from the Director of Quality & Client Advocacy summarizing any current data integrity or data recall investigations. The General Managers are also made aware of progress on these issues for their specific labs.

SECTION 18

PERSONNEL
(NELAC 5.5.2)

18.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Appendix 2.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff member that is undergoing training must have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff are 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 must 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

The laboratory makes every effort to hire analytical staff that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Experience and specialized training are occasionally accepted in lieu of a college degree. (Basic lab skills such as using a balance, etc. are also considered). For any analysis, thorough training and working with another experienced staff member until proficiency has been demonstrated is required.

Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum

education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job descriptions are located on the TestAmerica intranet site's Human Resources web-page. (Also see Section 4 for position descriptions/responsibilities.)

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e. g., Fuels, BTEX-GC, IC)	A college degree in an applied science or 2 years of college and at least 1 year of college applied sciences	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 applied sciences	Or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college applied sciences	And 2 years relevant experience Or 5 years of prior analytical experience
Operations Managers/Department Supervisors	Bachelor's Degree in an applied science or engineering An advanced (MS, PhD.) degree may substitute for one year of experience	And two years experience in environmental analysis of representative analytes for which they will oversee
Laboratory Director	Bachelor's Degree in science or a minor in chemistry	Or 10 years experience in the environmental laboratory industry
Quality Assurance Manager	Bachelor's degree in a basic or applied science and 1 year nonacademic analytical chemistry; Training in statistics or quality control procedures.	Or 4 years nonacademic analytical chemistry experience.
Technical Director	Bachelor's degree in basic or applied science or engineering and at least 24 college semester credit hours in chemistry	At least two years experience in environmental analysis; master's or doctoral degree may substitute for one year experience.

Analysts-in-training perform tasks under the direct supervision of a qualified analyst or Department supervisor. The person supervising an analyst-in-training is accountable for the quality of the

analytical data. The trainer must review and approve the trainee's data and any associated corrective actions.

18.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame*	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 20.

The training of technical staff is kept up to date by:

- 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 is 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 and records; benefit programs; timekeeping/payroll; and employee conduct (e. g., ethics). This information is maintained in the employee's secured personnel file.
- For each new method for which an analyst demonstrates capability, Figure 18-1, or an equivalent, may be used to summarize that all components of the training have been completed and approved.

Further details of the laboratory's training program are described in the SOP Training / NV08-199.

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 followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times, TestAmerica has established an Ethics Policy No. CA-L-P-001 and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy are not tolerated. Employees who violate this policy are subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy.
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e. g., peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. investigations and data recalls.
- Consequences for infractions, including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

Figure 18-1. **TRAINING SUMMARY**

Trainee: _____ **Date Training Began:**_____

Topic(s) of Training (circle): **Non-Analytical (General)** **Analytical Method** **Instrument**

SOPs Reviewed: _____

SOPs Signed-off in QA Office: Y / N

I. METHOD/PARAMETER _____

___ Detailed Reference Method/SOP
___ Basic Method/Instrument Theory
___ Safety Precautions
___ Waste Handling
___ Instrument
___ Routine Maintenance
___ Interferences
___ Extraction/Preparation

II. QUALITY CONTROL
___ Calibration Curve, Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)
___ Precision/Accuracy
___ MDL Study
___ Review of Chain-of-Custody
___ Documentation (sequences, maintenance, logbooks/worksheets, observations, modifications, standards)
___ QC Requirements (MS/MSD, LCS, Dups, Blanks, Surrogates, Internal Stds, Interference Checks, etc.)
___ Miscellaneous QC (Retention Time Window Studies, IDL)
___ Non-Conformance and Corrective Action Documentation

III. DATA HANDLING AND REPORTING
___ Review Equations and Calculations (concentrations, dry/wet weight)
___ Data Entry or Down-Loading
___ Significant Figures
___ Reporting Dilutions

IV. GENERAL TRAINING
Attach sheet to describe what was discussed. General Training Topics might include: Sample Receiving, Waste Disposal, Shipping, Safety.

Results of Start-up QC :

P&A Results Acceptable Y / N . Attach copy of Precision and Accuracy Results (Summary)

Comments (include any additional training requirements):_____

_____

For AIHA methods, the training period must be a minimum of 20 business days.

Trainee: _____ Date: _____

Trainer: _____ Date: _____

Group Manager: _____ Date: _____

QA Manager: _____ Date: _____

SECTION 19

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS
(NELAC 5.5.3)

19.1 OVERVIEW

TestAmerica Nashville is a 40,000 ft^2, secure, laboratory facility with controlled access, designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment, including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

19.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, and lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing is discontinued until the environmental conditions are returned to the required levels.

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

19.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. For example, volatile organic chemical handling areas, including sample preparation and waste disposal, are separated from volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

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. All doors have automatic closures which lock when closed, except the two main entrances which are locked at 5:30 p.m. each business day.

Visitors to the laboratory sign in and out in a visitors' logbook. A visitor is defined as any person who visits the laboratory who is not an employee of TestAmerica Nashville. The visitors' logbook is used to ensure that everyone gets out of the building safely in case of emergency. The visitor is provided with a "Visitor" identification card to wear while in 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 visitors' logbook.

SECTION 20

TEST METHODS AND METHOD VALIDATION
(NELAC 5.5.4)

20.1 OVERVIEW

TestAmerica Nashville 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 Nashville 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 SOP preparation, review, revision and control are incorporated by reference to SOPs: CW-Q-S-002 (Writing a Standard Operating Procedure (SOP)) and SOP Document Control / NV08-152.
- SOPs are reviewed at a minimum of every two 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

For each test method, the laboratory has available the published, referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory demonstrates that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

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 are 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 must 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 are used.

When clients do not specify the method to be used or methods are not required, the methods used must 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:

- *HASL-300 28th Edition, Environmental Measurements Laboratory (EML), 1997.*
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*

- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition /on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IIIB, June 2005; and Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261.*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform 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 determines the method utilized.

The laboratory must 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 must be documented.

20.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory must 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. A Demonstration of Capability is also performed when an instrument (new or used) is moved into a department and brought online for the first time in that analytical department.

20.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Technical Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the

laboratory's archiving procedures. Refer to Section 15, Control of Records and SOP Training / NV08-199.

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). See SOP Method Startup / NV08-203.

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project specifications).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs (determined during Work Request Review, see Section 7) are client specified reporting limits which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 20.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).

  Note: For the purposes of Ohio VAP, the term reporting limit (RL) is used exclusively by the laboratory.

- 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) are diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP or if unspecified to a concentration 1-4 times the laboratory RL.

20.4.3.3 At least four aliquots are prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days). Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

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 assesses 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, confirms 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) is used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

Methods on line prior to the effective date of this Section must be updated to the procedures outlined above as new analysts perform their demonstration of capability. A copy of the new record replaces that which was used for documentation in the past. At a minimum, the precision and accuracy of four mid-level laboratory control samples must have been compared to the laboratory's quality control acceptance limits.

20.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

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.

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 is 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. (See SOP Method Startup / NV08-203.)

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 must be followed. The laboratory determinations of MDLs are described in Section 20.7.

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 detected. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

Note: For the purposes of Ohio VAP, the terms MDL and reporting limit (RL) are used exclusively by the laboratory.

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

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 are analyzed over 2-4 days to provide a more realistic MDL.

Note: For the purposes of Ohio VAP, the term MDL is used exclusively by the laboratory.

20.7.1 MDLs are initially performed for each individual instrument and non-microbiological method analysis. Unless there are requirements to the contrary, the laboratory uses 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.) or

where the lab does not report values to the MDL. For 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 MDLs must be run against acceptable instrument QC, including ICVs and Tunes. This is to insure that the instrument is in proper working condition and falsely high or low MDLs 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 For Ohio VAP, the MDL spike concentration must not exceed the reporting limit.

20.7.5 The Reporting Limit (also may be referred to as Limit of Quantitation or LOQ) is generally between 2 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. For DoD, the RL is $\geq$ 3x MDL. If a sample is diluted or nominal prep volume.weight is vaired, the reported MDL and RL are adjusted according to the dilution factor.

20.7.6 There are three criteria for success:

- 10 times the MDL must be the spike concentration; if not, the MDL is set at 1/3 the RL. (The RL cannot be less than the spike concentration.)
- Recovery must be between 50 and 150% of the true value (unless specified otherwise in the method SOP, and
- The ratio of the RL to the MDL should be greater than two (preferably three of more).

If the MDL must be repeated to achieve these criteria, extraction or digestion must also be repeated. A higher spike level may be necessary. The test concentration used for the MDL calculation becomes the new RL.

20.7.7 The calculated MDL cannot be greater than the spike amount. If this occurs, repeat or increase the spike amount.

20.7.8 If the most recently 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 (Section 20.8), 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.). These alternate verification procedures must be documented in the laboratory SOP on MDLs (MDL / NV08-202).

20.7.9 Each of the seven 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.

20.7.10 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.

20.7.11 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.).

20.7.12 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, must be qualified as an estimated value.

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

20.7.14 MDLs and reporting limits are adjusted in LIMs based on moisture content and sample aliquot size.

20.7.15 Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP MDL/NV08-202 for details on the laboratory's MDL process.

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 seven 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, 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 Sections 20.7.8 and 20.7.11 for other options. This verification does not apply to methods that are not readily spiked (e. g., pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab must not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established (see 20.7). MDLs must be verified at least annually.

20.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory must comply with any regulatory requirements.

20.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis, each analyte has a specific time of elution from injection on 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 is not identified by the computer as a positive match of the analyte of interest.

Record the retention time for each single component analyte and surrogate to three decimal places (e. g., 0.007). Calculate the mean and standard deviation of the three absolute retention times for each single component analyte and surrogate. For multi-component analytes, choose three to five major peaks (see the determinative methods for more details) and calculate the mean and standard deviation of those peaks.

If the standard deviation of the retention times for a target compound is between 0.000 and 0.010, then the laboratory may either collect data from additional injections of standards or use a default standard deviation of 0.01 minutes.

The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time established during the 72 hour period. If the default standard deviation in (c) is employed, the width of the window is set at 0.03 minutes.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

The laboratory must calculate absolute retention time windows for each analyte and surrogate on each chromatographic column and instrument, except GC/MS.

If the instrument data system is not capable of employing compound-specific retention time windows, then the analyst may choose a window that minimizes false negatives and positives and apply it to all compounds. As noted above, other approaches may also be employed, but must be documented by the analyst. In general, you do not use a window greater than 0.2 to 0.3 minutes. If windows larger than this have been determined, a cause must be looked for and the windows should be re-determined.

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 is not 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, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations 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 minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take

into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

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. Note: This section does not apply to AIHA.

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 SOP LIMS / NV09-12 and Electronic Lab Data Archiving / NV09-171. The laboratory is currently running Element Datasystem which is a third party LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server 2005 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.
- 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 must 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 is installed on all servers and workstations. The anti-virus software is configured to check for virus signature file and program updates on a daily basis, and these updates are pushed to all servers and workstations. The anti-virus software is configured to clean any virus-infected file, if possible; otherwise, the file is deleted. Disks and CDs brought from any outside source that are not OEM software must be scanned for viruses before being accessed.
- The clocks on data acquisition systems for instruments may only be changed by IT, a department supervisor, a manager, or a director, and the change must be documented in the maintenance log. The Element clock can only be changed by the IT department.

- **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, Senior PMs, 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 laboratory's 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. Search permissions may also be granted so status may be checked.
(f) All qualifiers must be approved by the lab QA Manager before adding to standard reference tables (Static tables).
(g) Please contact Corporate QA or IT staff if you have any questions regarding implementation or interpretation of the Interlab LIMS Permissions policy.

20.13.1.2 **Ensure Information Availability:** Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

- 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 15-30 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 office. Access to these servers is limited to members of the Information Technology staff.
  - All supporting software is maintained for at least 10 years from the last raw data generated using that software. (Length of time is dependent on local regulations or client requirements (e. g., OH VAP requires 10 years).)
- System Back-up Overview and Procedures
  - Data from both servers and instrument attached PCs 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 are 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 of when electronically transmitting data.

- All servers are located in a secure area of the IT department offices. Access to the servers is limited to IT staff members and senior lab management.

- 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 project manager 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 are made available to clients via the secure web site. The logon page for this web site contains an agreement which states that the customer agrees not to alter any electronic data made available to them. The customer must accept this agreement before they are granted access the web site.

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.

Manual integration of peaks must be documented and reviewed, and the raw data must be flagged in accordance with Section 20.13.5 and 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 must be applied only when required by the method or per manufacturer's indication; otherwise, it is not performed. Calculations are independently verified by appropriate laboratory staff.

20.13.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

20.13.2.2 In general, concentration results are reported in milligrams per liter (mg/L) or micrograms per liter (µg/L) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. The units "mg/L" and "mg/kg" are the same as "parts per million (ppm)". The units "µg/L" and "µg/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).
- Occasionally, the client requests that results be reported in units which take into account the measured flow of water or air during the collection of the sample. When they provide this information, the calculations can be performed and reported.

20.13.2.3 The rounding rule is: round up if the digit to be discarded is larger than 5; round down if the digit to be discarded is less than 5. If the digit is exactly 5, round down if the preceding digit is even; round up if the preceding digit is odd.

20.13.2.4 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 reported to three significant figures. In general, results are reported to three significant figures on the final report.

20.13.2.5 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. Manually entered results are typed into LIMS in mg/L or mg/kg, except for low-level phenolics (ug/L) and parameters without mass-specific concentration measuring units (such as, NTU, micromhos, etc.).

20.13.2.6 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 then checks the data in Element against the raw data, and the instrument 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.

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.)

- The following information is required to be documented in Analytical Run Logs:
    - Method reference
    - Instrument ID
    - Sequence of standards, blanks, and samples including: dilutions, explanation of anomalies, standard ID numbers
    - Date of analytical batch
    - Analyst initials and date (Note: Initials across the pages if sheet taped in)
    - QC recoveries and RPDs (required for single target analyte methods only)
    - Any empty space crossed out with a "Z", dated and initialed
    - Reference to ID numbers of standards used
    - Evidence of department supervisor review on a monthly basis
    - pH/residual chlorine checks (volatiles and volatiles UST)
    - Reference to Maintenance log (when maintenance required)

- The following information is required to be documented in Prep Logs and/or Prep Sheets:
    - Method reference
    - Balance ID
    - Sequence of standards, blanks, and samples including: dilutions, explanation of anomalies, standard ID numbers, solvent ID numbers
    - Date and time of preparation
    - Analyst initials and date
    - How QC is prepared
    - Any empty space is crossed out with a "Z", dated and initialed.
    - Evidence of department supervisor review on a monthly basis
    - pH/residual chlorine checks

- 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 Technical Director or 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 outlined in several SOPs (e. g., Sample Control / NV02-01, Project Management / SA02-174, Data Package Procedure / NV08-139) to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data (CA-Q-S-002). The general review concepts are discussed below, more specific information can be found in the SOPs.

20.13.4.1 The data review process at TestAmerica Nashville 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.

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 and add data qualifiers if applicable (see Appendix 7 for list of common data qualifiers). To ensure data compliance, a department supervisor or group leader (or other designee) performs a second level of review. Second level review is accomplished by checking

reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Data review checklists are used to document both analyst and second level reviews. 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
- 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 may require reanalysis of the samples. Corrective action for analytical non-conformances is documented in the PIPE database. Problems may also be brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Manager, Technical Director, Operations Manager, or Department Supervisor for further investigation.

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

- Total Results are $\geq$ Dissolved results (e.g. metals)
- Total Solids (TS) $\geq$ TDS or TSS
- TKN $\geq$ Ammonia
- Total Phosphorus $\geq$ Orthophosphate
- COD $\geq$ TOC
- Total cyanide $\geq$ Amenable Cyanide
- TDS $\geq$ individual anions
- Total Chromium $\geq$ Hexavalent Chromium
- BOD $\geq$ cBOD

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

Manager then signs the final report. (*Also see section 26 on Reporting Results*). The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

20.13.4.6 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 must not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company 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 are documented by printing before and after chromatograms/spectra with a brief explanation of why the integration was performed. The chromatograms/spectra must be scaled in such a way that the reviewer can easily identify the changes. All manual integrations receive a second level review.

Figure 20-1. Example - Demonstration of Capability Documentation

Laboratory Name:_____

Laboratory Address:_____

Method:_____ Matrix:_____

Date:_____ Analyst(s):_____

Source of Analyte(s):_____

Analytical Results

Analyte	Conc. (units)	Rep 1	Rep 2	Rep 3	Rep 4	Average % Recovery	%RSD

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

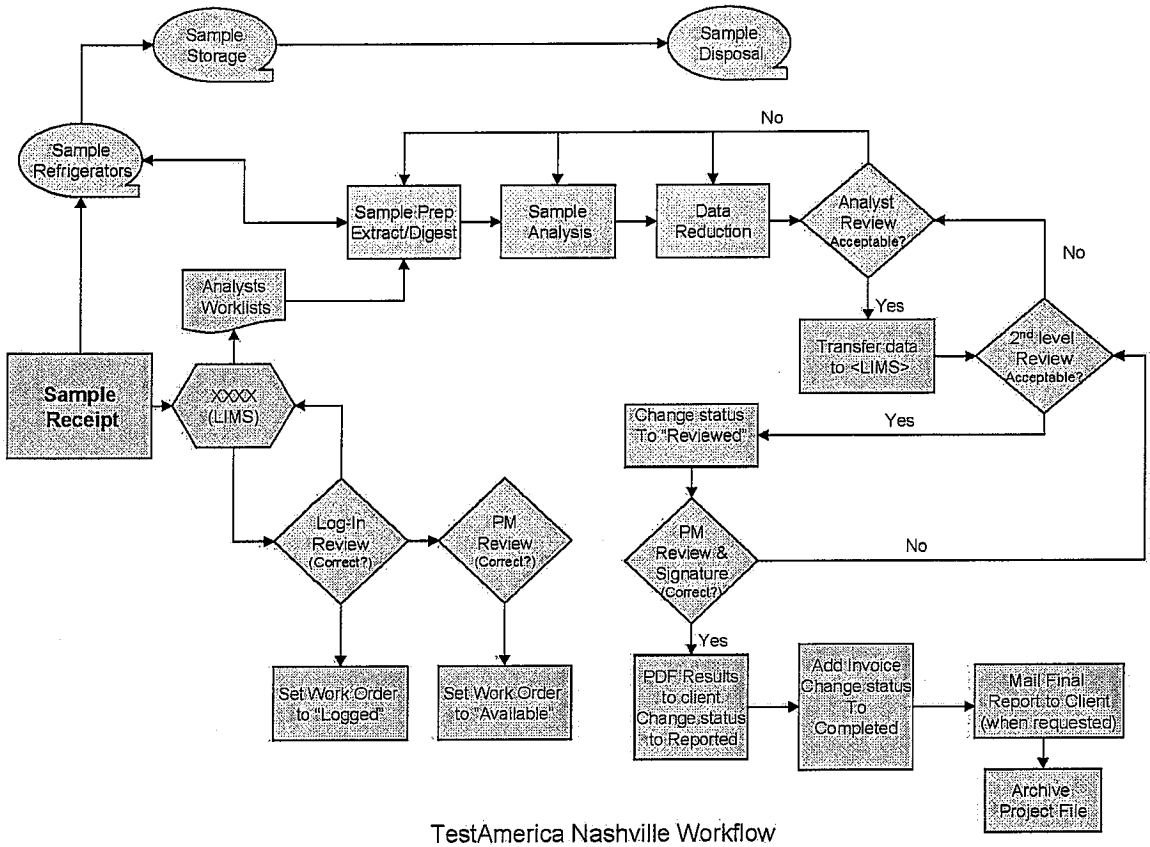
We, the undersigned, certify that:

1. The cited test method has met Demonstration of Capability requirements.
2. The test method was performed by the analyst(s) identified on this certification.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site.
4. The data associated with the method demonstration of capability are true, accurate, complete, and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility, and the associated information is well organized and available for review.

_____ _____
Analyst Signature Date

_____ _____
Technical Director Signature Date

Figure 20-2. **Work Flow**



TestAmerica Nashville 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. 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 Nashville follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

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 supervisors' 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 lists examples of schedules for routine maintenance. It is the responsibility of each Department supervisor to ensure that instrument maintenance logs, containing records of both preventive and corrective maintenance, are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals.

21.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs must be kept for all

major pieces of equipment. Instrument maintenance logs are also used to specify instrument parameters.

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 can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

21.2.5 In addition, the maintenance records contain:

- The identification of the instrument/equipment (instrument's Serial Number and Model Number).
- Any maintenance procedures and frequency or a reference to their location.

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 must 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 must examine the effect of this defect on previous analyses.

21.2.7 In the event of equipment malfunction that cannot be resolved, service must be obtained from the instrument vendor manufacturer or a qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements are made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved for the analysis, 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 are subcontracted.

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,

thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. A summary of support equipment requiring calibration checks can be found in Table 21-3. All raw data records associated with the support equipment are retained to document instrument performance; these include:

- instrument model number or a unique lab identification.
- identification of standards used for the calibration check.
- performance tolerances.
- results of the calibration checks, the initials of the individual making the check, and the date of the check.

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 must 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 national or international standards of measurement, or to national or international standard reference materials, whenever possible. Dilution standards are prepared from stock standards purchased from commercial suppliers. A standard log is maintained in LIMS by 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 then involves 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). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

21.4.1.7 A new calibration curve must be made yearly, at minimum. All curves must document the date created.

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 where a minimum of three 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 is 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 (or more) 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). Note: The calibration models in section 21.4.6.7 or 21.4.6.8 are used for Ion Chromatography (Average CF is not used.)

- 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 vary. The internal standard solution contains 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. Calculate the volume of the solution spiked into sample extracts 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 produces 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 results 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.

Calibration Factors and Response Factors for each analyte are calculated as follows:

$$\textbf{Calibration Factor (CF)} = \frac{A(s)}{C(s)}$$

$$\textbf{Response Factor (RF)} = \frac{A(s) \times C(is)}{A(is) \times C(s)}$$

where
A(s) = Peak area (or height) of the analyte or surrogate.
A(is) = Peak area (or height) of the internal standard.
C(s) = Concentration (or mass) of the analyte or surrogate, in ug/L.
C(is) = Concentration (or mass) of the internal standard, in ug/L.

Note: In the equation above, RF is unit-less, i. e., the units from the two area terms and the two concentration terms cancel out. Therefore, units other than ug/L may be used for the concentrations of the analyte, surrogate, and internal standard, provided that both C(s) and C(is) are expressed in the same units. The mass of the analyte and internal standard may also be used in calculating the RF value.

The CF or RF for each analyte at each concentration is tabulated to determine the graphical linearity of concentration versus response factor or calibration factor. The five (or more) CFs or RFs for each analyte in the initial calibration must have an acceptable Percent Relative Standard Deviation (% RSD) that is determined by each analytical method. If the RSD of the calibration or response factors is less than or equal to the acceptance limit stated in the published method over the calibration range, then linearity through the origin may be assumed, and the average calibration response factor may be used to determine sample concentrations. The CFs or RFs for each compound are calculated and kept in the calibration files.

The % Relative Standard Deviation is calculated as follows:

$$\%RSD = (SD / \overline{x_i}) \times 100$$

where SD = Standard Deviation of initial 5 CFs or RFs for each compound calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{\left(x_i - \overline{x_i}\right)^2}{n-1}}$$

where

$\overline{x_i}$ = Mean (Average) of initial 5 CFs or RFs for each compound.

n = number of standards

x_i = individual CF or RF

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 limit 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 may be re-run immediately (within 24 hours of the calibration run and prior to the processing of samples against the curve) 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 applies 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 analytical method 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. Changes to the upper end of the calibration range affect the need to dilute samples above the range, while changes to the lower end 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 0.995 or better ($r^2 \geq 0.99$) using the least squares method to be considered acceptable. In some cases it may be allowable 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." **OH VAP does not allow forcing through zero on any samples taken for the purpose of their program. South Carolina does not allow forcing through zero for the linear calibration curve.**

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 **must 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 **must 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 1st order fit or average RF.

Coefficient of Determination

$$r^2 = \frac{\left(\sum xy\right)^2}{\sum x^2 \sum y^2}$$

Correlation Coefficient

$$r = \frac{\left(\sum xy\right)}{\sqrt{\sum x^2 \sum y^2}}$$

where:

y = Response or Response ratio (see below)

x = Concentration

21.4.2.7.4 South Carolina does not allow the use of second order regression. Second order (quadratic) curve fits may not be used when analyzing any South Carolina samples.

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 departments' SOP reference binders and the Control Limits Manual.

In general, inorganic instrumentation is calibrated with external standards. Some exceptions would be Inductively Coupled Plasma (ICP), Inductively Coupled Plasma Mass Spec (ICPMS), and Ion Chromatography Mass Spec (ICMS). 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 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 or certified solutions, as applicable. See specific methods in *Standard Methods for the Examination of Water and Wastewater* (18 and 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.

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 determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

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 at the end of each analytical batch for non-GC/MS methods. 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 $\pm$ 20%, GC and HPLC $\pm$ 15%, Inorganics: $\pm$ 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 must 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 must be reanalyzed after a new calibration curve has been established, evaluated and accepted.

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:

$$\% \text{ Difference} = \frac{(\text{CF(v) or RF(v)}) - (\text{Avg. CF or RF})}{(\text{Avg. CF or RF})} \times 100$$

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:

$$\% \text{ Drift} = \frac{\text{Result - True Value}}{\text{True Value}} \times 100$$

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.

21.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification is determined by the purpose of the analyses being conducted. Data system library search routines do 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 must 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) are present in the sample spectrum.

21.5.1.2 The relative intensities of the major ions must 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 are reviewed for possible background contamination or presence of co-eluting compounds.

21.5.1.5 Ions present in the reference spectrum but not in the sample spectrum are reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.

The concentration of any non-target analytes identified in the sample (see above) are estimated. The same formulae as calibrated analytes is used with the following modifications: The areas A_s and A_{is} are from the total ion chromatograms, and the RF for the compound is assumed to be 1.

The resulting concentration is 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 10, largest non-target analyte peaks whose area count exceeds 10% of the nearest internal standard are termed "Tentatively Identified Compounds" (TICs). More or fewer TICs may be identified based on client requirements.

21.5.2 **TIC Reporting Limits** (RLs)

In general RLs cannot be specified because of the unknown nature of the TIC. Any reporting limit that is reported can only be evaluated as an estimate as the quantitation is based on the assumption that the TIC responds exactly as the IS responds which is most likely not the case. In general, it is not recommended to set a Reporting limit at too low of a concentration as it gives a false impression.

TICs that meet the above identification criteria (Section 21.5.1) at 10% area of the IS: The RL would be 10% of the concentration of the internal standard used for quantitation (e. g., 2.5 ug/L

for 8260B, 4.0 ug/L for 8270C). In general, if the 10% area criterion is not met, the TIC RLs are set at a level approximately five times the level of the poorest performer in the analysis.

If a compound meets the TIC criteria, the reporting limit must reflect the ratio between the TIC and the IS or five times the level of the poorest performer whichever is lower.

21.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

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 Section 21.6.2 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. The maintenance must be documented in the maintenance log and should be noted in the sequence log. 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 is typically built into the instrument software.

21.6.5 Since the limits are expressed in whole percentages, the results may be rounded to whole percentage before comparing to criteria when assessing the tune verification against the tune requirements. However, the comparison to the criteria is usually done automatically by the software and if the printout says "Fail" then there would have to be documentation on the raw data and comparison to the criteria if the lab intends to still accept the tune. In most cases the analyst is better off performing an adjustment and rerunning the tune standard.

21.6.6 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

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
ABSORPTION UNIT	MITSUBISHI	Sigma 10	7520591	1996	USED
ACCELERATED SOLVENT EXTRACTOR	DIONEX	ASE200	02060437	2002	NEW
ACCELERATED SOLVENT EXTRACTOR	DIONEX	ASE200	02060440	2002	NEW
AUTO BOAT	MITSUBISHI	ABC	75A10673	1996	USED
AUTOSAMPLER	CENTAC TECHNOLOGIES	ASX-510	120347ASX	2005	NEW
AUTOSAMPLER	AMERICAN PRECISION	3i9A	9033	1992	[1]
AUTOSAMPLER	AMERICAN PRECISION	32E-6108AY	9205	1992	[1]
AUTOSAMPLER	DIONEX	ASI-100	4290509	2005	NEW
AUTOSAMPLER	DIONEX	ASI-100	4440407	2005	NEW
AUTOSAMPLER	EST	CENTURION	CENT123020504	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT153112904	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT124030104	2004	[1]
AUTOSAMPLER	EST	CENTURION	CENT126030104	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT197042106	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT196041706	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT171060705	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT172060705	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT176102105	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT174060705	[1]	[1]
AUTOSAMPLER	EST	CENTURION	CENT198050106	[1]	[1]
AUTOSAMPLER	EST	ENCON	215081902	[1]	[1]
AUTOSAMPLER	EST	ENCON	219082202	[1]	[1]
AUTOSAMPLER	HEWLETT PACKARD	718593B	3114A25542	[1]	[1]
AUTOSAMPLER	HEWLETT PACKARD	HP7673	3247A30576	2005	[1]
AUTOSAMPLER	HEWLETT PACKARD	HP7673	3514A42318	[1]	[1]
AUTOSAMPLER	HEWLETT PACKARD	HP7673A	2843A1152	[1]	[1]
AUTOSAMPLER	HEWLETT PACKARD	HP7673	3248A33147	[1]	[1]
AUTOSAMPLER	HEWLETT PACKARD	HP7673	2546A01716	[1]	[1]
AUTOSAMPLER	HEWLETT PACKARD	HP7673	3514A42318	2007	USED
AUTOSAMPLER	SHIMADZU	SIL-10A	60341F	1997	NEW
AUTOSAMPLER	SHIMADZU	SIL-10A	C20363506886	1999	NEW
AUTOSAMPLER	SHIMADZU	SIL-10A	C20363506585	1999	NEW
AUTOSAMPLER	SHIMADZU	AOC20i	C11143602793	[1]	[1]
AUTOSAMPLER	SHIMADZU	AOC20i	C11144208289	2004	[1]
AUTOSAMPLER	SHIMADZU	AOC20i	C11143703828	[1]	[1]
AUTOSAMPLER	SHIMADZU	AOC20i	C11143703823	[1]	[1]

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
AUTOSAMPLER	SHIMADZU	AOC20i	C11143602454	1	1
AUTOSAMPLER	SUPERIOR ELECTRIC	MO61-LF-517	A218524	1992 OR 93	1
AUTOSAMPLER	SUPERIOR ELECTRIC	MO61-LF-517	033473653	2003	1
AUTOSAMPLER	SUPERIOR ELECTRIC	MO61-LF-517	040939389	2004	1
AUTOSAMPLER	THERMO JARRELL ASH	AS300	12677003	1994	NEW
AUTOSAMPLER	THERMO JARRELL ASH	AS300	0492	1997	NEW
AUTOSAMPLER	THERMO JARRELL ASH	AS300	67247	1998	USED
AUTOSAMPLER	OI ANALYTICAL	4552	LR92489	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	11798-895	1	1
AUTOSAMPLER	VARIAN	ARCHON	12314	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	13799	2002	NEW
AUTOSAMPLER	VARIAN	ARCHON	13795	2002	NEW
AUTOSAMPLER	VARIAN	ARCHON	13735	2002	NEW
AUTOSAMPLER	VARIAN	ARCHON	13790	2002	NEW
AUTOSAMPLER	VARIAN	ARCHON	13800	2002	NEW
AUTOSAMPLER	VARIAN	ARCHON	12201	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	12194	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	12307	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	12952	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	12761	1998	NEW
AUTOSAMPLER	VARIAN	ARCHON	12974	1999	NEW
AUTOSAMPLER	VARIAN	ARCHON	13161	1	1
AUTOSAMPLER	VARIAN	ARCHON	13812	1	1
AUTOSAMPLER	VARIAN	ARCHON	13765	1	1
AUTOSAMPLER	VARIAN	ARCHON	12945	1	1
AUTOSAMPLER	VARIAN	ARCHON	13722	1	1
AUTOSAMPLER	VARIAN	ARCHON	12920	1	1
AUTOSAMPLER	VARIAN	ARCHON	13600	1	1
AUTOSAMPLER	VARIAN	ARCHON	13641	1	1
AUTOSAMPLER	VARIAN	ARCHON	13087	1997	NEW
AUTOSAMPLER	VARIAN	ARCHON	12958	1996	USED
AUTOSAMPLER	VARIAN	ARCHON	13748	1995	NEW
AUTOSAMPLER	VARIAN	ARCHON	13291	1994	NEW
AUTOSAMPLER	VARIAN	ARCHON	13077	1	1
AUTOSAMPLER	VARIAN	ARCHON	13723	2006	USED
AUTOSAMPLER	VARIAN	ARCHON	13165	1994	NEW
AUTOSAMPLER TOWER	HEWLETT PACKARD	18596C	3530A43392	1	1
AUTOSAMPLER TOWER	HEWLETT PACKARD	18596C	3120A26333	1	1
AUTOSAMPLER TOWER	HEWLETT PACKARD	18596C	3120A27415	1	1
AUTOSAMPLER TOWER	HEWLETT PACKARD	18593A	2843A1162	1	1

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
AUTOSAMPLER TOWER	HEWLETT PACKARD	18593B	3114A25542	1	1
AUTOSAMPLER TOWER	HEWLETT PACKARD	18593B	3447A40940	1	1
AUTOSAMPLER TOWER	AGILENT	7683	US03815233	1	1
AUTOSAMPLER TOWER	AGILENT	7683	US91807060	1	1
AUTOSAMPLER TOWER	AGILENT	7683	US94209739	1	1
AUTOSAMPLER TOWER	AGILENT	7683	US00411367	1	1
AUTOSAMPLER TOWER	AGILENT	7683	CN30729442	2010	USED
AUTOSAMPLER TOWER	AGILENT	1200	DE64775625	2010	NEW
AUTOSAMPLER TRAY	HEWLETT PACKARD	18593B	3106A21456	1	1
AUTOSAMPLER TRAY	HEWLETT PACKARD	18593B	3415A35076	1	1
AUTOSAMPLER TRAY	HEWLETT PACKARD	18593B	3339A33311	1	1
AUTOSAMPLER TRAY	HEWLETT PACKARD		3348A31236	1	1
AUTOSAMPLER TRAY	HEWLETT PACKARD		(unreadable)	1	1
AUTOSAMPLER TRAY	HEWLETT PACKARD		3131A25799	1	1
AUTOSAMPLER TRAY	HEWLETT PACKARD		3304A31194	1	1
AUTOSAMPLER TRAY	AGILENT	7683	US82601220	1	1
AUTOSAMPLER TRAY	AGILENT	7683	US81100420	1	1
AUTOSAMPLER TRAY	AGILENT	7683	US24314927	1	1
AUTOSAMPLER TRAY	AGILENT	7683	US00407128	1	1
AUTOSAMPLER TRAY	AGILENT	7683	CN91653019	2010	USED
AUTOSAMPLER TRAY	AGILENT	1200	DE64775625	2010	NEW
AUTOSAMPLER WITH HEADSPACE	MARKELOV	HS9000	HS121053007	2007	NEW
AUTOSAMPLER WITH HEADSPACE	MARKELOV	HS9000	HS120053007	2007	NEW
BALANCE	DENVER INSTR.	XL610	NO113767	1	1
BALANCE	DENVER INSTR.	XE310	NO109645	1	1
BALANCE	METTLER	AE240	N28161	1993	NEW
BALANCE	METTLER	PB602-S	1118381704	1	1

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
BALANCE	METTLER	PB602	1117421936	1	1
BALANCE	METTLER	PB602-S	1126143319	2005	NEW
BALANCE	METTLER	PG802	1115352767	1	1
BALANCE	METTLER	PB602-S	1120430697	1	NEW
BALANCE	METTLER	AE200	F15224	1	1
BALANCE	METTLER	PM600T	H19877	1	1
BALANCE	METTLER	PB302	1116383230	1	1
BALANCE	METTLER	AE200	L94571	1	1
BALANCE	METTLER	PG203-S	119331062	1	NEW
BALANCE	METTLER	AE200	J63202	1	NEW
BALANCE	METTLER	PL601-S	1202140224	1	NEW
BALANCE	METTLER	AG204	1122173241	2003	NEW
BLOCK DIGESTOR	LACHAT	BD - 46	1800229	1994	NEW
BOD INCUBATOR	FISHER	307	WB05105311	1990	NEW
BOD INCUBATOR	FISHER	FU199ERWI	FGL52777	1989	USED
BOD INCUBATOR	KENMORE	253.65802508	BA73420257	2008	NEW
BOD INCUBATOR	EQUATHERM	HA757376	TA14SLB	1992	USED
CALORIMETER	PARR	1341	5427	1986	NEW
CENTRIFUGE	BECKMAN	ALLEGRA 6	ALS08D16	2009	NEW
CENTRIFUGE	CLAY ADAMS	DYNAC III 420104	3820031	1	NEW
CENTRIFUGE	CLAY ADAMS	DYNAC III 420104	4150009	1	NEW
CHILLER	NESLAB	CFT-33	293223	1993	NEW
COD REACTOR	HACH		901103566	1990	NEW
CONDUCTIVITY METER	WTW	330i	0148004	2002	NEW
DISCRETE ANALYZER	KONELAB	AQUA 20	E0719526	2004	NEW
DISCRETE ANALYZER	KONELAB	AQUA 20	S2419226	2009	USED
DISSOLVED OXYGEN METER	YSI	5100	00B0314	2000	NEW
DISSOLVED OXYGEN METER	YSI	5100	00D0552	2000	NEW
FLASHPOINT TESTER, AUTO	PETROLAB	PMA-4	741	1997	NEW
FLASHPOINT TESTER, AUTO	PETROLAB	PMA-4	741	1997	NEW
FLASHPOINT, OPEN CUP	FISHER	--	201N0005	2002	NEW
FLASHPOINT, PENSKY-MARTENS	FISHER	13-497-5	1787	1986	NEW
FLOW INJECTION ANALYZER	LACHAT	8000	A83000234	1995	NEW
FLOW INJECTION ANALYZER	LACHAT	FIA+	A83000-1323	1999	NEW
FLOW INJECTION ANALYZER	LACHAT	8500 FIA	050600000167	2008	USED
FLOW INJECTION ANALYZER	LACHAT	8500	090400001098	2009	NEW

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
FLUOROMETER	SEQUOIA - TURNER	450	B002262TV	1992	NEW
FURNACE	THERMOLYN	30400	10599810039263	1984	NEW
GC w/ECD/ECD	HEWLETT PACKARD	5890	2921A23313	[1]	[1]
GC w/ECD/ECD	PERKIN ELMER	AUTOSYS	610N9122009	2000	NEW
GC w/ECD/ECD	PERKIN ELMER	AUTOSYS	610N9122008	2000	NEW
GC w/ECD/ECD	PERKIN ELMER	AUTOSYS	610N01101203	2000	USED
GC w/ECD/ECD	PERKIN ELMER	AUTOSYS XL	610N9122010	2000	NEW
GC w/ECD/ECD	SHIMADZU	17A	C11123681357	1999	NEW
GC w/ECD/ECD	HEWLETT PACKARD	6890	US00011427	2000	NEW
GC w/ECD/ECD	HEWLETT PACKARD	5890	3336A61865	2006	USED
GC w/ECD/ECD	HEWLETT PACKARD	5890	3336A51644	2007	USED
GC w/ECD/ECD	HEWLETT PACKARD	7890A	CN10734082	2009	NEW
GC w/FID	HEWLETT PACKARD	5890	2728A13149	1997	USED
GC w/FID	HEWLETT PACKARD	5890	2950A27678	[1]	[1]
GC w/FID	HEWLETT PACKARD	5890	3108A34413	1999	USED
GC w/FID	HEWLETT PACKARD	5890	3235A45233	2006	USED
GC w/FID	HEWLETT PACKARD	5890	2950A26161	2006	USED
GC w/FID	HEWLETT PACKARD	5890	3203A42028	2006	USED
GC w/FID	HEWLETT PACKARD	5890/7673	3235A45233	2006	USED
GC w/FID	HEWLETT PACKARD	5890	3336A51997	2006	USED
GC w/FID	HEWLETT PACKARD	5890	3235A46759	2009	USED
GC w/FID	HEWLETT PACKARD	6890/7683	US00029922	2010	USED
GC w/FID	PERKIN ELMER	AUTOSYS	610N1040206	1992	NEW
GC w/FID	PERKIN ELMER	CLARUS 500	650N3100901	2003	NEW
GC w/FID	PERKIN ELMER	CLARUS 500	650N4031504	2004	NEW
GC w/FID	SHIMADZU	17A	C11123580493	1998	NEW
GC w/FID	SHIMADZU	17A	C11123681362	1999	NEW
GC w/FID	SHIMADZU	17A	C11123781625	1999	NEW
GC w/FID	SHIMADZU	17A	C11123781731	1999	NEW
GC w/FID	SHIMADZU	17A	C11123781531	1999	NEW
GC w/NPD/FPD	PERKIN ELMER	CLARUS 500	650N4061602	2004	NEW
GC w/PID/FID	HEWLETT PACKARD	5890	3027A29703	2001	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3126A36232	1998	USED
GC w/PID/FID	HEWLETT PACKARD	5890	2908A91269	1990	USED

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC w/PID/FID	HEWLETT PACKARD	5890	3133A37656	1996	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3203A42091	1996	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3336A58503	1998	USED
GC w/PID/FID	HEWLETT PACKARD	5890	2938A24989	1998	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3336A50264	1998	USED
GC w/PID/FID	HEWLETT PACKARD	5890	2938A25493	1998	USED
GC w/PID/FID	HEWLETT PACKARD	6890	US00041322	2002	NEW
GC w/PID/FID	HEWLETT PACKARD	6890	US00041324	2002	NEW
GC w/PID/FID	HEWLETT PACKARD	6890	US00027429	2002	NEW
GC w/PID/FID	HEWLETT PACKARD	5890	3336A60618	2003	USED
GC w/PID/FID	HEWLETT PACKARD	5890	DE00003878	2003	NEW
GC w/PID/FID	HEWLETT PACKARD	6890N	US10350005	2004	NEW
GC w/PID/FID	HEWLETT PACKARD	6890N	US10350002	2004	NEW
GC w/PID/FID	HEWLETT PACKARD	5890	2950A27370	2005	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3223A43282	2005	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3019A28662	2005	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3203A41711	2006	USED
GC w/PID/FID	HEWLETT PACKARD	5890	3203A41407	2007	USED
GC w/PID/FID	SHIMADZU	17A	C11123580601	1998	NEW
GC w/PID/FID	SHIMADZU	17A	01123681361	1999	NEW
GC w/PID/FID	TREMETRICS	9001	100035	1996	NEW
GC w/PID/FID	TREMETRICS	9001	100036	1996	NEW
GC w/PID/FID	VARIAN	3400	4035	1999	USED
GC w/TCD	SHIMADZU	8A	C10493313148	1998	[1]
GC/MS	HEWLETT PACKARD	5890II/5972	3307A00396	1997	USED
GC/MS	HEWLETT PACKARD	5890II/5971	3234A04319	1994	NEW
GC/MS	HEWLETT PACKARD	5890II/5971	2749A00081	1997	NEW
GC/MS	HEWLETT PACKARD	5890II/5972	3329A00693	1994	NEW
GC/MS	HEWLETT PACKARD	5890II5972	3501A02393	1995	NEW
GC/MS	HEWLETT PACKARD	6890/5973	US82311321	1999	USED

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS	HEWLETT PACKARD	6890/5973	US80210937	1999	USED
GC/MS	HEWLETT PACKARD	6890/5973	US94222434	2000	NEW
GC/MS	HEWLETT PACKARD	6890/5973N	US01140208s	2000	NEW
GC/MS	HEWLETT PACKARD	G1530A/ G1099A	US91421544	1999	NEW
GC/MS	HEWLETT PACKARD	G1530A/ G1099A	3435A01921	1998	[1]
GC/MS	HEWLETT PACKARD	6890/5973	US81221486	2000	NEW
GC/MS	HEWLETT PACKARD	6890/5973	US91921735	2000	NEW
GC/MS	HEWLETT PACKARD	6890/5973	US94212231	2000	NEW
GC/MS	HEWLETT PACKARD	6890/5973	US94211203	2000	NEW
GC/MS	HEWLETT PACKARD	6890/5973	US94260109	2001	USED
GC/MS	HEWLETT PACKARD	6890/5973N	US03340475	2001	NEW
GC/MS	HEWLETT PACKARD	6890/5973N	US03340479	2002	NEW
GC/MS	HEWLETT PACKARD	6890/5973N	US21844021	2002	NEW
GC/MS	HEWLETT PACKARD	6890/5973N	US21844025	2002	NEW
GC/MS	HEWLETT PACKARD	5890/5972	3336A57928	2004	USED
GC/MS	HEWLETT PACKARD	5890/5972	3235A44162	2005	USED
GC/MS	HEWLETT PACKARD	5890/5972	2423A01966	2005	USED
GC/MS	HEWLETT PACKARD	5890/5973	US00027481	2005	USED
GC/MS	HEWLETT PACKARD	6890/5973	4510250045	2005	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00037997	2006	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00037995	2006	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00027177	2006	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00033436	2006	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00008026	2006	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00022681	2006	USED
GC/MS	HEWLETT PACKARD	6890/5973	US00022412	2008	USED
GC/MS	HEWLETT PACKARD	6890/5973	US10462174	2009	NEW

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS w/ENTEC CONCENTRATOR	HEWLETT PACKARD	6890/5973N	US10450528	2001	NEW
GEL PERMEATION CLEANUP	O. I. ANALYTICAL	AUTOPREP 2000	E427330254	2004	NEW
HEADSPACE ANALYZER	TEKMAR	7000	91242001	2001	USED
HOTPLATES	THERMODYNE	CIMAREC 3		1991 -	NEW
HPLC	SHIMADZU	SCL-10AVP	C21013650343	1999	NEW
HPLC	DIONEX	TCC-100MSV	1280301	2005	NEW
HPLC	DIONEX	P680A LPG-4	5550503	2005	NEW
HPLC SYSTEM (ISOCRATIC)	SHIMADZU	SCL-10AVP	C21013650380	1999	NEW
HPLC	AGILENT	1200	DE64255220 DE60557139	2010	NEW
ICP - TRACE	JARRELL - ASH	61 E	472790	1997	USED
ICP – TRACE	JARRELL - ASH	61 E	295490	1994	NEW
ICP – TRACE	THERMO SCIENTIFIC	ICAP 6000 SERIES	20084103	2009	NEW
ICP/MS	HEWLETT PACKARD	7500	JP51201460	2005	NEW
ION CHROMATO-GRAPH	METROHM	732	5142	1998	NEW
ION CHROMATO-GRAPH	METROHM	732	5122	1998	NEW
ION CHROMATO-GRAPH	DIONEX	DX600	01110237	2005	USED
KARL – FISCHER TITRATOR	BRINKMAN	684	16840013	1993	NEW
MECHANICAL SHAKER	GLAS-COL	VS50012	399665	2005	NEW
MECHANICAL SHAKER	GLAS-COL	VS50012	399872	2005	NEW
MERCURY ANALYZER	LEEMAN	Hydra AA	2007	2002	NEW
MERCURY ANALYZER	LEEMAN	HYDRA AA	6008	2008	USED
MERCURY ANALYZER	LEEMAN	HYDRA II	0002	2010	NEW
MICROWAVE	CEM	MARS XPRESS 907501	MD2979	2009	NEW
MICROWAVE	CEM	MARS XPRESS 907501	MD8469	2006	NEW
MIDI-DISTILLATION	ANDREWS GLASS		MCVA1290374	1994	NEW
MIDI-DISTILLATION	WESTCO	EASY-DIST	EA-1006	1996	NEW
OVEN	BLUE M	SW11TA1	SW3034	1989	NEW
OVEN	BLUE M	SW17TA1	SW7252	1993	NEW
OVEN	BLUE M	SWIITA-1	SW3990	1	1
OVEN	FISHER	ISOTEMP 650G	803N0038	1	1
OVEN	FISHER	ISOTEMP 516G	903N0083	1	1
OVEN	FISHER	500	51100409	1	1
OVEN	NAPCO	620	(ILLEGIBLE)	1	1
OVEN	FISHER	ISOTEMP 650G	202N0036	2002	NEW

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
OXYGEN PROBE	ORION	97-08-00		1991	NEW
pH METER	ORION	330	005043	2000	NEW
pH/mv METER	ACCUMET	10	C9002414	1994	NEW
PH/mv METER	ACCUMET	XL15	5186494	2007	NEW
pH/mv METER	CORNING	220	12351	1991	NEW
pH/mvMETER	ACCUMET	AB15	AB92331859	2009	NEW
PURGE/TRAP	EST	ENCON	217082202 E	1997	NEW
PURGE/TRAP	EST	ENCON	126112900 E	1997	NEW
PURGE/TRAP	EST	ENCON	216081902 E	1994	NEW
PURGE/TRAP	EST	ENCON	218082202 E	1994	NEW
PURGE/TRAP	EST	ENCON	215081902E/P	1	1
PURGE/TRAP	EST	ENCON	219082202E/P	1	1
PURGE/TRAP	EST	ENCON	237082022	2006	USED
PURGE/TRAP	EST	ENCON	126112900	2006	USED
PURGE/TRAP	HEWLETT PACKARD	G1900-60500	3651A10630	1995	NEW
PURGE/TRAP	HEWLETT PACKARD	3000	3636A10579	1	1
PURGE/TRAP	O.I. ANALYTICAL	4560	K811460272	1998	NEW
PURGE/TRAP	O.I. ANALYTICAL	4560	D308371	1993	NEW
PURGE/TRAP	O.I. ANALYTICAL	4560	H421460320	1994	NEW
PURGE/TRAP	TEKMAR	3000	93251007	1993	NEW
PURGE/TRAP	TEKMAR	3000	95093006	1995	NEW
PURGE/TRAP	TEKMAR	3000	99053016	2003	1
PURGE/TRAP	TEKMAR	3000	94057008	1	1
PURGE/TRAP	TEKMAR	3000	98236009	1	1
PURGE/TRAP	TEKMAR	3000	98139001	1	1
PURGE/TRAP	TEKMAR	3000	98098001	1	1
PURGE/TRAP	TEKMAR	3000	98364008	1	1
PURGE/TRAP	TEKMAR	3000	93316011	1	1
PURGE/TRAP	TEKMAR	3000	94252002	1	1
PURGE/TRAP	TEKMAR	3000	98111004	1	1
PURGE/TRAP	TEKMAR	3000	93334005	1	1
PURGE/TRAP	TEKMAR	3000	95144001	1	1
PURGE/TRAP	TEKMAR	3000	95166007	1	1
PURGE/TRAP	TEKMAR	3000	94266005	1	1
PURGE/TRAP	TEKMAR	3000	99196020	1	1
PURGE/TRAP	TEKMAR	3000	97009013	1	1
PURGE/TRAP	TEKMAR	3000	98092002	1	1
PURGE/TRAP	TEKMAR	3000	995207010	1	1
PURGE/TRAP	TEKMAR	3000	98008002	1	1
PURGE/TRAP	TEKMAR	3000	3449A10215	1	1
PURGE/TRAP	TEKMAR	3000	95153007	1	1
PURGE/TRAP	TEKMAR	3000	98229017	1	1
PURGE/TRAP	TEKMAR	3000	94005035	1	1
PURGE/TRAP	TEKMAR	3000	94005015	1	1
PURGE/TRAP	TEKMAR	3000	96325013	1	1
PURGE/TRAP	TEKMAR	3000	93170002	1	1
PURGE/TRAP	TEKMAR	3000	99076004	1	1

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
PURGE/TRAP	TEKMAR	LCS-3000	94067010	2002	NEW
PURGE/TRAP	TEKMAR	3100	02115005	1	1
PURGE/TRAP	TEKMAR	3100	98152010	1	1
PURGE/TRAP	TEKMAR	3100	00104011	1	1
PURGE/TRAP	TEKMAR	3100	00104012	1996	USED
PURGE/TRAP	TEKMAR	3100	99305025	1	1
PURGE/TRAP	TEKMAR	3100	US01354002	2004	1
PURGE/TRAP	TEKMAR	3100	US02249003	2004	1
PURGE/TRAP	TEKMAR	3100	US02155008	1	1
PURGE/TRAP	TEKMAR	3100	US02326003	1	1
PURGE/TRAP	TEKMAR	3100	95129003	1	1
PURGE/TRAP	TEKMAR	3100	95039008	1	1
PURGE/TRAP	TEKMAR	3100	94104002	1	1
PURGE/TRAP	TEKMAR	3100	97273002	1	1
PURGE/TRAP	TEKMAR	LSC 2000	91309006	1997	NEW
PURGE/TRAP	TEKMAR	LSC2000	177003	1997	NEW
PURGE/TRAP	TEKMAR	LSC2000	90100003	1998	NEW
PURGE/TRAP	TEKMAR	LSC2000	90115009	1998	NEW
PURGE/TRAP	TEKMAR	LSC2000	88274012	1998	NEW
PURGE/TRAP	TEKMAR	LSC-2000	8826010	1988	NEW
PURGE/TRAP	TEKMAR	LSC-2000	91092004	1991	NEW
PURGE/TRAP	TEKMAR	LSC-2000	90043025	1991	NEW
PURGE/TRAP	TEKMAR	LSC-2000	92008004	1992	NEW
RECIPROCAL WATER BATH	NEW BRUNSWICK SCIENTIFIC	R 76	400364888	2003	NEW
ROTATOR	ASSOC. DESIGN	3740-48BRE		1994	NEW
SOLID PHASE EXTRACTOR	HORIZON TECHNOLOGY	SPE-3000XL	01-1200	2004	NEW
SOLVENT CONCENTRATOR	LABCORCO	NVAP	020998064F	2002	NEW
SOLVENT CONCENTRATOR	LABCORCO	NVAP	020897646F	2002	NEW
SOLVENT CONCENTRATOR	LABCORCO	NVAP	020998063F	2002	NEW
SONICATOR	SONICS & MATERIALS	VCX600	28785F	1999	NEW
SONICATOR	SONICS & MATERIALS	VCX600	19574D	1998	NEW
SONICATOR	SONICS & MATERIALS	VCX600	18683	2001	NEW
SONICATOR	SONICS & MATERIALS	QVC502	26925	1998	NEW
SONICATOR	SONICS & MATERIALS	VC501	23840F	1997	NEW
SONICATOR	SONICS & MATERIALS	VC750	31469F	2000	NEW
SONICATOR	SONICS & MATERIALS	VC750	37121G	2003	NEW
SONICATOR	SONICS & MATERIALS	VC750	31321G	2000	NEW

Table 21-1: Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
SOXHLET EXTRACTOR, AUTOMATED	GERHARDT	MULTISTAT SX/PC	NA	2007	NEW
SOXHLET EXTRACTOR, AUTOMATED	GERHARDT	MULTISTAT SX/PC	NA	2007	NEW
SOXHLET EXTRACTOR, AUTOMATED	GERHARDT	MULTISTAT SX/PC	NA	2007	NEW
SOXHLET EXTRACTOR, AUTOMATED	GERHARDT	MULTISTAT SX/PC	NA	2007	NEW
THERMOMETER (NIST)	ERTCO	15041D	1409	2000	NEW
THERMOMETER (NIST)	ERTCO	ASTM 62C	2918	[1]	[1]
TOC	SHIMADZU	5050	29118894	1993	NEW
TOC	SHIMADZU	TOC-VCSN	H51204635241	2009	NEW
TOC	O.I. ANALYTICAL	1030W	F923730891 AUTOSAMPLER: 612788821	2009	NEW
TOC W/SOLIDS OPTION	SHIMADZU	5050A	36001341	1999	NEW
TOX	MITSUBISHI	SIGMA 10	75R00110	1998	USED
TOX	MITSUBISHI	TOX-100	A7M41934	2009	USED
TOX	MITSUBISHI	TOX100	A7M20849	1999	NEW
TURBIDIMETER	HF	DRT – 100B	602164	2000	NEW
UV/VIS	SHIMADZU	160U	28D06563	1990	NEW
UV/VIS	SHIMADZU	1601	A10753782132	2001	NEW
UV/VIS	HACH	DR/2500	030500005514	2003	NEW
ZHE PRESSURE	MILLIPORE	T316	22361028	1993	NEW
ZHE ROTATOR (4)	MILLIPORE	Z3	455TR4042	1990	NEW

[1]Although equipment is operational and calibration maintained, this information is not available.

Table 21-2. Preventive Maintenance Procedures for Laboratory Equipment

Table 21-2: Instrument/Equipment Type	Activity	Frequency
Gas Chromatograph	Change septum	As needed – record
	Check gases	Daily
	Replace or clip column	As needed – record. Rerun calibration/RT study
	Clean detector	As needed – record
	Check autosampler seals	Daily
	Clean injectors; replace liners	As needed – record
	Clean or replace PID lamp	As needed – record
	Vendor repair	As needed – record work order
HPLC or IC	Check seals for leakage	Each use
	Replace seals/valves/lamps	As needed – record
	Replace suppressor (IC only)	As needed – record
	Replace column	As needed – record. Rerun calibration/RT study
	Clean source/analyzer	As needed – record
	Vendor repair	As needed – record work order
GC/MS	Change Merlin (SVOC only)	As needed – record
	Bake trap (VOC only)	Daily
	Clean source	As needed – record
	Change vacuum pump oil	Biannually – record
	Clean injector; replace liner (SVOC only)	Daily
	Replace column	As needed – record. Rerun calibration/RT study
	Vendor repair	As needed – record work order
ICP	Torch inspection	Each use
	Clean torch and nebulizer	As needed – record
	Inspect filters	Daily
	Change filters	As needed – record
	Inspect pump tubing	Daily
	Change pump tubing	As needed – record
	Vendor repair	As needed – record work order
	Inspect contact rings	Each use
	Clean windows	Each use
	Align lamp	Each use
	Vendor repair	As needed – record work order
Mercury Analyzer	Inspect tubes and reagents	Daily
	Vendor repair	As needed – record work order
Microwave	Check power output	Weekly
	Check cleanliness and rotation	Each use
	Vendor repair	As needed – record work order
InfraRed spectrometer	Change dessicant	As needed – record
	Vendor repair	As needed – record work order

Table 21-2: Instrument/Equipment Type	Activity	Frequency
pH Meter	Clean electrode	Each use
	Inspect electrode	Each use
	Vendor repair	As needed – record work order
TCLP Extractors And Zero Headspace Extractors	Verify rotation	Each use – record
	Check for leakage	Each use
	Vendor repair	As needed – record work order
Turbidimeter	Check lamp	Each use
	Clean sample holder	Each use
	Vendor repair	As needed – record work order
UV/VIS Spectrometer	Check paper	Daily
	Clean sample compartment	As needed
	Auto-check calibration	Daily at start-up
	Wavelength calibration	Six months – record
	Vendor repair	As needed – record work order
Total Organic Carbon Analyzer	Check gas flow	Daily
	Check fluid level (IC reservoirs)	Daily
	Replace "O" rings	As needed – record
	Check needle	Each use
	Replace scrubbers (halogen and CO_2)	Yearly – record
	Replace catalyst	As needed – record
	Vendor repair	As needed – record work order
Total Organic Halogen Analyzer	Clean inlet tube	As needed
	Clean cell	Each use
	Check electrode levels	Each use
	Vendor repair	As needed – record work order
Weighing balances	Clean pan	Each use
	Check calibration	Daily – record
	Vendor repair	As needed – record work order
Temperature devices: refrigerators, incubators, evaporators, flash point tester, COD reactor, water circulator, drying ovens	Monitor temperature	Daily or when used (refrigerators 2 times per day) – record
	Vendor repair	As needed – record work order
Ultrasonic Disruptors	Clean, Tune by depressing tuning button while adjusting % output knob until lowest reading is obtained. For dual head, disconnect one horn at a time.	Each use -- record
	Vendor repair	As needed – record work order

Table 21-2 Instrument/Equipment Type	Activity	Frequency
Discrete Analyzer	Perform "start-up"	Daily
	Wash procedure	Daily
	Run water blank	Daily
	Clear daily files	Daily
	Check water and waste container; empty if needed	Weekly
	Check cuvette bin	Weekly
	Check syringe plunger tip; replace syringe	Weekly; as needed
	Run dichromate at 480 ηm, if problems with water blanks are noted.	As needed
	Save database to CD	Monthly
	Delete messages	Monthly
	Clean/lubricate incubator rod and fetcher arm	Monthly
	Replace lamp	Every 6 months

Table 21-3. Periodic Calibration

Table 21-3: Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using A2LA-accredited NIST weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person semi-annually.	Calibrated semi-annually. Daily calibration verification prior to use.	± 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 A2LA-accredited NIST weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person semi-annually.	Calibrated semi-annually. Daily calibration verification prior to use.	± 0.5%	Clean. Replace.
A2LA-accredited NIST Weights	Accuracy determined by accredited weights and measurement laboratory.	1 year	As per certificate.	Replace.
NIST-Traceable Thermo-meter	Accuracy determined by A2LA-accredited weights and measurement laboratory.	1 year	As per certificate.	Replace.
Thermo-meter	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 1.2°C	Replace
Minimum-Maximum Thermo-meters	Against NIST-traceable thermometer	Yearly	± 1.5°C	Replace

Table 21-3: Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
InfraRed Temperature Guns	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 1.5°C	Repair/replace
Dial-type Therm-ometers	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 1.5°C	Replace
Digital Therm-ometers	Against NIST-traceable thermometer	Quarterly	±1.2°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again in two hours.	2.7 ± 1.7°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.
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. Note: For dispensers not used for analytical measurements, a label is applied to the device stating that it is not calibrated.	Monthly	± 2% Calculate accuracy by dividing weight by stated volume times 100 for percent.	Adjust. Replace.

Table 21-3: 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	Cell impedance calibrated with three KCl standards.	Each use.	$r \geq 0.99$	Recalibrate.
Deionized Water	Check in-line conductivity meter on system with conductivity meter in Inorganics Department.	Weekly	<10 µmhos/cm^2	Record on log. Report discrepancies to Technical Director.
Barometer	Barometric pressure checked against 17025 standards	Yearly	±5 mBars	Replace.

SECTION 22

MEASUREMENT TRACEABILITY
(NELAC 5.5.6)

22.1 OVERVIEW

Traceability of measurements must 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 are 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. Class A Glassware should be routinely inspected for chips, acid etching or deformity. If the Class A glassware is suspect, the accuracy of the glassware must be assessed prior to use.

22.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement are 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.

Calibration laboratory's policy for achieving measurement traceability is defined and includes the subsequent elements of uncertainty.

The uncertainty calculations of the calibration laboratory are supported by uncertainty budgets and are represented by expanded uncertainties typically using a coverage factor of k=2 to approximate the 95% confidence level. This explanation accompanies the measurement result and the associated uncertainty.

The tolerance uncertainty ratio (TUR) is calculated using the expanded uncertainty of the measurement, not the collective uncertainty of the measurement standards. A statement to this effect accompanies the TUR along with the coverage factor and confidence level.

The calibration report or certificate submitted to TestAmerica Nashville contains, in a well designed format, a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. Opinions and interpretations of results are presented along with the basis

upon which they were made and identified as such. The report may be submitted by facsimile or other electronic means as long as the requirements of the International Standard are achieved. If significant amendments are made to a calibration certificate, a supplemental certificate for the serial-number-specified piece of equipment is so identified. When a new certificate is offered, it uniquely identifies and references the one it replaces. All calibration reports are filed in the QA Office.

The calibration laboratory supports in-house calibration systems: documented procedures for in-house calibrations, evidence by a report, certificate, or sticker, for an appropriate amount of time; training records of calibration personnel; certificates from accreditation services demonstrating traceability to national or international standards of measurement; procedures for evaluating measurement uncertainty; timely and documented recalibration of reference standards. When subcontracting to a calibration laboratory, TestAmerica Nashville does not use a firm who subcontracts the work.

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, NVLAP, NIST with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a description of the standard, a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to Table 9-1 in Section 9 for general storage requirements, and to method SOPs "Standards and Reagents" section and SOP Standards Control / NV08-214 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 in three-ring binders in the analytical departments of the laboratory. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs and SOP Standard Control / NV08-214.

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 must 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 (include prep date for reagents)
- Standard ID (from LIMS)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Special Health/Safety warnings if applicable. See EH&S manual for further information.

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)
- 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.

To maintain traceability, standard ID numbers must be noted on all 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 as outlined in lab Method SOPs; and 3) according to SOP Standard Control / SA08-214 and Table 9-2.

SECTION 23

SAMPLING
(NELAC 5.5.7)

23.1 OVERVIEW

TestAmerica Nashville 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

When new containers arrive at the laboratory, the date of receipt is recorded on the packing list received with them for retained documentation. Periodically, containers are evaluated for cleanliness based upon their intended parameter sample analysis. Upon request, the containers are then sent to clients for use in collecting samples. The shipping date, type and number of containers are maintained on file by the lab. Shipping personnel insure that container stock is rotated so that "first in" is "first out." When a client requests containers, a client services representative creates a container request in LIMS; it is then stored permanently in LIMS with a unique container order number. Copies of the container request are printed for the shipping department. One copy goes to the client with the containers; one copy is filed in the shipping department.

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.

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 are analyzed along with the field samples.

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 must 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 are also affected by the site and sample handling conditions evaluated by the other types of blanks. The sampling time for the equipment blank begins 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 is 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 are to be used for sampling. Alternatively, they may be purchased as certified organic-free for targets analyzed. 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 all holding times based on the date and specific time of sampling or to the hour, versus "days" approach.

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. The time of initiation of purging is considered the injection time, but data systems record the start of the chromatographic run rather than the start of purging. Hence, if a sample is so near expiration that the start-of-purging time rather than the chromatographic run time is needed to document the integrity of the sample; the analyst must observe and record the start-of-purging time in the instrument log. Extractions, e. g., for high level soils, must be completed in time to allow for analysis to be initiated within the maximum allowable holding time.

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 or preservation requirements are not met, the reports must be qualified using a flag, footnote or case narrative. "Analyze immediately" is an EPA designation reserved for tests which, for compliance monitoring projects, are performed by field instrumentation or a laboratory "generally within 15 minutes" of sampling (Federal Register, Vol. 48, No. 209, p. 11). TestAmerica qualifies data for these parameters if analysis cannot be performed within 15 minutes of sampling. "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.

Each sample is handled by analysts as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Refer to SOP Sample Subsampling, Homogenization and Compositing / NV-08-229 for specific details on taking sample aliquots and subsampling.

SECTION 24

HANDLING OF SAMPLES
(NELAC 5.5.8)

Sample management procedures at TestAmerica Nashville 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 is initiated when bottles are sent to the field or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 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
- 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 relinquished or received 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. The receipt from the courier is stored in Sample Control by date; it lists all receipts each date.

24.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, Sample Control completes the custody seal (Figure 24-2), retains the shipping record with the COC, and initiates an internal COC (Figure 24-3) for laboratory use by analysts and a sample disposal record (Figure 24-4).

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 is 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 and in full detail in SOP Sample Control / NV02-01.

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 on a Cooler Receipt Form, Figure 24-5.

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 that require thermal preservation.

- Samples are 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 are considered acceptable. This must be documented on the COC.

- 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 Cooler Receipt Form and in LIMS. In the case of volatiles, it is recorded after analysis on the run log and benchsheet. Chlorine is checked on samples requiring extractable organics, BOD, TOX, cyanide, fluoride, ammonia, TKN, CBOD and Nitrate; presence or absence is recorded.

24.2.1.4 After inspecting the samples, the sample control receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions on the Cooler Receipt Form and store them in appropriate refrigerators or storage locations.

24.2.1.5 If samples are received without a COC, TestAmerica provides 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 the walk-in cooler. The person receiving the samples must record the date and time received, the presence or absence of ice and custody seals, the temperature of samples, presence and type of packing material, 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 are documented using the PIPE non-conformance database (see Section 13) and are resolved by consultation with the client. If the sample acceptance criteria (Section 24.3) are not met, the laboratory must 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.

Note: North Carolina requires that they be notified when samples are processed that do not meet sample acceptance criteria.

24.2.1.9 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.

24.2.2 Sample Control

All samples that are received by the laboratory are logged into the LIMS to allow the laboratory to track and evaluate sample progress. Each group of samples that are logged in together (typically one project from a given client/sampling event) is assigned a unique job number. Within each job, 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 with an alphabetic letter added to the sample number. 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;
- State or country of origin of sample. (Also, see Appendix 13, A13.7.1, for AIHA guidelines.)
- 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)

Complete details are described in SOP Sample Control / NV02-01.

24.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy that clearly outlines the circumstances under which samples are 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;
- sample container must be received in good condition;
- the project manager is notified if any sample fails to meet the criteria listed in the sample acceptance policy.

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 with all laboratory-supplied container shipments.

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 or freezers, as required. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed, at minimum, every two weeks. Samples are not stored in refrigeration units containing standards or reagents. Samples are also stored away from food and other potentially contaminating sources. Samples must not be stored in the refrigerator compartment of a unit that has standards stored in the freezer compartment.

After all analyses are complete, samples are placed into sample storage for at least 60 days. This area is at room temperature. At the end of approximately 60 days, they are disposed of in accordance with SOP Sample Disposal / NV10-83.

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 designated, isolated areas. Any sample that is known to be hazardous at the time of receipt or after completion of analysis is placed in one of two refrigerators designated for highly contaminated samples. Foreign and U. S. soils, requiring separate storage (as specified in SOP USDA Disposal / NV10-162) due to potential contamination with foreign organisms, are tagged with an orange sticker, and placed in specified locations. Foreign soils are heat-treated prior to disposal.

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). For sample shipments which include water/solid volatile organic analyses, a trip blank is enclosed when required by method specifications or state or regulatory programs. The chain-of-custody form is signed by the laboratory 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 are 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 Waste Disposal / NV10-83). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory removes or defaces sample labels prior to disposal, unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record (Figure 24-4) must be completed.

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes must be stored, managed, and disposed of in accordance with all federal and state laws and regulations. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to this document and SOP Waste Disposal / NV10-83.

Figure 24-1. **Example: Chain of Custody (COC)**

Nashville Division
2960 Foster Creighton
Nashville, TN 37204

Phone: 615-726-0177
Toll Free: 800-765-0980
Fax: 615-726-3404

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?

Compliance Monitoring? Yes____ No____

Enforcement Action? Yes____ No____

Client Name/Account #: _____

Address: _____

City/State/Zip: _____

Project Manager: _____

Telephone Number: _____ Fax No.: _____

Sampler Name: (Print) _____

Sampler Signature: _____

Site State: _____

PO#: _____

TA Quote #: _____

Project ID: _____

Project #: _____

							Preservative								Matrix						Analyze For:														RUSH TAT (Pre-Schedule)	Standard TAT	Fax Results	Send QC with report
Sample ID / Description	Date Sampled	Time Sampled	No. of Containers Shipped	Grab	Composite	Field Filtered	Ice	HNO_3 (Red Label)	HCl (Blue Label)	NaOH (Orange Label)	H_2SO_4 Plastic (Yellow Label)	H_2SO_4 Glass (Yellow Label)	None (Black Label)	Other (Specify)	Groundwater	Wastewater	Drinking Water	Sludge	Soil	Other (specify)																				

Special Instructions:

Method of Shipment: FEDEX

Laboratory Comments:
Temperature Upon Receipt:
VOCs Free of Headspace? Y N

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by TestAmerica:	Date	Time

Figure 24-2. **Example: Custody Seal**

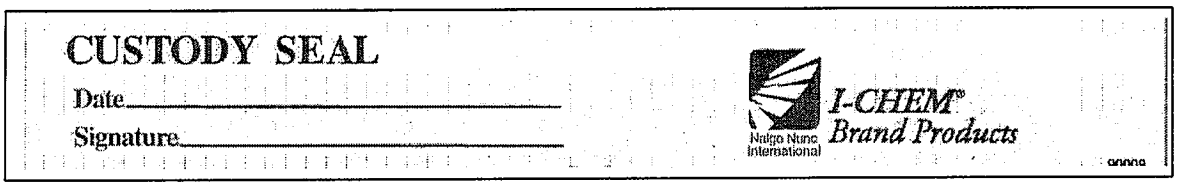


Figure 24-3. **Example: Internal Chain of Custody (COC)**

VOLATILES

Client ID	Lab Number
Influent	03-A114050
Midfluent	03-A114051
MID-BAC 1	03-A114052
MID-GAC 2	03-A114053
MID-GAC3	03-A114054
Effluent	03-A114055

Relinquished by	Received by	Reason	Date	Time

Figure 24-4. **Example: Sample Disposal Record**

Sample #	Shelf	Bottle	Day In	Day Out	Name	Disposed

Figure 24-5. **Cooler Receipt Form**

Cooler Received/Opened On_____

1. Tracking #_____(last 4 digits, FedEx)

Courier: _____ IR Gun ID_____

2. Temperature of rep. sample or temp blank when opened:_____*Degrees Celsius*

3. If Item #2 temperature is 0°C or less, was the representative sample or temp blank frozen? YES NO...NA

4. Were custody seals on outside of cooler? YES...NO...NA

If yes, how many and where:_____

5. Were the seals intact, signed, and dated correctly? YES...NO...NA

6. Were custody papers inside cooler? YES...NO...NA

I certify that I opened the cooler and answered questions 1-6 (intial) _____

7. Were custody seals on containers: YES NO and Intact YES...NO...NA

Were these signed and dated correctly? YES...NO...NA

8. Packing mat'l used? Bubblewrap Plastic bag Peanuts Vermiculite Foam Insert Paper Other None

9. Cooling process: Ice Ice-pack Ice (direct contact) Dry ice Other None

10. Did all containers arrive in good condition (unbroken)? YES...NO...NA

11. Were all container labels complete (#, date, signed, pres., etc)? YES...NO...NA

12. Did all container labels and tags agree with custody papers? YES...NO...NA

13a. Were VOA vials received? YES...NO...NA

b. Was there any observable headspace present in any VOA vial? YES...NO...NA

14. Was there a Trip Blank in this cooler? YES...NO...NA If multiple coolers, sequence #_____

I certify that I unloaded the cooler and answered questions 7-14 (intial) _____

15a. On pres'd bottles, did pH test strips suggest preservation reached the correct pH level? YES..NO..NA

b. Did the bottle labels indicate that the correct preservatives were used YES...NO...NA

If preservation in-house was needed, record standard ID of preservative used here_____

16. Was residual chlorine present? YES...NO...NA

I certify that I checked for chlorine and pH as per SOP and answered questions 15-16 (intial) _____

17. Were custody papers properly filled out (ink, signed, etc)? YES...NO...NA

18. Did you sign the custody papers in the appropriate place? YES...NO...NA

19. Were correct containers used for the analysis requested? YES...NO...NA

20. Was sufficient amount of sample sent in each container? YES...NO...NA

I certify that I entered this project into LIMS and answered questions 17-20 (intial) _____

I certify that I attached a label with the unique LIMS number to each container (intial) _____

21. Were there Non-Conformance issues at login? YES...NO Was a PIPE generated? YES...NO...#_____

SECTION 25

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.

- Evaluation criteria and corrective action for method blanks is defined in the specific standard operating procedure for each analysis.

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.

These blanks may be termed Initial Calibration Blanks (ICB) or Continuing Calibration Blanks (CCB).

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. Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.

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 and SOP Refrigerator and Freezer Holding Blanks for Volatile Sample Storage Units / NV08-224).

25.3.8 Field blanks, equipment blank and trip blanks, when received, are analyzed in the same manner as other field samples. Blanks are not knowingly 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 provides information to identify the different 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) (matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluate 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.

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, Teflon Chips, 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), an initial calibration verification standard is reported as the LCS, as long as the more stringent criteria is met.

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 The LCS is made from a different source from the calibration standard source.

25.4.1.5 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.).

25.4.1.6 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.

25.4.1.7 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory spikes all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in certain 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) are used to control the test method. The selected components of each spiking mix must represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory must also ensure that all reported components are used in the spike mixture within a two-year time period.

25.4.1.7.1 For methods that have 1-10 target analytes, spike all components.

25.4.1.7.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

25.4.1.7.3 For methods with more than 20 target analytes, spike at least 16 components.

25.4.1.7.4 Exception: Due to analyte incompatibility in pesticides, toxaphene and chlordane are only spiked at client request based on specific project needs.

25.4.1.7.5 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.

25.4.1.8 **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 that 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 spikes all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in certain 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) are used to control the test method. The selected components of each spiking mix must represent all chemistries, elution patterns and masses, permit-specified analytes and other client requested components. However, the laboratory must also 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 25.4.1.8 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 must be reported, with data qualifiers, to the client whose sample produced poor recovery. See specific method SOPs and Section 13 for the discussion of corrective actions.

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 When required in organic methods, 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). Consult the method-specific SOPs for details on the internal standard compounds, calculations and acceptance criteria.

25.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

25.6.1 As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits or regulatory mandated control limits. When this occurs, the regulatory or project limits 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 is to 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 are the results to all be from a similar matrix, but the spiking levels are also approximately the same (within a factor of 2). Similarly, the matrix spike and surrogate results must 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 avoids 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, leads 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 are discarded if they were the result of human or mechanical error or sample concentration exceeded spike level by > 4x. (Right clicking on the control chart and selecting View Data from the drop down menu allows viewing a table of all the charted points with any qualifiers. This assists in determining if any points are to be discarded prior to limit generation.)

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). The system defaults to collecting the previous three months' data. This time frame is shortened if there are more than 200 points since the system slows down tremendously. The time frame is extended if there are not 20-30 points].

25.6.3.1 Regardless of the calculated limit, the limit is no tighter than the Calibration Verification (ICV/CCV) (unless the analytical method specifies a tighter limit).

25.6.3.2 The lowest acceptable recovery limit is 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

25.6.3.3 The maximum acceptable recovery limit is 150%.

25.6.3.4 The maximum acceptable RPD limit is 50%. 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.

25.6.3.6 The QA department generates a Control Limits Manual that contains tables summarizing the precision and accuracy acceptability limits for analyses performed at TestAmerica Nashville. The Control Limits Manual is considered to be part of the QA Manual and therefore carries the same revision number as the current QA Manual. Letter suffixes are added to the revision number if it becomes necessary to update the Control Limits Manual during the course of the year prior to a QA manual update. This manual includes an effective date, is updated each time new limits are generated and is located in each analytical department and the QA office. Unless otherwise noted, limits within these tables are laboratory generated. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Director and QA Manager) and entered into the LIMS. The Quality Assurance department maintains an archive of all limits used within the laboratory, as described in SOP Archiving / NV08-194. Archived limits are available upon request.

25.6.3.7 Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

25.6.4 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 are 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 the analyte results are below the

reporting limit and the LCS is above the upper control limit. See specific method SOPs for complete discussion of acceptance criteria and corrective action.

25.6.5 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 13.

25.6.6 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. Dilutions or cleanup procedures may be required when obvious chromatographic interference is present. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). See specific method SOPs for a more detailed discussion of acceptance criteria and corrective action.

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. Once values are approved, they are distributed to the analysts, entered in LIMS analyte by analyte, and tabulated in the Control Limits Manual.

25.8 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

25.8.1 The laboratory has written and approved method SOPs 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

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 conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory must work with the client during project set up to develop an acceptable solution. 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 must 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 on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report must contain the following information:

26.2.1 A report title (e. g., Analytical Report for Samples) with a "sample results" column header.

26.2.2 Each report page printed on company letterhead which includes the laboratory name, address and telephone number.

26.2.3 A unique identification of the report (e. g., work order number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

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. Pages are automatically paginated by LIMS when the report is created.

26.2.4 A copy of the chain of custody (COC).

- Any COCs involved with subcontracting are included.

- There is a statement on the front of the report that says, "The Chain of Custody, X page(s), is included and is an integral part of this report." The number of pages of the CoC (X) is calculated automatically by the number of pages that are scanned in the CoC folder. Any pages scanned with the CoC (i. e., non-conformances, emails, etc.) are included in the page count.

- 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 (e. g., 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. The analysis time is always included on the report. The preparation date and time are included for those methods that require a separate preparation.

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 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 (included on the Cooler Receipt Form, which is part of the CoC).

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. For applying an

electronic signature, refer to the Electronic Signature Policy (Section 26.4) and the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002).

26.2.20 When NELAC accreditation is required, the lab certifies that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not. Accreditations/certifications are included near the end of the report, listed by method.

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 (e. g., partial report, draft report). A complete report must be sent once all of the work has been completed.

26.2.26 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica network subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

26.2.27 Reports for Ohio VAP work require a VAP affidavit be completed and included with the report.

26.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Nashville offers three 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 II is a report plus summary information, including results for the method blank reported to the laboratory MDL, 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. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. 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 Nashville offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), EXCEL, dBASE, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs are 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 ELECTRONIC REPORTING AND SIGNATURE POLICY

Following the lead of the Federal Paperwork Reduction Act, TestAmerica has implemented policies and procedures to help reduce paper usage. One of these procedures is to generate final reports and provide them to clients in pdf format.

Laboratory Director appointed representatives may approve final reports using an electronic signature that is applied to the report at the time of generation. This policy is prepared to state that the electronically applied signatures on TestAmerica Nashville reports are as legally binding as a handwritten "wet signature." This policy is intended to prevent the possibility of non-repudiation (denial that an individual signed the document) and to insure authenticity and security. In order to insure the electronic signatures are valid and unequivocally represent the identity of the signer, TestAmerica uses 21 CFR Part 11 "Electronic Records; Electronic Signatures" from the FDA as well as EPA's procurement policy (EPS 00-01) as guidance documents for this policy.

In order to ensure authenticity of the reports, the following conditions must be met:

26.4.1 Report Content

- State that the report was electronically signed.
- The printed name and title of the signer must be underneath the signature.
- The date and time when the signature was executed is represented in the "Report Issued" entry on the cover page of the report.
- The meaning of the signature: (e. g., reviewed and approved).

In order to insure the integrity of the signatures, the following security features have been implemented.

26.4.2 General Requirements

- The identity of the signatory must be verified before an electronic signature can be created for that person.
- Each electronic signature must be unique to a single individual and must not be reused by or assigned to another individual
- Persons using an electronic signature must certify that the electronic signatures in the system are intended to be the legally binding equivalent to their traditional handwritten signature. On this certification, the signatory states that their passwords are to remain completely confidential and can only be used by the genuine owner of the password and the sign-off does not take place until each page has been viewed.

26.4.3 Components and Controls

Two distinct identification components are utilized for each individual. The components are a) user name b) password. Each signing requires that the entry of the username and the password be reentered. The signatures are not copied, excised or transferred from the report by ordinary means.

The report is not changed once the signature has been applied and the pdf files are stored on the file server with security as well as password protected to ensure no changes are made to the file.

"pdf" reports must be backed up on a magnetic tape or other durable storage media (e. g., DVD) and maintained secure for up to 10 years.

26.5 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.

26.5.1 Numeric results with values outside of the calibration range, either high or low are qualified as "estimated."

26.5.2 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.

26.5.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

26.5.4 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 must determine if a response can be prepared. If so, the Laboratory Director designates the appropriate member of the management team to prepare a response. The response must 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, and a comment must be added suggesting that the client verify the opinion or interpretation with their regulator.

26.6 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If TestAmerica Nashville is not able to provide the client the requested analysis, the samples are 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.

26.7 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica must 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 must not be released.

Note: This does not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica does, 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.

26.7.1 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. If you are not the intended

recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify us immediately by telephone at the 1-800-765-0980 (or for e-mails: please notify us immediately by e-mail or by phone (1-800-765-0980) and delete this material from any computer).

26.8 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

26.9 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 retained on the Archive data server, as is the original report. When the pdf of a report is created, the pdf name has the work order number and the date and time that the pdf was created. The original report has the earliest date, and any revisions have later dates and times.

When the report is re-issued, a notation that the report has been revised is placed on the cover/signature page of the report along with a brief explanation of reason for the re-issue and a reference back to the last final report generated. For Example: *Report was revised on 11/3/07 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/07 at 10:47am.*

26.10 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

26.10.1 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 reanalyzes samples at a client's request with the following caveats.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within ±1 reporting limit for samples ≤ 5x the reporting limit, the original analysis is 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 investigates the discrepancy and reanalyzes 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 is typically charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Department Supervisor, Technical Director, QA Manager, or Laboratory Director if unsure.

26.10.2 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:

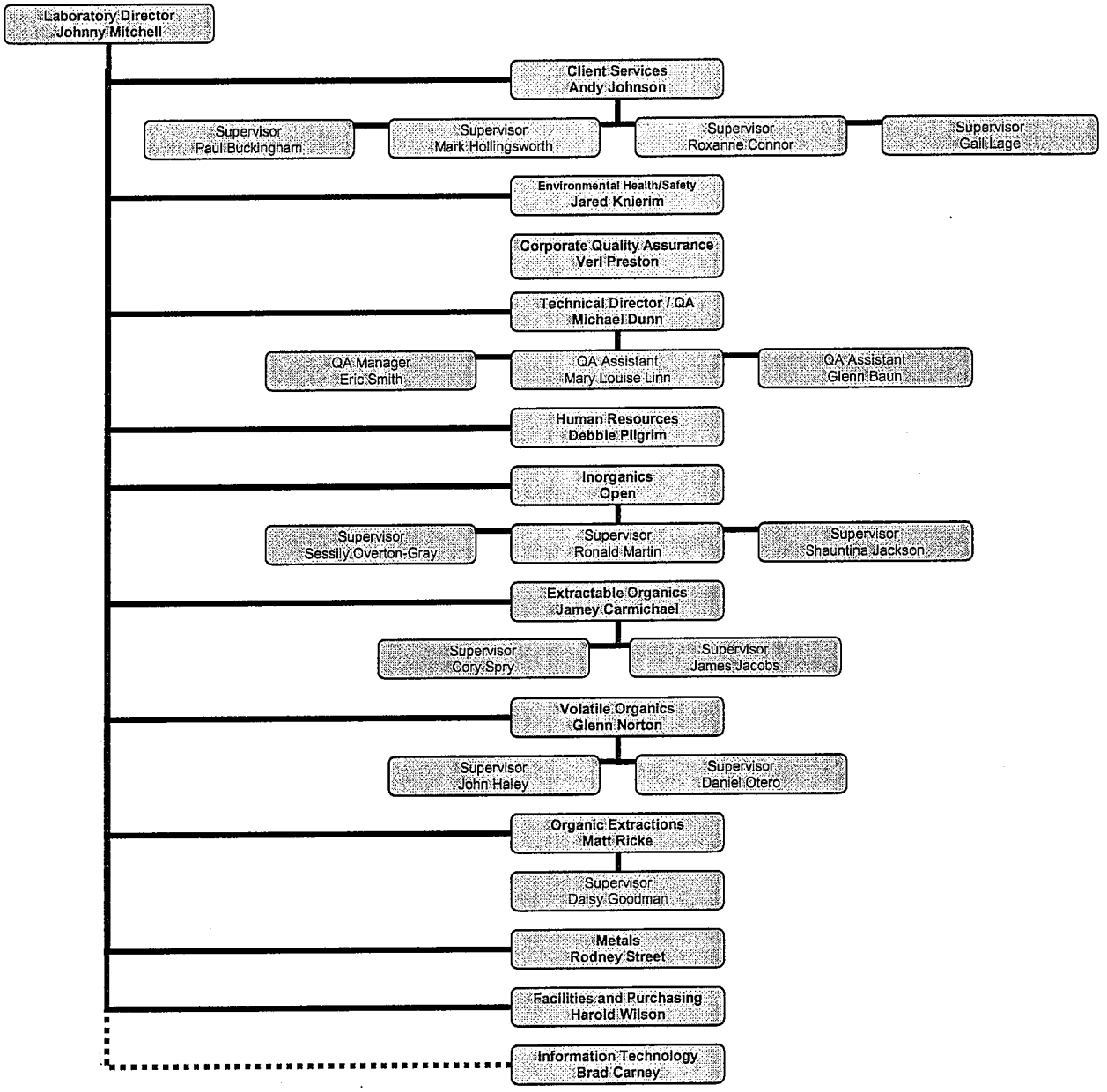
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e. g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- 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.

26.10.3 Multiple Reports

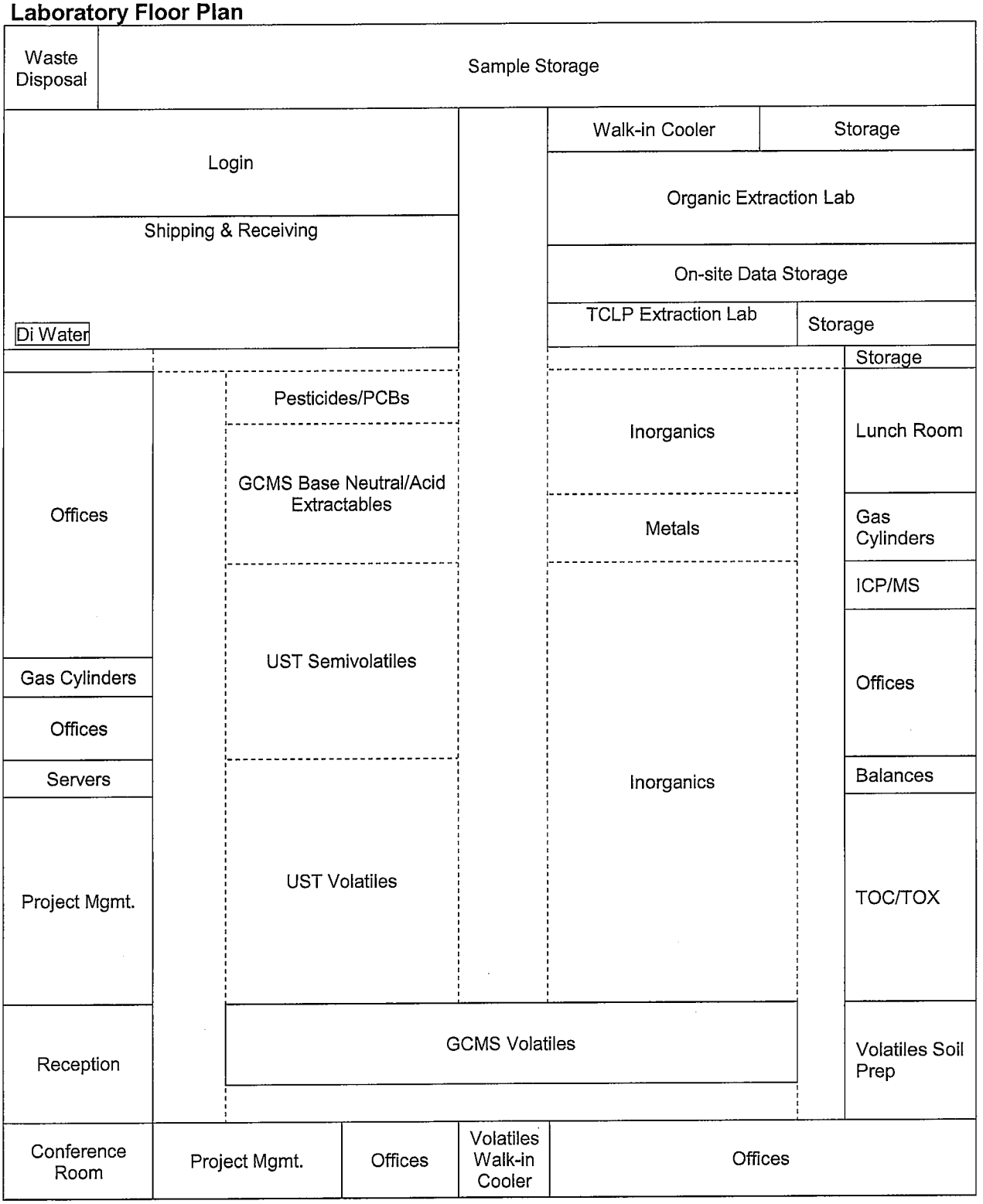
TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by the lab QA Manager.

(Reserved)

Laboratory Organization Chart



Laboratory Floor Plan



(Reserved)

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)

Aliquot
A measured portion of a sample used for analysis.

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)

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 must 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)

Continuing Calibration Blank:
solvent blank following CCV.

Continuing Calibration Verification: A standard from the calibration curve that is used to verify that the instrument remains properly calibrated throughout the analytical run.

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)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst is most frequently 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.

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)

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 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)

Initial Calibration Blank:
Solvent blank immediately following ICV.

Initial Calibration Verification:
A standard from a second source that is analyzed to verify the calibration curve.

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. 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 must 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 pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples are 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 generates 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.

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~~ are to 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 must 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 are 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) are to 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 is 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 are analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory documents their procedure to select the use of an appropriate type of duplicate. The selected sample(s) are to 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 are 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)

Method Reporting Limit:
The laboratory nominal Quantitation Limit (QL) or the level of sensitivity required by the client but not lower than the LOD.

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)

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)

Report Limit (RL):
The laboratory nominal Quantitation Limit (QL) or the level of sensitivity required by the client but not lower than the LOD.

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 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression generates 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 spikes all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in certain 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 are used to control the test method. The selected components of each spiking mix must represent all chemistries, elution patterns and masses permit specified analytes and other client requested components. However, the laboratory must also 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, but 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 is 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.

Acronyms:

BS – Blank Spike
BSD – Blank Spike Duplicate
CAR – Corrective Action Report
CCB – Continuing Calibration Blank

CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
CQMP – Corporate Quality Managemetn Plan
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
ICB – Initial Calibration Blank
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
MB – Method Blank
MDL – Method Detection Limit
MRL – Method Reporting 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
QL – Quantitation Limit
RF – Response Factor
RL – Report Limit
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

See Controlled Document QAF-45, TestAmerica Nashville Acronyms, Keywords, and Definitions.

Laboratory Certifications, Accreditations, Validations

TestAmerica Nashville 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:

Organization	Lab Number	Organization	Lab Number
A2LA	0453-07	Mississippi	none
AIHA	100790	Montana	none
Alabama	41150	Nevada	TN00032
Alaska	UST-087	New Hampshire (2nd NELAC)	2963
Arkansas	88-0737	New Jersey (2nd NELAC)	TN965
Arizona	AZ0473	New York (2nd NELAC)	11342
California	01168CA	North Carolina	387
Colorado	none	North Dakota	R-146
Connecticut	PH-0220	Oklahoma	9412
USACE	none	Oregon (2nd NELAC)	TN200001
Florida (1° NELAC)	E87358	Pennsylvania (2nd NELAC)	68-00585
Illinois (2nd NELAC)	200010	Rhode Island	LAO00268
Iowa	131	South Carolina	84009001, 002
Kansas (2nd NELAC)	E-10229	Tennessee	02008
Kentucky	90038	Texas (2nd NELAC)	T104704077
Kentucky UST	19	Utah (2nd NELAC)	6157260177
Louisiana Drinking H_2O	LA080021	Virginia	00323
Louisiana (2nd NELAC)	01945	Washington	C1712
Maryland	316	West Virginia	219
Massachusetts	M-TN032	Wisconsin	998020430
Minnesota	047-999-345	Wyoming UST	A2LA 0453-07

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 Nashville 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 must 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.

If the company decides 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 must 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.

Data Qualifiers

<	< [Custom Value]
>	> [Custom Value]
A-01	[Custom Value]
B	Analyte was detected in the associated Method Blank.
B1	Analyte was detected in the associated method blank. Analyte concentration in the sample is greater than 10x the concentration found in the method blank.
B7	Analyte detected in refrigerator/freezer holding blank. Reported value for this sample within 10x detected concentration in holding blank.
BCD	The contamination reported in the HPLC method blank for one detector was not confirmed by the other detector.
C	Calibration Verification recovery was above the method control limit for this analyte. Analyte not detected, data not impacted.
C1	Calibration Verification recovery was above the method control limit for this analyte, however the average % difference for all analytes met method criteria.
C2	Calibration Verification recovery was below the method control limit for this analyte, however the average % difference for all analytes met method criteria.
C4	Calibration Verification recovery was below the method control limit for this analyte.
C8	Calibration Verification recovery was above the method control limit for this analyte. A high bias may be indicated.
CF2	Confirmatory analysis was past holding time.
CF5	The sample was originally analyzed with a positive result, however the reanalysis did not confirm the presence of the analyte.
CF6	Results confirmed by reanalysis.
CF7	Result may be elevated due to carry over from previously analyzed sample.
CISP	The concentration indicated for this analyte is derived from a single point calibration.
CL1	Recovery for this analye was within Laboratory historical limits but outside contract required limits of 70-130 %.
CN4	Amenable cyanide results reported from total determination method.
CSTM	[Custom Value]
E	Concentration exceeds the calibration range and therefore result is semi-quantitative.
E1	Concentration estimated. Analyte exceeded calibration range. Reanalysis not possible due to insufficient sample remaining.
E3	Concentration estimated. Analyte exceeded calibration range. Reanalysis not peformed due to holding time requirements.
EPH%	[Custom Value] %RPD
H	Sample analysis performed past method-specified holding time.
H1	Sample analysis performed past the method-specified holding time per client's approval.
H10	The holding time calculation is based on a sampling time of 00:00 on the sampling date noted on the Chain of Custody. No sampling time was provided to the laboratory.
H2	Initial analysis within holding time. Reanalysis for the required dilution or confirmation was past holding time.
H3	Sample was received and analyzed past holding time.

H4	Sample was extracted past holding time, but analyzed within analysis holding time.
H8	The sample was extracted past the holding time.
HT2	Received out of 48 hour hold for 5035 preparation.
HT3	Sample received with insufficient holding time remaining for analysis to be performed within the method's holding time requirements.
HTI	The holding time for this test is immediate. The laboratory measurement, therefore, may not be suitable for compliance purposes.
I	Internal Standard recovery was outside of method limits. Matrix interference was confirmed by reanalysis.
ID2	Secondary ion abundances were outside method requirements. Identification based on analytical judgement.
IH1	Target analyte was detected in the method blank at or above the reporting limit. The background was subtracted from the QC samples and the client's sample(s).
IH10	Target analyte was not detected in the method blank at or above the reporting limit. The QC samples and client sample(s) were not blank corrected.
IH2	Target analyte was detected in the method blank at or above the reporting limit. The background was not subtracted from the client's sample(s).
IH3	Target analyte was detected in the client's field blank at or above the reporting limit. The background was subtracted from the client's sample(s).
IH4	Target analyte was detected in the client's field blank at or above the reporting limit. The background was not subtracted from the client's sample(s).
IH8	Target analyte was detected in the method blank below the reporting limit but above the MDL. The background was subtracted from the QC samples and the client's sample(s).
J	Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). Concentrations within this range are estimated.
K	The sample dilutions set-up for the BOD analysis did not meet the oxygen depletion criteria of at least 2 mg/l. Therefore the reported result is an estimated value only.
K1	The sample dilutions set up for the BOD analysis failed to meet the criteria of a residual dissolved oxygen of at least 1 mg/L. Therefore the reported result is an estimated value only.
K2	The seed depletion was outside the method acceptance limits. Therefore, the reported result is an estimated value only.
K3	The dilution water D.O. depletion was > 0.2 mg/L.
K4	The seed depletion was not within method recommended limits. The LCS, which is a means of checking dilution water quality and seed effectiveness, was within acceptance limits.
K5	Residual chlorine detected. Sample dechlorinated prior to analysis.
L	Laboratory Control Sample and/or Laboratory Control Sample Duplicate recovery was above the acceptance limits. Analyte not detected, data not impacted.
L1	Laboratory Control Sample and/or Laboratory Control Sample Duplicate recovery was above acceptance limits.
L2	Laboratory Control Sample and/or Laboratory Control Sample Duplicate recovery was below acceptance limits.
L4	Laboratory Control Sample and/or Laboratory Control Sample Duplicate recovery was below the acceptance limits. A low bias to sample results is indicated.
M1	The MS and/or MSD were above the acceptance limits due to sample matrix interference. See Blank Spike (LCS).

M10	Matrix Spike recovery was low. Data Reported per ADEQ policy 0154.000
M2	The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
M3	Results exceeded the linear range in the MS/MSD and therefore are not available for reporting. The batch was accepted based on acceptable recovery in the Blank Spike (LCS).
M4	The MS/MSD required a dilution due to matrix interference. Because of this dilution, the matrix spike concentrations in the sample were reduced to a level where the recovery calculation does not provide useful information. See Blank Spike (LCS).
M6	Any analyte not run due to matrix
M7	The MS and/or MSD were above the acceptance limits. See Blank Spike (LCS).
M8	The MS and/or MSD were below the acceptance limits. See Blank Spike (LCS).
M9	Matrix Spike recovery was high. Data Reported per ADEQ policy 0154.000
MCP	No results were reported for the MS and/or MSD due to a clogged autosampler port. Batch was accepted based on Blank Spike (LCS) recoveries.
MHA	Due to high levels of analyte in the sample, the MS/MSD calculation does not provide useful spike recovery information. See Blank Spike (LCS).
MNR	No results were reported for the MS/MSD. The sample used for the MS/MSD required dilution due to the sample matrix. Because of this, the spike compounds were diluted below the detection limit.
MNR1	There was no MS/MSD analyzed with this batch due to insufficient sample volume. See Blank Spike.
MNR3	Insufficient sample received to meet method QC requirements.
MNR4	Insufficient sample received to meet method QC requirements. Batch QC requirements satisfy ADEQ policies 0154.000 and 0155.000
N1	See case narrative.
N2	See corrective action report.
NO	No
NoRES	>100,000
P	The sample, as received, was not preserved in accordance to the referenced analytical method.
P1	Sample received and analyzed without chemical preservation.
P12	The method required trip blank was not provided along with this sample.
P2	Sample received without chemical preservation, but preserved by the laboratory.
P3	Sample was received above recommended temperature.
P4	Sample received in inappropriate sample container.
P6	Sample received unpreserved, however the sample was analyzed within 7 days per EPA recommendation.
P7	Sample filtered in lab.
P8	Sample unable to be adjusted to correct pH due to matrix.
P9	This analyte has been shown to degrade upon preservation with HCl and cannot accurately be quantitated.
pH	pH [Custom Value]
pH<1	pH<1
pH<2	pH<2
pH>12	pH>12
pH>13	pH>13

pH>2	pH>2
P-HS	Sample container contained headspace.
PV	Acid preservation was indicated on the sample vial. However, a pH of <2 was not obtained.
PX	Sample for VOA analysis not received in preserved VOA vials or Encore or similar sampling device.
Q2	The chromatographic pattern is consistent with diesel fuel.
Q3	The chromatographic pattern is not consistent with diesel fuel.
Q5	Results in the diesel organics range are primarily due to overlap from a gasoline range product.
QFL	Florisil clean-up (EPA 3620) performed on extract.
QGP	Gel Permeation (EPA 3640) clean-up performed on extract.
QP	Hydrocarbon result partly due to individual peak(s) in quantitation range.
QP1	The primary contamination elutes between [Custom Value], which is in the motor oil range.
QP2	The primary contamination elutes between [Custom Value], which is in the diesel fuel range.
QP3	The primary contamination elutes between [Custom Value], which is in the kerosene range.
QP4	The primary contamination elutes between [Custom Value], which is in the mineral spirits range.
QP5	There was insufficient contamination present to perform a pattern match.
QP6	The contamination did not match any standards in our library.
QP7	The contamination is similar to our [Custom Value] standard.
QSG	Silica Gel clean-up performed on extracts.
QSP	Sulfuric Acid / Permanganate (EPA3665) clean-up performed on extract.
QSU	Sulfur (EPA 3660) clean-up performed on extract.
QU	Unquantitated hydrocarbons present in the sample outside of the reported carbon range.
R	The RPD exceeded the method control limit. The individual analyte QA/QC recoveries, however, were within acceptance limits.
R1	The RPD between the primary and confirmatory analysis exceeded 40%. Per method 8000B, the higher value was reported.
R10	The RPD between the primary and confirmatory analysis exceeded 40%. Per method 8000B, the lower value was reported due to apparent chromatographic problems.
R12	The RPD between the primary and confirmatory analysis exceeded 40%. Per method 8000C, the lower value was reported.
R2	The RPD exceeded the acceptance limit.
R3	The RPD exceeded the acceptance limit due to sample matrix effects.
R4	Due to the low levels of analyte in the sample, the duplicate RPD calculation does not provide useful information.

R7	LCS/LCSD RPD exceeded the acceptance limit. Recovery met acceptance criteria.
R9	Sample RPD exceeded the laboratory control limit.
RL1	Reporting limit raised due to sample matrix effects.
RL4	Reporting limit raised due to insufficient sample volume.
S10	Insufficient sample available for reanalysis.
S12	Sample highly flammable and ignited upon contact.
S6	Sediment present.
S7	Sample breakthrough to 2nd section is > 10%. Results may be biased low.
SB	Sustained burning when exposed to open flame.
SPS	Percent solids result provided by the client.
SSV	Solvent volume not present on sample vial. The lab has assumed a 1:1 ratio.
STW	No tare weight present on sample vial. Result should be considered an estimated value.
T1	Method approved by EPA, but not yet licensed by ADHS.
T2	Cited ADHS licensed method does not contain this analyte as part of method compound list.
T4	The cited licensed method does not contain this analyte as part of the method compound list.
T5	Less than the prescribed sample amount was available to perform the leachate extraction. The volume of extraction fluid was adjusted proportionately based on the method prescribed ratio of extraction fluid to sample weight.
T6	The temperature during the 18 hour TCLP extraction exceeded the 21-25 degrees C range stated in EPA Method 1311. The temperature range during the extraction was [Custom Value] degrees C.
T7	Tentatively identified compound. Concentration is estimated based on the closest internal standard.
T8	The reported result cannot be used for compliance purposes.
TND	Compound not detected using TIC procedure. Quantitation is estimated based on closest Internal Standard. An assumption is made that the compound will purge or extract and respond chromatographically consistent with target compounds analyzed by this method.
YES	Yes
Z	Due to sample matrix effects, the surrogate recovery was below the acceptance limits.
Z1	Surrogate recovery was above acceptance limits.
Z10	Surrogate outside laboratory historical limits but within method guidelines. No effect on data.
Z11	Surrogate low but all targets within method criteria. No effect on data.
Z2	Surrogate recovery was above the acceptance limits. Data not impacted.
Z3	The sample required a dilution due to the nature of the sample matrix. Because of this dilution, the surrogate spike concentration in the sample was reduced to a level where the recovery calculation does not provide useful information.
Z5	Due to sample matrix effects, the surrogate recovery was outside acceptance limits. Secondary surrogate recovery was within the acceptance limits.
Z6	Surrogate recovery was below acceptance limits.

Z7	Surrogate recovery was high. Data reported per ADEQ policy 0154.000.
Z8	Surrogate recovery was low. Data reported per ADEQ policy 0154.000.
ZE	The EPH surrogate recovery was outside QC limits due to poor fractionation. Both fractions were evaluated for all EPH carbon ranges. The sample was non-detect at the reporting limit for all carbon ranges, so the data was accepted without further analysis.
ZX	Due to sample matrix effects, the surrogate recovery was outside the acceptance limits.

For Ohio VAP: The laboratory must implement corrective action procedures to resolve the deviation and limit qualification of the final results. The laboratory is not permitted to deviate from its VAP approved SOP if it intends to attest under affidavit that the "results" are VAP certified. When all corrective actions listed in the SOP have been exhausted, it may be necessary to use technical judgment in which case the decision process and rationale is presented in the final report and/or affidavit and the data will be noted as 'not VAP certified' on the affidavit.

Federal Appendix I - Constituents for Assessment Monitoring (40 CFR Part 258)

Appendix I Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
VOLATILES			
Acetone	67-64-1		8260B
Acrylonitrile	107-13-1		8260B
Benzene	71-43-2	0.005	8260B
Bromochloromethane; Chlorobromomethane	74-97-5		8260B
Bromodichloromethane; Dichlorobromomethane	75-27-4	**	8260B
Bromoform; Tribromomethane	75-25-5	**	8260B
Carbon disulfide	75-15-0		8260B
Carbon tetrachloride	56-23-5	0.005	8260B
Chlorobenzene	108-90-7	0.1	8260B
Chloroethane; Ethyl chloride	75-00-3		8260B
Chloroform; Trichloro-methane	67-66-3	**	8260B
Dibromochloromethane; Chlorodibromomethane	124-48-1	**	8260B
1,2-Dibromo-3-chloropro-pane; DBCP	96-12-8	0.0002	8011
1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4	0.00005	8011
o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1	0.6	8260B
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	0.075	8260B
trans-1,4-Dichloro-2-butene	110-57-6		8260B
1,1-Dichloroethane; Ethylidene chloride	75-34-3		8260B
1,2-Dichloroethane; Ethylene dichloride	107-06-2	0.005	8260B
1,1-Dichloroethylene; Vinylidene chloride; 1,1-Dichloroethene	75-35-4	0.007	8260B
cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2	0.07	8260B
trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5	0.1	8260B
1,2-Dichloropropane; Propylene dichloride	78-87-5	0.005	8260B
cis-1,3-Dichloropropene	10061-01-5		8260B
trans-1,3-Dichloropropene	10061-02-6		8260B
Ethylbenzene	100-41-4	0.7	8260B
2-Hexanone; Methyl butyl ketone	591-78-6		8260B
Methyl bromide; Bromomethane	74-83-9		8260B
Methyl chloride; Chloromethane	74-87-3		8260B
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3		8260B
Methyl iodide; Iodomethane	74-88-4		8260B
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1		8260B
Methylene chloride; Dichloromethane	75-09-2	0.005	8260B
Styrene	100-42-5	0.1	8260B
1,1,1,2-Tetrachloroethane	630-20-6		8260B
1,1,2,2-Tetrachloroethane	79-34-5		8260B
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	0.005	8260B
Toluene	108-88-3	1	8260B
1,1,1-Trichloroethane; Methyl chloroform	71-55-6	0.2	8260B
1,1,2-Trichloroethane	79-00-5	0.005	8260B
Trichloroethylene; Trichloroethene	79-01-6	0.005	8260B

Appendix I Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
Trichlorofluoromethane	75-69-4		8260B
1,2,3-Trichloropropane	96-18-4		8260B
Vinyl acetate	108-05-4		8260B
Vinyl chloride; Chloroethene	75-01-4	0.002	8260B
Xylene (total)	96-47-6, 108-38-3, 106-42-3, 1330-20-7.	10	8260B
METALS			
Antimony	7440-36-0	0.006	6010B
Arsenic	7440-38-2	0.05	6010B
Barium	7440-39-3	2.0	6010B
Beryllium	7440-41-7	0.004	6010B
Cadmium	7440-43-9	0.005	6010B
Chromium	7440-47-3	0.1	6010B
Cobalt	7440-48-4		6010B
Copper	7440-50-8	1	6010B
Lead	7439-92-1	0.015	6010B
Nickel	7440-02-0	0.1	6010B
Selenium	7782-49-2	0.05	6010B
Silver	7440-22-4	0.1	6010B
Thallium	7440-28-0	0.002	6010B
Vanadium	7440-62-2		6010B
Zinc	7440-66-6	5	6010B

Note: Depending upon the state, additional constituents may be required.

Federal Appendix II - Constituents for Assessment Monitoring (40 CFR Part 258)

Appendix II Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
VOLATILES			
Acetone	67-64-1		8260B
Acetonitrile; Methyl cyanide	75-05-8		8260B
Acrolein	107-02-8		8260B
Acrylonitrile	107-13-1		8260B
Allyl chloride	107-05-1		8260B
Benzene	71-43-2	0.005	8260B
Bromochloromethane; Chlorobromomethane	74-97-5		8260B
Bromodichloromethane; Dichlorobromomethane	75-27-4	**	8260B
Bromoform; Tribromomethane	75-25-5	**	8260B
Carbon disulfide	75-15-0		8260B
Carbon tetrachloride	56-23-5	0.005	8260B
Chlorobenzene	108-90-7	0.1	8260B
Chloroethane; Ethyl chloride	75-00-3		8260B
Chloroform; Trichlorome-thane	67-66-3	**	8260B
Chloroprene	126-99-8		8260B
Dibromochloromethane; Chlorodibromomethane	124-48-1	**	8260B
1,2-Dibromo-3-chloropro-pane; DBCP	96-12-8	0.0002	8011
1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4	0.00005	8011
o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1	0.6	8260B
m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1		8260B
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	0.075	8260B
trans-1,4-Dichloro-2-butene	110-57-6		8260B
Dichlorodifluoromethane	75-71-8		8260B
1,1-Dichloroethane; Ethylidene chloride	75-34-3		8260B
1,2-Dichloroethane; Ethylene dichloride	107-06-2	0.005	8260B
1,1-Dichloroethylene; Vinylidene chloride; 1,1-Dichloroethene	75-35-4	0.007	8260B
cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2	0.07	8260B
trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5	0.1	8260B
1,2-Dichloropropane; Propylene dichloride	78-87-5	0.005	8260B
1,3-Dichloropropane; Trimethylene dichloride	142-28-9		8260B
2,2-Dichloropropane; Isopropylidene chloride	594-20-7		8260B
1,1-Dichloropropene	563-58-6		8260B
cis-1,3-Dichloropropene	10061-01-5		8260B
trans-1,3-Dichloropropene	10061-02-6		8260B
Ethylbenzene	100-41-4	0.7	8260B
Ethyl methacrylate	97-63-2		8260B
2-Hexanone; Methyl butyl ketone	591-78-6		8260B
Isobutyl alcohol	78-83-1		8260B
Methacrylonitrile	126-98-7		8260B
Methyl bromide; Bromomethane	74-83-9		8260B
Methyl chloride; Chloromethane	74-87-3		8260B
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3		8260B
Methyl iodide; Iodomethane	74-88-4		8260B
Methyl methacrylate	80-62-6		8260B

Appendix II Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1		8260B
Methylene bromide; Dibromomethane	74-95-3		8260B
Methylene chloride; Dichloromethane	75-09-2	0.005	8260B
Propionitrile; Ethyl cyanide	107-12-0		8260B
Styrene	100-42-5	0.1	8260B
1,1,1,2-Tetrachloroethane	630-20-6		8260B
1,1,2,2-Tetrachloroethane	79-34-5		8260B
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	0.005	8260B
Toluene	108-88-3	1	8260B
1,1,1-Trichloroethane; Methyl chloroform	71-55-6	0.2	8260B
1,1,2-Trichloroethane	79-00-5	0.005	8260B
Trichloroethylene; Trichloroethene	79-01-6	0.005	8260B
Trichlorofluoromethane	75-69-4		8260B
1,2,3-Trichloropropane	96-18-4		8260B
Vinyl acetate	108-05-4		8260B
Vinyl chloride; Chloroethene	75-01-4	0.002	8260B
Xylene (total)	96-47-6, 108-38-3, 106-42-3, 1330-20-7.	10	8260B
SEMIVOLATILES			
Acenaphthene	83-32-9		8270C
Acenaphthylene	208-96-8		8270C
Acetophenone	98-86-2		8270C
2-Acetylaminofluorene; 2-AAF	53-96-3		8270C
4-Aminobiphenyl	92-67-1		8270C
Anthracene	120-12-7		8270C
Benzo[a]anthracene; Benzathracene	56-55-3		8270C
Benzo[b]fluoranthene	205-99-2		8270C
Benzo[k]fluoranthene	207-08-9		8270C
Benzo[ghi]perylene	191-24-2		8270C
Benzyl alcohol	100-51-6		8270C
Bis(2-chloroethoxy)methane	111-91-1		8270C
Bis(2-chloroethyl)ether; Dichloroethyl ether	111-44-4		8270C
Bis(2-chloroisopropyl)ether; Bis(2-chloro-1-methylethyl) ether; 2,2-Dichlorodiisopro-pyl ether; DCIP	108-60-1		8270C
Bis(2-ethylhexyl) phthalate	117-81-7	0.006	8270C
4-Bromophenyl phenyl ether	101-55-3		8270C
Butyl benzyl phthalate	85-68-7		8270C
p-Chloroaniline; 4-Chloro-aniline	106-47-8		8270C
Chlorobenzilate	510-15-6		8270C
p-Chloro-m-cresol; 4-Chloro-3-methylphenol	59-50-7		8270C
2-Chloronaphthalene	91-58-7		8270C
2-Chlorophenol	95-57-8		8270C
4-Chlorophenyl phenyl ether	7005-72-3		8270C
Chrysene	218-01-9		8270C
m-Cresol; 3-Methylphenol	108-39-4		8270C
o-Cresol; 2-Methylphenol	95-48-7		8270C

Appendix II Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
p-Cresol; 4-Methylphenol	106-44-5		8270C
Diallate	2303-16-4		8270C
Dibenz[a,h]anthracene	53-70-3		8270C
Dibenzofuran	132-64-9		8270C
Di-n-butyl phthalate	84-74-2		8270C
3,3'-Dichlorobenzidine	91-94-1		8270C
2,4-Dichlorophenol	120-83-2		8270C
2,6-Dichlorophenol	87-65-0		8270C
Diethyl phthalate	84-66-2		8270C
o,o-Diethyl-o-2-pyrazinyl phosphorothioate; Thionazin	297-97-2		8270C
Dimethoate	60-51-5		8270C
p-(Dimethylamino)azoben-zene	60-11-7		8270C
7,12-Dimethylbenz[a]an-thracene	57-97-6		8270C
3,3'-Dimethylbenzidine	119-93-7		8270C
2,4-Dimethylphenol	105-67-9		8270C
Dimethyl phthalate	131-11-3		8270C
m-Dinitrobenzene	99-65-0		8270C
4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol	534-52-1		8270C
2,4-Dinitrophenol	51-28-5		8270C
2,4-Dinitrotoluene	121-4-2		8270C
2,6-Dinitrotoluene	606-20-2		8270C
Di-n-octyl phthalate	117-84-0		8270C
Diphenylamine	122-39-4		8270C
Disulfoton	298-04-4		8270C
Ethyl methanesulfonate	62-50-0		8270C
Famphur	52-85-7		8270C
Fluoranthene	206-44-0		8270C
Fluorene	86-73-7		8270C
Hexachlorobenzene	118-74-1	0.001	8270C
Hexachlorobutadiene	87-68-3		8270C
Hexachlorocyclopentadiene	77-47-4	0.05	8270C
Hexachloroethane	67-72-1		8270C
Hexacloroproprene	1888-71-7		8270C
Indeno[1,2,3-cd]pyrene	193-39-5		8270C
Isodrin	465-73-6		8270C
Isophorone	78-59-1		8270C
Isosafrole	120-58-1		8270C
Kepone	143-50-0		8270C
Methapyrilene	91-80-5		8270C
3-Methylcholanthrene	56-49-5		8270C
Methyl methanesulfonate	66-27-3		8270C
2-Methylnaphthalene	91-57-6		8270C
Methyl parathion; Parathion methyl	298-00-0		8270C
Naphthalene	91-20-3		8270C
1,4-Naphthoquinone	130-15-4		8270C
1-Naphthylamine	134-32-7		8270C
2-Naphthylamine	91-59-8		8270C
o-Nitroaniline; 2-Nitroaniline	88-74-4		8270C

Appendix II Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
m-Nitroaniline;3-Nitroaniline	99-09-2		8270C
p-Nitroaniline; 4-Nitroaniline	100-01-6		8270C
Nitrobenzene	98-95-3		8270C
o-Nitrophenol; 2-Nitrophenol	88-75-5		8270C
p-Nitrophenol; 4-Nitrophenol	100-02-7		8270C
N-nitrosodi-n-butylamine	924-16-3		8270C
N-nitrosodiethylamine	55-18-5		8270C
N-nitrosodimethylamine	62-75-9		8270C
N-nitrosodiphenylamine	86-30-6		8270C
N-nitrosodipropylamine; Di-n-propyl-nitrosamine; N-nitroso-n-dipropylamine	621-64-7		8270C
N-nitrosomethylethylamine	1059-95-6		8270C
N-nitrosopiperidine	100-75-4		8270C
N-nitrosopyrrolidine	930-55-2		8270C
5-Nitro-o-toluidine	99-55-8		8270C
Parathion	56-38-2		8270C
Pentachlorobenzene	608-93-5		8270C
Pentachloronitrobenzene	82-68-8		8270C
Phenacetin	62-44-2		8270C
Phenanthrene	85-01-8		8270C
Phenol	108-95-2		8270C
p-Phenylenediamine	106-50-3		8270C
Phorate	298-02-2		8270C
Pronamide	23950-58-5		8270C
Pyrene	129-00-0		8270C
Safrole	94-59-7		8270C
1,2,4,5-Tetrachlorobenzene	95-94-3		8270C
2,3,4,6-Tetrachlorophenol	58-90-2		8270C
o-Toluidine	95-53-4		8270C
1,2,4-Trichlorobenzene	120-82-1		8270C
2,4,5-Trichlorophenol	95-95-4		8270C
2,4,6-Trichlorophenol	88-06-2		8270C
o,o,o-Triethyl phosphoro-thioate; Terbufos	126-68-1		8270C
sym-Trinitrobenzene; 1,3,5-Trinitrobenzene	99-35-4		8270C
Benzo[a]pyrene	50-32-8	0.0002	8310
ORGANOCHLORINE PESTICIDES/PCBs			
Aldrin	309-00-2		8081A
alpha-BHC; alpha-Benzene hexachloride	319-84-6		8081A
beta-BHC; beta-Benzene hexachloride	309-85-7		8081A
delta-BHC;delta-Benzene hexachloride	319-86-8		8081A
gamma-BHC; gamma-Benzene hexachloride; Lindane	58-89-9	0.0002	8081A
alpha-Chlordane	5103-71-9	0.002	8081A
gamma-Chlordane	5103-74-2	0.002	8081A
4,4'-DDD	72-54-8		8081A
4,4'-DDE	72-55-9		8081A
4,4'-DDT	50-29-3		8081A
Dieldrin	60-57-1		8081A
Endosulfan I	959-98-8		8081A

Appendix II Constituents	CAS Registry Number	Maximum Contaminant Level (mg/L)	RCRA Method
Endosulfan II	33213-65-9		8081A
Endosulfan sulfate	1031-07-8		8081A
Endrin	72-20-8	0.002	8081A
Endrin aldehyde	7421-93-4		8081A
Heptachlor	76-44-8	0.0004	8081A
Heptachlor epoxide	1024-57-3	0.0002	8081A
Methoxychlor	72-43-5	0.04	8081A
Toxaphene	8001-35-2	0.003	8081A
Polychlorinated biphenyls; PCBs; Aroclors	1336-36-3, 12674-11-2, 11104-28-2, 11141-16-5, 53469-21-9, 12672-29-6, 11097-69-1, 11096-82-5	0.0005	8082
HERBICIDES			
2,4-D; 2,4-Dichlorophenoxy-acetic acid	94-75-7	0.02	8151A
2,4,5-T; 2,4,5-Trichlorophen-oxyacetic acid	93-76-5		8151A
2,4,5-TP; 2,4,5-Trichloro-phenoxypropanoic acid; Silvex	93-72-1	0.05	8151A
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	88-85-7		8151A
Pentachlorophenol	87-86-5	0.001	8151A
METALS			
Antimony	7440-36-0	0.006	6010B
Arsenic	7440-38-2	0.05	6010B
Barium	7440-39-3	2.0	6010B
Beryllium	7440-41-7	0.004	6010B
Cadmium	7440-43-9	0.005	6010B
Chromium	7440-47-3	0.1	6010B
Cobalt	7440-48-4		6010B
Copper	7440-50-8	1	6010B
Lead	7439-92-1	0.015	6010B
Nickel	7440-02-0	0.1	6010B
Selenium	7782-49-2	0.05	6010B
Silver	7440-22-4	0.1	6010B
Thallium	7440-28-0	0.002	6010B
Tin	7440-31-5		6010B
Vanadium	7440-62-2		6010B
Zinc	7440-66-6	5	6010B
Mercury	7439-97-6	0.002	7470A
OTHER INORGANICS			
Cyanide	57-12-5	0.2 as Free	9012B
Sulfide	18496-25-8		9034

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Appendix IX Constituents	CAS Registry Number	RCRA Method
VOLATILES		
Acetone	67-64-1	8260B
Acetonitrile; Methyl cyanide	75-05-8	8260B
Acrolein	107-02-8	8260B
Acrylonitrile	107-13-1	8260B
Allyl chloride	107-05-1	8260B
Benzene	71-43-2	8260B
Bromodichloromethane; Dichlorobromomethane	75-27-4	8260B
Bromoform; Tribromomethane	75-25-5	8260B
Carbon disulfide	75-15-0	8260B
Carbon tetrachloride	56-23-5	8260B
Chlorobenzene	108-90-7	8260B
Chloroethane; Ethyl chloride	75-00-3	8260B
Chloroform; Trichloro-methane	67-66-3	8260B
Chloroprene	126-99-8	8260B
Dibromochloromethane; Chlorodibromomethane	124-48-1	8260B
1,2-Dibromo-3-chloropro-pane; DBCP	96-12-8	8011
1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4	8011
o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1	8260B
m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1	8260B
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	8260B
trans-1,4-Dichloro-2-butene	110-57-6	8260B
Dichlorodifluoromethane	75-71-8	8260B
1,1-Dichloroethane; Ethylidene chloride	75-34-3	8260B
1,2-Dichloroethane; Ethylene dichloride	107-06-2	8260B
1,1-Dichloroethylene; Vinylidene chloride; 1,1-Dichloroethene	75-35-4	8260B
cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2	8260B
trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5	8260B
1,2-Dichloropropane; Propylene dichloride	78-87-5	8260B
cis-1,3-Dichloropropene	10061-01-5	8260B
trans-1,3-Dichloropropene	10061-02-6	8260B
1,4-Dioxane	123-91-1	8260B
Ethylbenzene	100-41-4	8260B
Ethyl methacrylate	97-63-2	8260B
Hexachlorobutadiene	87-68-3	8260B
2-Hexanone; Methyl butyl ketone	591-78-6	8260B
Isobutyl alcohol	78-83-1	8260B
Methacrylonitrile	126-98-7	8260B
Methyl bromide; Bromomethane	74-83-9	8260B
Methyl chloride; Chloromethane	74-87-3	8260B
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3	8260B
Methyl iodide; Iodomethane	74-88-4	8260B
Methyl methacrylate	80-62-6	8260B
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	8260B
Methylene bromide; Dibromomethane	74-95-3	8260B

Appendix IX Constituents	CAS Registry Number	RCRA Method
Methylene chloride; Dichloromethane	75-09-2	8260B
Propionitrile; Ethyl cyanide	107-12-0	8260B
Styrene	100-42-5	8260B
1,1,1,2-Tetrachloroethane	630-20-6	8260B
1,1,2,2-Tetrachloroethane	79-34-5	8260B
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	8260B
Toluene	108-88-3	8260B
1,1,1-Trichloroethane; Methyl chloroform	71-55-6	8260B
1,1,2-Trichloroethane	79-00-5	8260B
Trichloroethylene; Trichloroethene	79-01-6	8260B
Trichlorofluoromethane	75-69-4	8260B
1,2,3-Trichloropropane	96-18-4	8260B
Vinyl acetate	108-05-4	8260B
Vinyl chloride; Chloroethene	75-01-4	8260B
Xylenes (total)	96-47-6, 108-38-3, 106-42-3, 1330-20-7.	8260B
SEMIVOLATILES		
Acenaphthene	83-32-9	8270C
Acenaphthylene	208-96-8	8270C
Acetophenone	98-86-2	8270C
2-Acetylaminofluorene; 2-AAF	53-96-3	8270C
4-Aminobiphenyl	92-67-1	8270C
Aniline	62-53-3	8270C
Anthracene	120-12-7	8270C
Aramite	140-57-8	8270C
Benzo(a)anthracene; Benzathracene	56-55-3	8270C
Benzo(a)pyrene	50-32-8	8270C
Benzo(b)fluoranthene	205-99-2	8270C
Benzo(k)fluoranthene	207-08-9	8270C
Benzo(ghi)perylene	191-24-2	8270C
Benzyl alcohol	100-51-6	8270C
Bis(2-chloroethoxy)methane	111-91-1	8270C
Bis(2-chloroethyl)ether; Dichloroethyl ether	111-44-4	8270C
Bis(2-chloro-1-methylethyl) ether; 2,2-Dichlorodiiso-propyl ether; DCIP	108-60-1	8270C
Bis(2-ethylhexyl) phthalate	117-81-7	8270C
4-Bromophenyl phenyl ether	101-55-3	8270C
Butyl benzyl phthalate	85-68-7	8270C
p-Chloroaniline; 4-Chloro-aniline	106-47-8	8270C
Chlorobenzilate	510-15-6	8270C
p-Chloro-m-cresol; 4-Chloro-3-methylphenol	59-50-7	8270C
2-Chloronaphthalene	91-58-7	8270C
2-Chlorophenol	95-57-8	8270C
4-Chlorophenyl phenyl ether	7005-72-3	8270C
Chrysene	218-01-9	8270C
m-Cresol; 3-Methylphenol	108-39-4	8270C

Appendix IX Constituents	CAS Registry Number	RCRA Method
o-Cresol; 2-Methylphenol	95-48-7	8270C
p-Cresol; 4-Methylphenol	106-44-5	8270C
Diallate	2303-16-4	8270C
Dibenz(a,h)anthracene	53-70-3	8270C
Dibenzofuran	132-64-9	8270C
Di-n-butyl phthalate	84-74-2	8270C
3,3'-Dichlorobenzidine	91-94-1	8270C
2,4-Dichlorophenol	120-83-2	8270C
2,6-Dichlorophenol	87-65-0	8270C
Diethyl phthalate	84-66-2	8270C
o,o-Diethyl-o-2-pyrazinyl phosphorothioate; Thionazine	297-97-2	8270C
Dimethoate	60-51-5	8270C
p-(Dimethylamino)azobenzene	60-11-7	8270C
7,12-Dimethylbenz(a)anthracene	57-97-6	8270C
3,3'-Dimethylbenzidine	119-93-7	8270C
2,4-Dimethylphenol	105-67-9	8270C
Dimethyl phthalate	131-11-3	8270C
a,a-Dimethylphenethylamine	122-09-8	8270C
m-Dinitrobenzene; 1,3-Dinitrobenzene	99-65-0	8270C
4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol	534-52-1	8270C
2,4-Dinitrophenol	51-28-5	8270C
2,4-Dinitrotoluene	121-4-2	8270C
2,6-Dinitrotoluene	606-20-2	8270C
Di-n-octyl phthalate	117-84-0	8270C
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	88-85-7	8270C
Diphenylamine	122-39-4	8270C
Disulfoton	298-04-4	8270C
Ethyl methanesulfonate	62-50-0	8270C
Famphur	52-85-7	8270C
Fluoranthene	206-44-0	8270C
Fluorene	86-73-7	8270C
Hexachlorobenzene	118-74-1	8270C
Hexachlorobutadiene	87-68-3	8270C
Hexachlorocyclopentadiene	77-47-4	8270C
Hexachloroethane	67-72-1	8270C
Hexachlorophene	70-30-4	8270C
Hexacloroproprene	1888-71-7	8270C
Indeno(1,2,3-cd)pyrene	193-39-5	8270C
Isodrin	465-73-6	8270C
Isophorone	78-59-1	8270C
Isosafrole	120-58-1	8270C
Kepone	143-50-0	8270C
Methapyrilene	91-80-5	8270C
3-Methylcholanthrene	56-49-5	8270C
Methyl methanesulfonate	66-27-3	8270C
2-Methylnaphthalene	91-57-6	8270C
Methyl parathion; Parathion methyl	298-00-0	8270C
Naphthalene	91-20-3	8270C

Appendix IX Constituents	CAS Registry Number	RCRA Method
1,4-Naphthoquinone	130-15-4	8270C
1-Naphthylamine	134-32-7	8270C
2-Naphthylamine	91-59-8	8270C
o-Nitroaniline; 2-Nitroaniline	88-74-4	8270C
m-Nitroaniline;3-Nitroaniline	99-09-2	8270C
p-Nitroaniline; 4-Nitroaniline	100-01-6	8270C
Nitrobenzene	98-95-3	8270C
5-Nitro-o-toluidine	99-55-8	8270C
o-Nitrophenol; 2-Nitrophenol	88-75-5	8270C
p-Nitrophenol; 4-Nitrophenol	100-02-7	8270C
4-Nitroquinoline 1-oxide	56-57-5	8270C
N-nitrosodi-n-butylamine	924-16-3	8270C
N-nitrosodiethylamine	55-18-5	8270C
N-nitrosodimethylamine	62-75-9	8270C
N-nitrosodiphenylamine	86-30-6	8270C
N-nitrosodipropylamine; Di-n-propyl-nitrosamine; N-nitroso-n-dipropylamine	621-64-7	8270C
N-nitrosomethylethylamine	1059-95-6	8270C
N-nitrosomorpholine	59-89-2	8270C
N-nitrosopiperidine	100-75-4	8270C
N-nitrosopyrrolidine	930-55-2	8270C
Parathion	56-38-2	8270C
Pentachlorobenzene	608-93-5	8270C
Pentachloroethane	76-01-7	8270C
Pentachloronitrobenzene	82-68-8	8270C
Pentachlorophenol	87-86-5	8270C
Phenacetin	62-44-2	8270C
Phenanthrene	85-01-8	8270C
Phenol	108-95-2	8270C
p-Phenylenediamine; 1,4-Phenylenediamine	106-50-3	8270C
Phorate	298-02-2	8270C
2-Picoline	109-06-8	8270C
Pronamide	23950-58-5	8270C
Pyrene	129-00-0	8270C
Pyridine	110-86-1	8270C
Safrole	94-59-7	8270C
1,2,4,5-Tetrachlorobenzene	95-94-3	8270C
2,3,4,6-Tetrachlorophenol	58-90-2	8270C
Tetraethylpyrophosphate, Sulfotep	3689-24-5	8270C
o-Toluidine	95-53-4	8270C
1,2,4-Trichlorobenzene	120-82-1	8270C
2,4,5-Trichlorophenol	95-95-4	8270C
2,4,6-Trichlorophenol	88-06-2	8270C
o,o,o-Triethyl phosphoro-thioate; Terbufos	126-68-1	8270C
sym-Trinitrobenzene; 1,3,5-Trinitrobenzene	99-35-4	8270C
ORGANOCHLORINE PESTICIDES/PCBs		
Aldrin	309-00-2	8081A
alpha-BHC; alpha-Benzene hexachloride	319-84-6	8081A

Appendix IX Constituents	CAS Registry Number	RCRA Method
beta-BHC; beta-Benzene hexachloride	309-85-7	8081A
delta-BHC;delta-Benzene hexachloride	319-86-8	8081A
gamma-BHC; gamma-Benzene hexachloride; Lindane	58-89-9	8081A
alpha-Chlordane	5103-71-9	8081A
gamma-Chlordane	5103-74-2	8081A
4,4'-DDD	72-54-8	8081A
4,4'-DDE	72-55-9	8081A
4,4'-DDT	50-29-3	8081A
Dieldrin	60-57-1	8081A
Endosulfan I	959-98-8	8081A
Endosulfan II	33213-65-9	8081A
Endosulfan sulfate	1031-07-8	8081A
Endrin	72-20-8	8081A
Endrin aldehyde	7421-93-4	8081A
Heptachlor	76-44-8	8081A
Heptachlor epoxide	1024-57-3	8081A
Methoxychlor	72-43-5	8081A
Toxaphene	8001-35-2	8081A
Polychlorinated biphenyls; PCBs; Aroclors	1336-36-3, 12674-11-2, 11104-28-2, 11141-16-5, 53469-21-9, 12672-29-6, 11097-69-1, 11096-82-5	8082
HERBICIDES		
2,4-D; 2,4-Dichlorophenoxy-acetic acid	94-75-7	8151A
2,4,5-T; 2,4,5-Trichlorophen-oxyacetic acid	93-76-5	8151A
2,4,5-TP; 2,4,5-Trichloro-phenoxypropanoic acid; Silvex	93-72-1	8151A
METALS		
Antimony	7440-36-0	6010B
Arsenic	7440-38-2	6010B
Barium	7440-39-3	6010B
Beryllium	7440-41-7	6010B
Cadmium	7440-43-9	6010B
Chromium	7440-47-3	6010B
Cobalt	7440-48-4	6010B
Copper	7440-50-8	6010B
Lead	7439-92-1	6010B
Nickel	7440-02-0	6010B
Selenium	7782-49-2	6010B
Silver	7440-22-4	6010B
Thallium	7440-28-0	6010B
Tin	7440-31-5	6010B
Vanadium	7440-62-2	6010B
Zinc	7440-66-6	6010B
Mercury	7439-97-6	7470A

Appendix IX Constituents	CAS Registry Number	RCRA Method
OTHER INORGANICS		
Cyanide	57-12-5	9012B
Sulfide	18496-25-8	9034
DIOXINS		
2,3,7,8-Tetrachlorodibenzo-o-dioxin	1746-01-6	8280A/ 8290
Polychlorinated dibenzo-furans; PCDFs	NA	8280A/ 8290
Polychlorinated dibenzo-p-dioxins; PCDDs	NA	8280A/ 8290

Federal Target Compound and Analyst List

TCL/TAL Constituents	CAS Registry Number	RCRA Method
VOLATILES		
Acetone	67-64-1	8260B
Benzene	71-43-2	8260B
Bromodichloromethane; Dichlorobromomethane	75-27-4	8260B
Bromoform; Tribromomethane	75-25-5	8260B
Carbon disulfide	75-15-0	8260B
Carbon tetrachloride	56-23-5	8260B
Chlorobenzene	108-90-7	8260B
Chloroethane; Ethyl chloride	75-00-3	8260B
Chloroform; Trichlorome-thane	67-66-3	8260B
Dibromochloromethane; Chlorodibromomethane	124-48-1	8260B
o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1	8260B
m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1	8260B
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	8260B
1,1-Dichloroethane; Ethylidene chloride	75-34-3	8260B
1,2-Dichloroethane; Ethylene dichloride	107-06-2	8260B
1,1-Dichloroethylene; Vinylidene chloride; 1,1-Dichloroethene	75-35-4	8260B
cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2	8260B
trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5	8260B
1,2-Dichloropropane; Propylene dichloride	78-87-5	8260B
cis-1,3-Dichloropropene	10061-01-5	8260B
trans-1,3-Dichloropropene	10061-02-6	8260B
Ethylbenzene	100-41-4	8260B
2-Hexanone; Methyl butyl ketone	591-78-6	8260B
Methyl bromide; Bromomethane	74-83-9	8260B
Methyl chloride; Chloromethane	74-87-3	8260B
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3	8260B
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	8260B
Methylene chloride; Dichloromethane	75-09-2	8260B
Styrene	100-42-5	8260B
1,1,2,2-Tetrachloroethane	79-34-5	8260B
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	8260B
Toluene	108-88-3	8260B
1,1,1-Trichloroethane; Methyl chloroform	71-55-6	8260B
1,1,2-Trichloroethane	79-00-5	8260B
Trichloroethylene; Trichloroethene	79-01-6	8260B
Vinyl chloride; Chloroethene	75-01-4	8260B
Xylene (total)	96-47-6, 108-38-3, 106-42-3, 1330-20-7.	8260B
SEMIVOLATILES		
Acenaphthene	83-32-9	8270C
Acenaphthylene	208-96-8	8270C
Anthracene	120-12-7	8270C
Benzo(a)anthracene; Benzathracene	56-55-3	8270C
Benzo(a)pyrene	50-32-8	8270C

TCL/TAL Constituents	CAS Registry Number	RCRA Method
Benzo(b)fluoranthene	205-99-2	8270C
Benzo(k)fluoranthene	207-08-9	8270C
Benzo(ghi)perylene	191-24-2	8270C
Bis(2-chloroethoxy)methane	111-91-1	8270C
Bis(2-chloroethyl)ether; Dichloroethyl ether	111-44-4	8270C
Bis(2-chloro-1-methylethyl) ether; 2,2-Dichlorodiisopropyl ether; DCIP; 2,2'-Oxybis(1-chloropropane)	108-60-1	8270C
Bis(2-ethylhexyl) phthalate	117-81-7	8270C
4-Bromophenyl phenyl ether	101-55-3	8270C
Butyl benzyl phthalate	85-68-7	8270C
Carbazole	86-74-8	8270C
p-Chloro-m-cresol; 4-Chloro-3-methylphenol	59-50-7	8270C
2-Chloronaphthalene	91-58-7	8270C
2-Chlorophenol	95-57-8	8270C
4-Chlorophenyl phenyl ether	7005-72-3	8270C
Chrysene	218-01-9	8270C
m-Cresol; 3-Methylphenol	108-39-4	8270C
o-Cresol; 2-Methylphenol	95-48-7	8270C
p-Cresol; 4-Methylphenol	106-44-5	8270C
Dibenz(a,h)anthracene	53-70-3	8270C
Dibenzofuran	132-64-9	8270C
Di-n-butyl phthalate	84-74-2	8270C
3,3'-Dichlorobenzidine	91-94-1	8270C
2,4-Dichlorophenol	120-83-2	8270C
Diethyl phthalate	84-66-2	8270C
2,4-Dimethylphenol	105-67-9	8270C
Dimethyl phthalate	131-11-3	8270C
4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol	534-52-1	8270C
2,4-Dinitrophenol	51-28-5	8270C
2,4-Dinitrotoluene	121-4-2	8270C
2,6-Dinitrotoluene	606-20-2	8270C
Di-n-octyl phthalate	117-84-0	8270C
Fluoranthene	206-44-0	8270C
Fluorene	86-73-7	8270C
Hexachlorobenzene	118-74-1	8270C
Hexachlorobutadiene	87-68-3	8270C
Hexachlorocyclopentadiene	77-47-4	8270C
Hexachloroethane	67-72-1	8270C
Indeno(1,2,3-cd)pyrene	193-39-5	8270C
Isophorone	78-59-1	8270C
2-Methylnaphthalene	91-57-6	8270C
Naphthalene	91-20-3	8270C
o-Nitroaniline; 2-Nitroaniline	88-74-4	8270C
m-Nitroaniline;3-Nitroaniline	99-09-2	8270C
p-Nitroaniline; 4-Nitroaniline	100-01-6	8270C
Nitrobenzene	98-95-3	8270C
o-Nitrophenol; 2-Nitrophenol	88-75-5	8270C
p-Nitrophenol; 4-Nitrophenol	100-02-7	8270C
N-nitrosodiphenylamine	86-30-6	8270C

TCL/TAL Constituents	CAS Registry Number	RCRA Method
N-nitrosodipropylamine; Di-n-propyl-nitrosamine; N-nitroso-n-dipropylamine	621-64-7	8270C
Pentachlorophenol	87-86-5	8270C
Phenanthrene	85-01-8	8270C
Phenol	108-95-2	8270C
Pyrene	129-00-0	8270C
1,2,4-Trichlorobenzene	120-82-1	8270C
2,4,5-Trichlorophenol	95-95-4	8270C
2,4,6-Trichlorophenol	88-06-2	8270C
ORGANOCHLORINE PESTICIDES/PCBs		
Aldrin	309-00-2	8081A
alpha-BHC; alpha-Benzene hexachloride	319-84-6	8081A
beta-BHC; beta-Benzene hexachloride	309-85-7	8081A
delta-BHC;delta-Benzene hexachloride	319-86-8	8081A
gamma-BHC; gamma-Benzene hexachloride; Lindane	58-89-9	8081A
alpha-Chlordane	5103-71-9	8081A
gamma-Chlordane	5103-74-2	8081A
4,4'-DDD	72-54-8	8081A
4,4'-DDE	72-55-9	8081A
4,4'-DDT	50-29-3	8081A
Dieldrin	60-57-1	8081A
Endosulfan I	959-98-8	8081A
Endosulfan II	33213-65-9	8081A
Endosulfan sulfate	1031-07-8	8081A
Endrin	72-20-8	8081A
Endrin aldehyde	7421-93-4	8081A
Endrin ketone	53494-70-5	8081A
Heptachlor	76-44-8	8081A
Heptachlor epoxide	1024-57-3	8081A
Methoxychlor	72-43-5	8081A
Toxaphene	8001-35-2	8081A
Polychlorinated biphenyls; PCBs; Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260	12674-11-2, 11104-28-2, 11141-16-5, 53469-21-9, 12672-29-6, 11097-69-1, 11096-82-5	8082
METALS		
Aluminum	7429-90-5	6010B
Antimony	7440-36-0	6010B
Arsenic	7440-38-2	6010B
Barium	7440-39-3	6010B
Beryllium	7440-41-7	6010B
Cadmium	7440-43-9	6010B
Calcium	7440-70-2	6010B
Chromium	7440-47-3	6010B
Cobalt	7440-48-4	6010B
Copper	7440-50-8	6010B

TCL/TAL Constituents	CAS Registry Number	RCRA Method
Iron	7439-89-6	6010B
Lead	7439-92-1	6010B
Magnesium	7439-95-4	6010B
Manganese	7436-96-5	6010B
Nickel	7440-02-0	6010B
Potassium	7440-09-7	6010B
Selenium	7782-49-2	6010B
Silver	7440-22-4	6010B
Sodium	7440-23-5	6010B
Thallium	7440-28-0	6010B
Vanadium	7440-62-2	6010B
Zinc	7440-66-6	6010B
Mercury	7439-97-6	7470A

Federal Priority Pollutant List

PPL Constituents	CAS Registry Number	CWA Method
VOLATILES		
Acrolein	107-02-8	624
Acrylonitrile	107-13-1	624
Benzene	71-43-2	624
Bromodichloromethane; Dichlorobromomethane	75-27-4	624
Bromoform; Tribromomethane	75-25-5	624
Carbon tetrachloride	56-23-5	624
Chlorobenzene	108-90-7	624
Chloroethane; Ethyl chloride	75-00-3	624
2-Chloroethyl vinyl ether	110-75-8	624
Chloroform; Trichloromethane	67-66-3	624
Dibromochloromethane; Chlorodibromomethane	124-48-1	624
o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1	624
m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1	624
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	624
1,1-Dichloroethane; Ethylidene chloride	75-34-3	624
1,2-Dichloroethane; Ethylene dichloride	107-06-2	624
1,1-Dichloroethylene; Vinylidene chloride; 1,1-Dichloroethene	75-35-4	624
trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5	624
1,2-Dichloropropane; Propylene dichloride	78-87-5	624
cis-1,3-Dichloropropene	10061-01-5	624
trans-1,3-Dichloropropene	10061-02-6	624
Ethylbenzene	100-41-4	624
Methyl bromide; Bromomethane	74-83-9	624
Methyl chloride; Chloromethane	74-87-3	624
Methylene chloride; Dichloromethane	75-09-2	624
1,1,2,2-Tetrachloroethane	79-34-5	624
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	624
Toluene	108-88-3	624
1,1,1-Trichloroethane; Methyl chloroform	71-55-6	624
1,1,2-Trichloroethane	79-00-5	624
Trichloroethylene; Trichloroethene	79-01-6	624
Vinyl chloride; Chloroethene	75-01-4	624
SEMIVOLATILES		
Acenaphthene	83-32-9	625
Acenaphthylene	208-96-8	625
Anthracene	120-12-7	625
Benzidine	92-87-5	625
Benzo(a)anthracene; Benzathracene	56-55-3	625
Benzo(a)pyrene	50-32-8	625
Benzo(b)fluoranthene	205-99-2	625
Benzo(k)fluoranthene	207-08-9	625
Benzo(ghi)perylene	191-24-2	625
Bis(2-chloroethoxy)methane	111-91-1	625
Bis(2-chloroethyl)ether; Dichloroethyl ether	111-44-4	625
Bis(2-chloro-1-methylethyl) ether; 2,2-Dichlorodiisopropyl ether; DCIP; 2,2'-Oxybis(1-chloropropane)	108-60-1	625

PPL Constituents	CAS Registry Number	CWA Method
Bis(2-ethylhexyl) phthalate	117-81-7	625
4-Bromophenyl phenyl ether	101-55-3	625
Butyl benzyl phthalate	85-68-7	625
p-Chloro-m-cresol; 4-Chloro-3-methylphenol	59-50-7	625
2-Chloronaphthalene	91-58-7	625
2-Chlorophenol	95-57-8	625
4-Chlorophenyl phenyl ether	7005-72-3	625
Chrysene	218-01-9	625
Dibenz(a,h)anthracene	53-70-3	625
Di-n-butyl phthalate	84-74-2	625
3,3'-Dichlorobenzidine	91-94-1	625
2,4-Dichlorophenol	120-83-2	625
Diethyl phthalate	84-66-2	625
2,4-Dimethylphenol	105-67-9	625
Dimethyl phthalate	131-11-3	625
4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol	534-52-1	625
2,4-Dinitrophenol	51-28-5	625
2,4-Dinitrotoluene	121-4-2	625
2,6-Dinitrotoluene	606-20-2	625
Di-n-octyl phthalate	117-84-0	625
1,2-Diphenylhydrazine	122-66-7	625
Fluoranthene	206-44-0	625
Fluorene	86-73-7	625
Hexachlorobenzene	118-74-1	625
Hexachlorobutadiene	87-68-3	625
Hexachlorocyclopentadiene	77-47-4	625
Hexachloroethane	67-72-1	625
Indeno(1,2,3-cd)pyrene	193-39-5	625
Isophorone	78-59-1	625
Naphthalene	91-20-3	625
Nitrobenzene	98-95-3	625
o-Nitrophenol; 2-Nitrophenol	88-75-5	625
p-Nitrophenol; 4-Nitrophenol	100-02-7	625
N-nitrosodimethylamine	62-75-9	625
N-nitrosodiphenylamine	86-30-6	625
N-nitrosodipropylamine; Di-n-propyl-nitrosamine; N-nitroso-n-dipropylamine	621-64-7	625
Pentachlorophenol	87-86-5	625
Phenanthrene	85-01-8	625
Phenol	108-95-2	625
Pyrene	129-00-0	625
1,2,4-Trichlorobenzene	120-82-1	625
2,4,6-Trichlorophenol	88-06-2	625
ORGANOCHLORINE PESTICIDES/PCBs		
Aldrin	309-00-2	608
alpha-BHC; alpha-Benzene hexachloride	319-84-6	608
beta-BHC; beta-Benzene hexachloride	309-85-7	608
delta-BHC;delta-Benzene hexachloride	319-86-8	608
gamma-BHC; gamma-Benzene hexachloride; Lindane	58-89-9	608

PPL Constituents	CAS Registry Number	CWA Method
alpha-Chlordane	5103-71-9	608
gamma-Chlordane	5103-74-2	608
4,4'-DDD	72-54-8	608
4,4'-DDE	72-55-9	608
4,4'-DDT	50-29-3	608
Dieldrin	60-57-1	608
Endosulfan I	959-98-8	608
Endosulfan II	33213-65-9	608
Endosulfan sulfate	1031-07-8	608
Endrin	72-20-8	608
Endrin aldehyde	7421-93-4	608
Endrin ketone	53494-70-5	608
Heptachlor	76-44-8	608
Heptachlor epoxide	1024-57-3	608
Methoxychlor	72-43-5	608
Toxaphene	8001-35-2	608
Polychlorinated biphenyls; PCBs; Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260	12674-11-2, 11104-28-2, 11141-16-5, 53469-21-9, 12672-29-6, 11097-69-1, 11096-82-5	608
METALS		
Antimony	7440-36-0	200.7
Arsenic	7440-38-2	200.7
Beryllium	7440-41-7	200.7
Cadmium	7440-43-9	200.7
Chromium	7440-47-3	200.7
Copper	7440-50-8	200.7
Lead	7439-92-1	200.7
Nickel	7440-02-0	200.7
Selenium	7782-49-2	200.7
Silver	7440-22-4	200.7
Thallium	7440-28-0	200.7
Zinc	7440-66-6	200.7
Mercury	7439-97-6	245.1
DIOXIN		
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	8280A/ 8290
MISCELLANEOUS		
Asbestos		
Cyanide	57-12-5	SM4500-CN C, E
Phenols	NA	420.1& 420.4

Industrial Hygiene Specific Information

A13.1 TestAmerica Nashville holds accreditation with the American Industrial Hygiene Association for metals, inorganic acids, and particulates analyses. The QA/QC systems and objectives described in this QA Manual are the same as those followed for analysis of industrial hygiene samples. The methods used are those currently approved by the U.S. OSHA and NIOSH, in particular from the NIOSH Manual of Analytical Methods.

A13.2 QUALITY ASSURANCE OBJECTIVES

ANALYTE	LCS ACCURACY %	Reporting Limit µg/FILTER or TUBE
Metals by NIOSH 7303		
Aluminum	80-120	1.25
Arsenic	80-120	1.25
Beryllium	80-120	1.25
Cadmium	80-120	1.25
Calcium	80-120	1.25
Chromium	80-120	2.50
Cobalt	80-120	1.25
Copper	80-120	1.25
Iron	80-120	1.25
Lead	80-120	1.25
Lithium	80-120	1.25
Magnesium	80-120	1.25
Manganese	80-120	1.25
Molybdenum	80-120	1.25
Nickel	80-120	1.25
Selenium	80-120	1.25
Silver	80-120	1.25
Sodium	80-120	1.25
Strontium	80-120	1.25
Thallium	80-120	1.25
Titanium	80-120	1.25
Vanadium	80-120	1.25
Zinc	80-120	12.5
Particulates by NIOSH 0500	NA	NA

NA: Not Applicable

A13.3 SAMPLE HOLDING TIMES AND MEDIA REQUIREMENTS

Parameter	Maximum Holding Time	Cool to 4°C	Sampling Media	Flow Rate, L/min	Maximum Volume, Liters
Metals	Indefinitely	No	MCE Filter Casssette	1-4	200-2000
Particulates	Indefinitely	No	PVC Filter Cassette with Preweighed Filter (Do not use matched-weight filters for paint sampling; use filters pre-weighed by the lab.)	1-2	7-133

A13.4 PROFICIENCY TESTING

A13.4.1 Proficiency testing is performed for each accredited AIHA Field of Testing (FoT). The laboratory participates in and follows all proficiency testing requirements, including frequency of testing, as outlined in current effective AIHA Policy Modules 3, 6A, and 6B.

A13.4.2 Where an AIHA PT program is available for a certified FoT, the laboratory participates in that program. For FoTs not covered by available AIHA supplied PT samples, the laboratory demonstrates competency annually for that FoT through the implementation of one of the following three alternatives outlined in AIHA Policies Module 6A, section 6A.3 and Module 6B, section 6B.3: a third party proficiency testing program, a round robin program between a minimum of 3 AIHA accredited laboratories within the TestAmerica network, or a comprehensive internal QC program.

A13.5 AMENDED REPORTS

A13.5.1 Amended AIHA reports contain the following statement in **bold print** in the comments section on the cover page of the amended report, in addition to the notation requirements in Section 26.9:

> "Supplement to Test Report" along with the WorkOrder number of the original report, the date of the original report, and the time the original report was generated.

A13.6 SUBCONTRACTING

A13.6.1 Unless directed otherwise by a client or regulatory agency, subcontracted work for Fields of Testing covered by the scope of accreditation of TestAmerica Nashville is performed by an AIHA accredited laboratory.

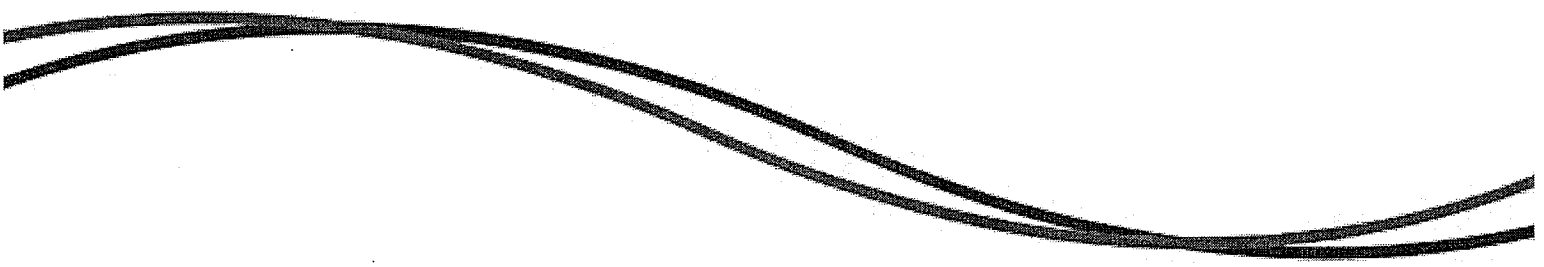
A13.7 TEST REPORTS

A13.7.1 For client projects containing only AIHA-certified parameters (NIOSH methods), "AIHA" is entered into the "Location" field in the Element project set-up screen. If the client's project includes other non-NIOSH methods, the state of origin is entered into the "Location" field to ensure proper reporting per AIHA requirements.

A13.8 Control Limit generation for Duplicate QC data The Taylor* approach is used to generate control limits for Duplicate QC data for NIOSH methods. This is a root-mean-square approach, where the root-mean-square sum of the RPD value is derived and that value is then used as a standard deviation. 2x and 3x that value are plotted as warning and control limits.

*Taylor, John K., Quality Assurance of Chemical Measurement, pp. 22-23, Lewis Publishers, Chelsea, MI 1987.

End of Document



Company Confidential & Proprietary

APPENDIX B

Field Standard Operating Procedures

WELL DEVELOPMENT STANDARD OPERATING PROCEDURE

This procedure is for the development of groundwater monitoring wells that have been installed in overburden or bedrock interface formations. Before a newly constructed well can be used for water-quality sampling, measuring water levels, or aquifer testing, it must be developed. Well development refers to the procedure used to clear the well and formation around the screen of fine-grained materials (sands, silts, and clays) produced during drilling or naturally occurring in the formation.

Well development is completed to remove fine-grained materials from the well but in such a manner as to not introduce fines from the formation into the sand pack. Well development continues until the well responds to water level changes in the formation (i.e., a good hydraulic connection is established between the well and formation) and the well produces clear, sediment-free water to the extent practical.

After 24 hours following installation of the filter pack and annular seal, each newly installed well will be developed by a combination of mechanical surging and over-pumping using bailers, inertial pumps with surge blocks, or mechanical submersible pumps. The well development procedures presented below are the recommended standards. However, due to variations in conditions, changes in these well development standards may be necessary in order to facilitate the successful completion of developing the monitoring well.

Procedure:

1. Don appropriate safety equipment.
2. Attach appropriate pump and lower tubing into well.
3. Turn on pump. Groundwater will be removed until a minimum of one times the volume of water added during drilling or well installation activities has be removed, if feasible.
4. Surging will be performed by raising and lowering the pump in the well to open and close the check valve in the pump several times to pull fine-grained material from the well.
5. Collect the groundwater sample in a glass jar to determine relative turbidity, and measure and record the temperature, pH, and specific electrical conductance.
6. The fourth and fifth steps will be repeated until groundwater is relatively silt-free; no further change is noted; and the temperature, pH, and specific conductance readings have stabilized to within 10 percent for three consecutive readings at regular volume intervals (e.g., 1-gallon intervals) or until six additional well volumes have been removed, whichever occurs first. If possible, a turbidity less than 50 nephelometric turbidity units (NTUs) will be obtained in addition to the achievement of stable analytical parameters..
7. The developing equipment will be raised two feet and then Steps 4 and 5 will be repeated.
8. Step 6 will be repeated until entire well screen has been developed.
9. If the well purges dry before meeting well development criteria, the well will be developed by bailing it dry a minimum of two times over a period of 48 hours.

GROUNDWATER SAMPLE COLLECTION STANDARD OPERATING PROCEDURE

The following describes two techniques for groundwater sampling: "Low Stress/Low Flow Methods" and "Bailers".

"Low Stress/Low Flow" methods are preferred and will be employed when it is critical to collect groundwater samples where sediment/colloid presence is significant, particularly in fine-grained formations. Analyses typically sensitive to turbidity/sediment issues are Polychlorinated biphenyls (PCBs), Semi-volatile compounds (SVOCs) and metals.

The "Bailer" method may be employed if low-flow cannot be used for location-specific reasons or where the collection of parameters less sensitive to turbidity/sediment issues are being collected (volatile organics - VOCs, and general chemistry).

> *NOTE: If Non-aqueous phase liquids (NAPL) (light or dense) are detected in a monitoring well, groundwater sample collection will not be conducted and the Project Manager must be contacted to determine a course of action.*

Preparation:

- Verify well identification and location using borehole log details and location layout figures. Note the condition of the well and inform the Project Coordinator of any necessary repair work required.
- Prior to opening the well cap, measure the breathing space above the well casing with a PID to establish baseline levels. Repeat this measurement once the well cap is opened. If either of these measurements exceeds the air quality criteria in the health and safety plan, field personnel should adjust their PPE accordingly.
- Prior to commencing the groundwater purging/sampling tasks, a water level must be obtained to determine the well volume for hydraulic purposes. In some settings it maybe necessary to allow the water level time to equilibrate. This condition exists if a watertight seal exists at the well cap and the water level has fluctuated above the top of screen; creating a vacuum or pressurized area in this air space. Three water level checks will verify static water level conditions or changing conditions.
- Calculate the water volume in the well. Typically overburden well volumes consider only the quantity of water standing in the well screen and riser.
- Estimate natural groundwater flow rate into well to determine the approximate pumping rate for purging/sampling activities.

Low Flow Method:

- The preferred method for groundwater sampling will be the low stress/low flow method described below.
- Bladder pumps/submersible variable rate pumps (i.e., Grundfos™ Rediflo or equivalent) are typically employed.

- Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified by the project requirements. The pump intake must be at the mid-point of the well screen to prevent disturbance and resuspension of any sediment in the screen base.
- Before starting the pump, measure the water level again with the pump in the well leaving the water level measuring device in the well when completed.
- Purge the well at a target of 100 milliliters per minute (ml/min) to minimize groundwater drawdown and will not exceed 500 ml/min. During purging, the water level should be monitored approximately every 5 minutes, or as appropriate. A steady flow rate should be maintained that results in drawdown of 0.3 feet or less. The rate of pumping should not exceed the natural flow rate conditions of the well being sampled. Care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record adjustments made to the pumping rates and water levels immediately after each adjustment.
- During the purging of the well, monitor and record the field indicator parameters (pH, temperature, conductivity, oxidation-reduction (redox) reaction potential (ORP), dissolved oxygen (DO), and turbidity) approximately every five minutes. Development will continue until the temperature, pH, and specific conductance of the purged well has stabilized. Stabilization is achieved when three consecutive readings for each parameter are within 10 percent of each other. Groundwater sample collection may proceed if groundwater stabilization has not occurred after the removal of six well volumes or as determined and documented by Field Staff.
- The pump must not be removed from the well between purging and sampling.

Bailers

- Using a disposable high density polyethylene (HDPE) bailer, slowly lower the bailer into the well and raise it from the well with disposable polypropylene cord to minimize disturbance of sediment in the well and prevent splashing. Bailers and cord will be dedicated to each well to prevent cross-contamination. Contact between the bailer and cord and the ground or unclean surfaces will be prevented.
- Purged groundwater will be poured out of the top of the bailer into a graduated 5-gallon bucket, or equivalent, to measure volume. Wells will be purged until three well volumes have been removed or until dryness.
- If a well is purged dry, groundwater samples will be collected after the water level returns to 80 percent of the original level before purging, or after 48 hours, whichever occurs first.
- Water samples will be collected into laboratory-supplied containers by connecting a dedicated bailer sampling attachment to the check valve end of the bailer. The attachment provides a slow and steady stream of water to reduce volatilization of VOCs.
- Field parameters (temperature, pH, specific conductance, ORP, and DO) will be measured following sample collection.
- The bailers and cords will be disposed following sample collection, as described in the QAPP Section 6.2.13.

GROUNDWATER SAMPLE COLLECTION STANDARD OPERATING PROCEDURE

Sampling Techniques

- If an alternate pump is utilized, the first pump discharge volumes should be discarded to allow the equipment a period of acclimation to the groundwater.
- If using a bailer, water samples will be collected by connecting a dedicated bailer sampling attachment to the check valve end of the bailer.
- Samples are typically collected directly from the pump or bailer with the groundwater being discharged directly into the appropriate sample container. Avoid handling the interior of the bottle or bottle cap and don new gloves for each well sampled to avoid contamination of the sample.
- Order of sample collection:
  - Volatile organic compounds
  - Semi-volatile organic compounds
  - Polychlorinated biphenyls
  - Metals
- For low stress/low flow sampling, samples should be collected at a flow rate between 100 and 500 mL/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 feet.
- The pumping rate used to collect a sample for VOCs should not exceed 100 mL/min. Samples should be transferred directly to the final container 40 mL glass vials completely full and topped with a teflon cap. Once capped the vial must be inverted and tapped to check for headspace/air presence (bubbles). If air is present the sample vial will be discarded, and re-collected until free of air.
- Sample labels/sample identification
- All samples must be labeled with:
  - A unique sample number
  - Date and time
  - Parameters to be analyzed
  - Project Reference ID
  - Samplers initials
- Labels should be secured to the bottle and should be written in indelible inks.

Field Notes

- Field notes must document all the events, equipment used, and measurements collected during the sampling activities. The log book should document the following for each well sampled:
  - Identification of well
  - Well depth

- Static water level depth and measurement technique
- Sounded well depth
- Presence of immiscible layers and detection/collection method
- Well yield – high or low
- Purge volume and pumping rate
- Time well purged
- Measured field parameters
- Purge/sampling device used
- Well sampling sequence
- Sampling appearance
- Sample odors
- Sample volume
- Types of sample containers and sample identification
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and method(s)
- Sample distribution and transporter
- Laboratory shipped to
- Chain of custody number for shipment to laboratory
- Field observations on sampling event
- Name collector(s)
- Climatic conditions including air temperature
- Problems encountered and any deviations made from the established sampling protocol.

EXPLORATORY TEST PITS STANDARD OPERATING PROCEDURE

Exploratory test pits are important sources of subsurface information relating to geologic conditions and environmental site assessment. Test pit excavation programs are regularly used for:

- surficial geological mapping activities including routine soil identification and sampling,
- delineating overburden thickness in areas of shallow bedrock,
- determining the extent of potentially contaminated zones, and
- exposing existing underground structures or buried objects for detailed documentation or as a means to establish the soil profile.

Proposed test pit locations and depths may be modified throughout the execution of the excavation program as the accumulated geologic data and test results are interpreted. For this reason it is essential that all records are maintained current and complete and that uncertainties are identified for resolution as they occur. Field staff members are responsible for maintaining communication with the project manager and for logistical coordination of the field effort within the Revised Workplan scope and budgetary limits.

Test pit excavation programs are by nature more destructive than other subsurface exploration methods. Field staff should be extremely clear as to the expectations of the client and project manager with regard to site damage and restoration efforts, prior to conducting the test pits.

Test Pit Excavations

Test pits will be excavated using a 300 Series excavator (or equivalent equipment sufficient to meet the total depth requirements) at the proposed locations shown on Figure 6 of the Revised Site Investigation Workplan, August 2011. The total depth of the test pits will be approximately 3 to 5 feet into native soil (assumed to be as deep as approximately 15 to 20 bgs feet in some locations) unless the capability of the excavator is exceeded by depth or obstructions. Excavation width will be between 3 to 5 feet (approximate width of excavator bucket) and anticipated pit length will be approximately 15 feet.

Spoils from the test pits will be collected on polyethylene sheeting and the open excavation and spoils will be photographed. Test pits will be inspected for buried drums and debris and conditions within the pit will be evaluated. As discussed further under Environmental Sampling and Monitoring, soil sample locations within the pit will be selected based on field screening, visual and olfactory conditions, total depth, and stratigraphy.

If intact drums are encountered during excavating, these will be left in place for future remediation with the exception as noted below under Drum Remnants. Observations and locations of drum remnants, intact drums (rusted, perforated, etc.), or other significant findings (e.g., condition of containers, layers of colored fill material, etc.) will be documented in the field logbook with clear location identification in the event that removal is required in the future. In the event of rain, spoils collected on polyethylene sheeting will be covered with visqueen and straw berms will be erected around the spoils pile to limit potential for surface runoff. These materials will be readily available onsite to accommodate potential weather conditions. Spoils will be returned to the excavation within the same working day that they are excavated.

Due to safety concerns, work area access concerns, and surface water runoff concerns, test pits will be backfilled immediately after sampling is complete. No test pit excavations will remain open overnight.

EXPLORATORY TEST PITS STANDARD OPERATING PROCEDURE

Test Pit Logging and Monitoring

Test pit logging standards require thorough documentation and qualification of all natural and man-made materials and structures encountered. This includes detailed descriptions of any fill materials, overburden soils, bedrock, groundwater, contamination and structures encountered including accurate measurements of the depth and extent of each.

Test pits will be logged and photographed to document the nature of the material/soil within the test pit, identify soil/backfill horizons, and other observations such as water level (if encountered), PID readings, visual staining, and stratification. Dimensions (length, width, and depth) of each test pit will be measured and recorded in a field logbook and shown on the Environmental Test Pit Log (template provided in Appendix C of the Revised Workplan). Sample locations within the test pit will also be graphically shown on the Environmental Test Pit Log. The naming scheme for newly excavated test pits will be TP-1001, TP-1002, etc.

Fill materials and overburden soils will be described as encountered. While the bedrock may not be penetrated to a great extent in a test pit, if encountered, effort will be made to qualify the competency of the bedrock through excavation rates and to describe the bedrock hardness, type, weathering and fracturing. Stratigraphic contacts between separate geologic units are drawn with a solid line while variations in texture, density, weathering or color occurring within a unit are distinguished with a dashed line.

Careful observation and documentation will be made of the location and rates of groundwater inflow within a test pit which may help to make the distinction between perched groundwater and the water table. The seasonal high water level may be discernible through mottling or oxidation.

Man-made objects will be documented in detailed scale drawings shown in plan and elevation perspective. Every effort should be made to properly identify the type of object encountered based upon construction, geometry and any other observation. Qualification must be made wherever possible to document the condition of the object encountered as well.

Environmental Monitoring and Sampling

Environmental sampling combined with discrete field screening of soil for contaminants will be conducted during the performance of test pit explorations. If deemed necessary by field conditions during excavation, continuous monitoring of air quality within the work zone may also be conducted to address H&S concerns.

Environmental Monitoring: Documentation of volatile organic compounds (VOC) in the soil through headspace screening is required in order to provide real-time guidance in the field to direct the sampling. Additional soil from each sample location will be collected and placed in a Whirl-Pak® bag, or equivalent for VOC field screening, as described in Section 6.2.3 of the QAPP. Particular attention is given to discoloration or odors noted, however, it is company policy to avoid fumes and odors at all times.

Environmental Soil Sampling: Environmental soil samples obtained for chemical analyses from within the test pits will be determined with special attention given to the rationale behind determining the precise zone to sample. One to three soil samples will be collected from each test

pit with sample locations determined by field conditions such as: total depth, stratigraphy, olfactory and visual observations (i.e., staining, drum remnants, etc.), and PID readings.

Samples will be collected from soils brought to the surface in the bucket of the excavator. Soil samples will be placed, not forced, into appropriate sample containers as outlined by the chemical analytical methods. Soils collected from a discrete zone should be homogenized and a representative portion placed into appropriate laboratory-supplied containers as specified in Table A-V of the QAPP. Samples will be packaged and shipped to the analytical laboratory for analysis of VOCs, SVOCs, PCBs, and metals as documented in Table I of the Revised Site Investigation Workplan, August 2011, and further discussed in Section 6.4 of the QAPP. The sample jars will be placed in coolers with ice to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory. Sample collection, sample handling, and sample preservation will be performed in accordance with Section 6.3 of the QAPP.

Samples collected from within the test pits will use the following example naming conventions: TP-1001-SO-001 (soil sample #1 from within test pit TP-1001) and TP-1001-GW-001 (groundwater sample #1 from within test pit TP-1001). Duplicate samples will follow the same naming convention with a unique sample number such that they are submitted blind to the laboratory (i.e., the laboratory cannot tell that the sample is a field duplicate); notes will be kept in the field log book and/or sampling record to identify which samples are primary and field duplicate pairs.

Environmental Water Sampling: Sampling of groundwater encountered in test pits must be carefully considered relative to Site specific conditions and potential impacts resulting from the excavation equipment and activity. Visual or olfactory evidence of groundwater contamination should be carefully detailed in order to help direct potential subsequent groundwater sampling through acceptable means.

If groundwater is encountered within a test pit, this may be one selection criteria used for selecting sample locations within the pit. Conditions within the pit will be evaluated and if sampling is deemed appropriate, a grab water sample using a stainless steel sample cup mounted on a telescoping pole and a grab soil sample from above the water table may be collected. Samples will be submitted to TestAmerica for analysis of VOCs, SVOCs, PCBs, and metals (Table I of Revised Workplan). Water and soil samples will be placed in coolers with ice to cool the samples to a temperature of 4 degrees Celsius (°C) plus or minus (±) 2°C until received by the laboratory.

Drum Remnants

The intent of the test pit exploration activities is to characterize soil and identify the nature of anomalous areas and buried objects within the Site boundaries. If drums and/or drum remnants are uncovered in a test pit, they will be inspected by field staff from the ground surface or by bringing the drum to the surface using the excavator (if the drum conditions appear structurally sufficient). For safety reasons, no work will be conducted from within the excavations.

Drum and/or drum remnant inspection will consist of the following:

- Observing conditions of the drums and remnants (holes, perforations, rusting, pitting, etc.);

- Observing labeling that may be helpful in identifying drum contents (spray paint labels or waste codes, written labels, etc.);
- Observing the presence of other uncontainerized waste materials/pallets, etc.;
- Conducting field screening measurements with a PID; and
- Photographing and videotaping of the test pit installation and inspection activities.

It is anticipated that excavated material will be returned back to the test pits upon completion. However, in the event drums are encountered, the following contingency procedures have been identified.

Drum Remnants: If drum remnants are encountered, remnants may be excavated and placed on polyethylene sheeting. These locations will be evaluated at the time they are discovered and may be selected as locations for soil sampling. Drum remnants will be returned to the test pit along with excavated soils.

Intact Drums: In the event that intact drums are encountered, a provision has been included in the Revised Workplan to remove one drum from one test pit for characterization testing. Results of drum inspections may be used to select a drum for sampling, determine appropriate sampling methods, and determine appropriate analytical methods. The individual drum selected for sampling must be in good condition (preferably with labels). A drum will not be selected for sampling if it is bulging, shows signs of corrosion, and/or has mineralization around the bungs or drum tops. Drum selection may be biased toward one that is located in the uppermost layer within a test pit and/or a drum that does not appear to be consistent with information in the operational records. Drum selection may also be based on direction from MDNR field personnel. Other intact drums encountered will be left in the test pits for future remediation.

One 70-gallon over-pack vessel will be brought to the site at the beginning of test pit activities for use in the event that an intact drum is selected for sampling. The removed drum will be placed in the over-pack vessel prior to sampling. The sampling will consist of the following:

1. don Level B personal protective equipment (PPE) with a full face supplied-air respirator
2. open/pierce the drum with non-sparking tools,
3. collect a representative of the drum contents, and
4. seal the drum.

The removed drum will not be returned to the test pit. The over-pack will be sealed, labeled, and set aside for appropriate disposal based on the sample results. Additional intact drums encountered will be left in the test pits for future remediation.

After collection, drum samples will be submitted to the laboratory for analysis. Analytes are assumed to be the same as for soil sampling plus Toxicity Characteristic Leaching Procedure (TCLP) for VOCs and metals. A drum sample would use the following example naming conventions: TP-1001-DR-001 (drum sample #1 from within test pit TP-1001).

Documentation

Site conditions, soil logging, sample identification and tracking, test and data collection, sketches, photographs, events, personnel onsite, incidents, discussions and issues must be recorded for all field activities.

EXPLORATORY TEST PITS STANDARD OPERATING PROCEDURE

Field Book: The field book is a first line repository of anything observed or discussed onsite without regard to potential use or merit. While the type of information in the field book may in some cases be informal or general in nature, the field book is a legal document and is the property of Haley & Aldrich. Long after a project is completed and the file is closed the field notes may provide an invaluable record of details that may not have been recorded elsewhere.

Photographs: Photographic documentation of site conditions, activities and incidents are very useful for conveying a visual perspective to what may be difficult to describe otherwise. In addition, subject identification within the photograph by means of a white board and use of the camera date/time feature (if so equipped) renders ease to later captioning as does indicating on a site plan during shooting the approximate location and direction of the shot by frame number.

Test Pit Logs: Test pit logs must be completed entirely and without omission to stand alone as documentation of the subsurface conditions at a given point. Each test pit log contains a header to identify the project, client and test pit designation and to document the test pit location, the ground surface elevation, contractor and equipment used, Haley & Aldrich Project Manager, Field Representative, date, weather conditions and groundwater entry. Within the body of the test pit log each sampling event is recorded in a column by including sample type, designation and depth. Separate columns are used for USCS group symbol and the USCS identification and description. A column for indicating PID readings is also included in the Environmental Test Pit Log. In the test pit log footer standing groundwater observations noted during the execution of the excavation are carefully recorded in relation to the excavation activity in order to assist in the interpretation of the reading. Boulder counts and test pit dimensions are also recorded in the footer.

As-Built Test Pit Locations and Elevations: An accurate sketch showing the actual (as-built) location of completed test pits must accompany the test pit logs. In addition, the estimated elevation of the ground surface or excavation reference elevation must also be included. Locations and elevations should be measured with 0.1 ft. precision from known or permanent features whenever possible, however, establishment of a temporary baseline and/or series of benchmarks may be necessary in open or virgin sites. An existing site plan with location and elevation data may have been provided for use during the test pit program. In such cases the scale and elevation datum should be verified and the accuracy of the horizontal and vertical data should be checked. All excavation and field references should be painted or staked in the field as appropriate for future field survey.

Geologic Profiles: Simple geologic columns of individual excavations may be quickly sketched in the field and combined as needed in order to produce a two-dimensional stratigraphic cross-section or geologic profile. This exercise may be useful in the development and support of the geologic interpretation of the stratigraphy and in the identification of data gaps during the test pit program.

APPENDIX C

Forms

Nashville
2960 Foster Creighton Drive

Nashville, TN 37204
phone 615.726.0177 fax 615.726.3403

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Bruce Wilkinson**	**Site Contact:**	**Date:**	COC No:
Haley & Aldrich, Inc.	**Tel/Fax: 913-217-6910**	**Lab Contact:**	**Carrier:**	_____ of _____ COCs
8735 Rosehill Road	**Analysis Turnaround Time**			Job No.
Lenexa, KS 66030	Calendar (C) or Work Days (W) _____			
(913) 217-6900 Phone	TAT if different from Below _____			
(913) 599-5822 FAX	☐ 2 weeks			SDG No.
Project Name: Site Investigation	☐ 1 week			
Site: Former Leeds Assembly Plant-Northern Parcel	☐ 2 days			
P O #	☐ 1 day			

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**																Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For _____ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

HALEY & ALDRICH

FIELD CHANGE REQUEST

Page of

CLIENT:		**LOCATION:**	
PROJECT NAME:		**PROJECT NUMBER:**	
SUBJECT:		**DATE:**	

Original Work Plan Requirements:

Reason for Field Change Request:

Proposed Field Change:

Any Change in Contract Time or Cost? (If Yes, attach detail) ☐ **Yes** ☐ **No**

Proposed By: ☐ **Approved** ☐ **Disapproved**

Requestor	**Date**	**Project Manager Signature**	**Date**

HALEY & ALDRICH

EQUIPMENT CALIBRATION RECORD

Page Page of

INSTRUMENT: _____ **SERIAL NUMBER:** _____

PROJECT NAME: _____ **PROJECT NUMBER:** _____

SITE: _____ **PERSONNEL:** _____

Date	Time	Initials	Calibration Parameter	Calibration Standard	Standard Lot Number	Standard Expiration	Standard Value	Instrument Measurement	Weather Conditions	Condition of Instrument	Action

APPENDIX B

Health and Safety Plan

HALEY & ALDRICH, INC.
SITE-SPECIFIC HEALTH & SAFETY PLAN

For

Former Leeds Assembly Plant – Northern Parcel

South of 6817 Stadium Drive

Project/File No. 37294

Prepared by: Dennis Kreitzburg Date: 11/17/2010

Revised by: Mariruth Gruis Date: 8/16/2011

APPROVALS: The following signatures constitute approval of this Health & Safety Plan

Ana T. Mora - Regional H&S Coordinator	Date
Bruce W. Wilkinson - Site Project Manager	Date
Scott A. Boston - Corporate H&S Manager (Only required per request of RHSCs)	Date

Date printed: 8/15/2011 at 10:21 PM

Note: This HASP has been developed for Haley & Aldrich purposes only and is not for use by others.

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APPENDIX A - HASP AMENDMENT FORM

APPENDIX B – ISSUANCE AND COMPLIANCE, SITE SAFETY OFFICER ROLES AND RESPONSIBILITIES, AND TRAINING REQUIREMENTS

Note: This HASP has been developed for Haley & Aldrich purposes only and is not for use by others.

1. PROJECT INFORMATION AND EMERGENCY RESOURCES

Project Name: Former Leeds Assembly-Northern Parcel	**H&A File No.: 37294**
Location: Kansas City, Missouri	
Client/Site Contact: Phone Number: Emergency Phone Number:	Robert W. Hare, P.E., CHMM 313.486.2908 419.277.0815
General Contractor: **Superintendent:** Phone Number: Emergency Phone Number:	Enter General Contractor Name Enter Superintendent Name Enter Superintendent Phone Number Enter Superintendent Emergency Number
H&A Project Manager: Phone Number: Emergency Phone Number:	Bruce A. Wilkinson 913.217.6910 857.498.1277
Regional Health & Safety Coordinator: Phone Number: Emergency Phone Number:	Ana T. Mora 913-217-6903 816-206-0791
Nearest Hospital: Address: (see map on next page) Phone Number:	Truman Medical Center Hospital Hill 2301 Holmes Street Kansas City, MO 64108 (816) 404-1000
Emergency Response Number:	**911**
Other Local Emergency Response Number:	Kansas City Police East Patrol 816-234-5530
Other Ambulance, Fire, Police, or Environmental Emergency Resources:	Inter City Fire Protection District 816-461-9090

Work Scope:

This Site-Specific Health and Safety Plan addresses the health and safety practices and procedures that will be employed by all Haley & Aldrich employees participating in the site characterization of the Project Site. This plan is based on an assessment of the site-specific health and safety risks available to Haley & Aldrich and Haley & Aldrich's experience with other project sites. The scope of work for the Site Characterization includes:

The soil investigation will be completed by installing 22 test pits. The total depth of the test pits will be approximately 3 to 5 feet into native soil unless the capability of the excavotor is exceeded by depth or obstructions. One to three soil samples will be collected from each test pit to be determined by field conditions such as: total depth, visual observations, and photoionization detector readings. The spoils from the test pits will be collected on polyethelene sheeting and the open excavation and spoils will be photographed. The spoils will be returned to the excavation, compacted by the excavator, and the pavement will be replaced. The soil samples will be sent to the analytical laboratory for analysis of VOCs, SVOCs, PCBs, and the select metals.

Note: This HASP is developed for Haley & Aldrich purposes only and not for use by others.

The groundwater investigation will be completed by installing 18 shallow (up to 20 feet deep) and 4 deep wells (up to 60 feet deep). The monitoring wells will be installed in two rounds. The first round of wells will be installed, developed and sampled before installing the second round of wells to confirm if the locations are appropriate. The monitoring wells will be developed and sampled using low-flow methods for VOCs, SVOCs, PCBs, and the selected metals.

Subcontractor(s) to be involved in on-site activities:

Firm Name	Work Activity
Enter Subcontractor Name	Enter Work Activity
Enter Subcontractor Name	Enter Work Activity
Enter Subcontractor Name	Enter Work Activity

Projected Start Date: Enter Start Date

Projected Completion Date: Enter Completion Date

Estimated Number of Days to Complete Field Work: Enter Number of Days

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Directions to the Nearest Hospital:

- Leave the site via the east entrance, you are on E 39th Street.
- Head east on E 39th Street until it ends and turn left (north) onto Raytown Road.
- Raytown Road becomes the Manchester Trafficway.
- After 0.7 miles turn right onto I-70 West.
- After 1.7 miles take the Jackson Avenue Exit (Exit 5C).
- At the end of the ramp merge onto E 29th Street heading west.
- E 29 Street becomes Myrtle Avenue.
- After 0.25 miles turn left (west) onto E 27th Street.
- After 2 miles turn right at Holmes Street.
- After 0.5 miles your have reached the Truman Medical Center at 2301 Holmes St, Kansas City, MO.

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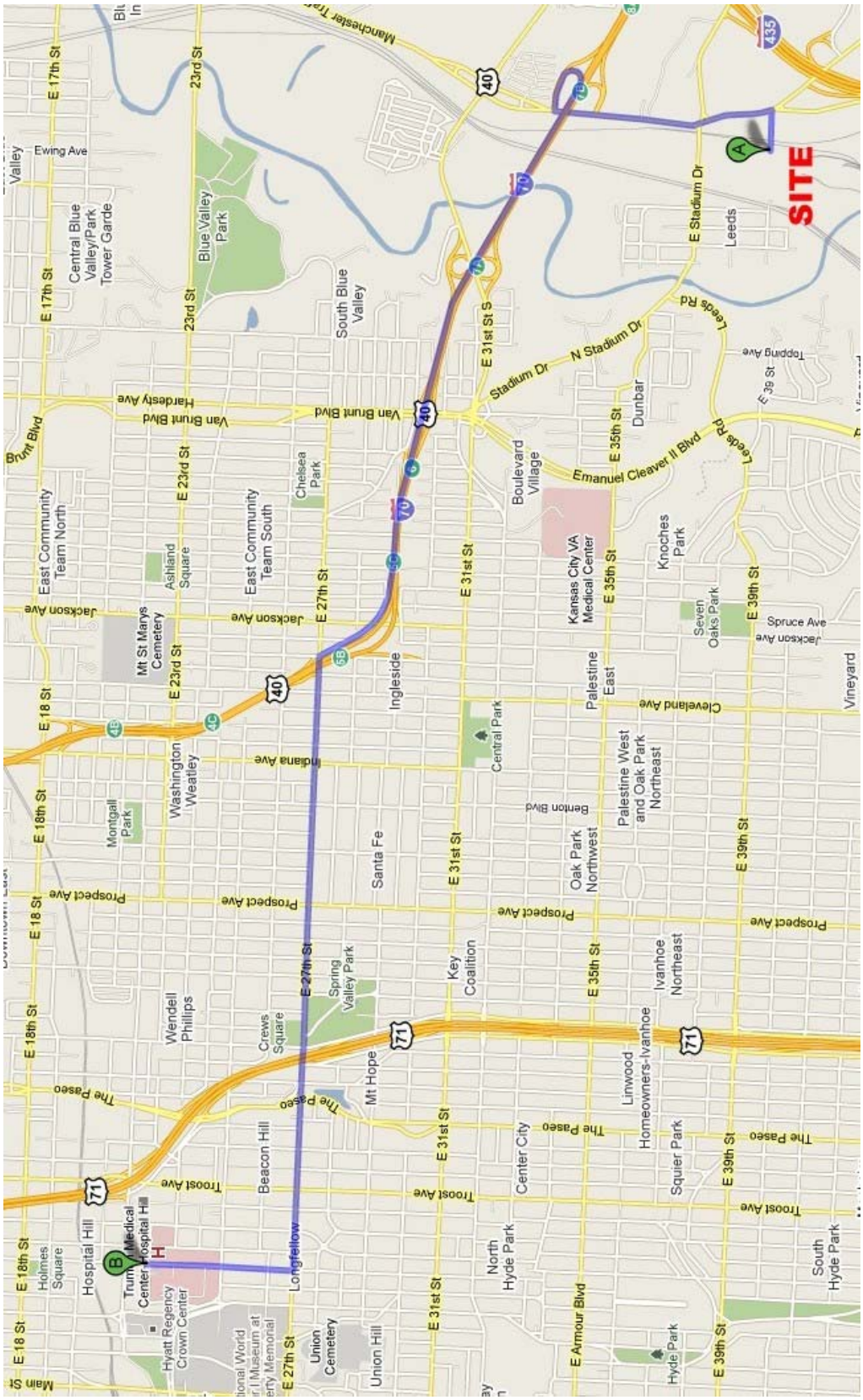

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2. SITE DESCRIPTION

Site Classification:

☑ Industrial	☐ Commercial	☐ Other Specify

General Description:

The approximate 15-acre Site is nearly entirely paved and is used for parking and storage. The one building on-site is a railroad siding shed. The site is in an industrial area.

Background and Historic Site Usage:

The Site was used for farming until the Leeds Assembly plant was constructed on the parcel adjacent to the north of the Site in 1928. Around that time railroads were constructed across the Site. The railroad siding shed near the eastern edge of the property boundary was built between 1957 and 1965. The former propane storage area in the northwest corner of the site was built between 1969 and 1978. Fill placement on the east half and northern edge of the Site occurred between 1950 and 1952. Fill placement in the southwestern portion of the Site occurred between 1952 and 1960. By 1963 nearly the entire Site was paved and has remained largely unchanged since.

Project Scope:

The soil investigation will be completed by installing 22 test pits. The total depth of the test pits will be approximately 3 to 5 feet into native soil unless the capability of the excavator is exceeded by depth or obstructions. One to three soil samples will be collected from each test pit to be determined by field conditions such as: total depth, visual observations, and photoionization detector readings. The spoils from the test pits will be collected on polyethelene sheeting and the open excavation and spoils will be photographed. The spoils will be returned to the excavation, compacted by the excavator, and the pavement will be replaced. The soil samples will be sent to the analytical laboratory for analysis of VOCs, SVOCs, PCBs, and the selected metals.

The groundwater investigation will be completed by installing 18 shallow (up to 20 feet deep) and 4 deep wells (up to 60 feet deep). The monitoring wells will be installed in two rounds. The first round of wells will be installed, developed and sampled before installing the second round of wells to confirm if the locations are appropriate. The monitoring wells will be developed and sampled using low-flow methods for VOCs, SVOCs, PCBs, and the selected metals.

Overview of Hazards:

Hazards expected to be encountered are the potential hazards related to the fill material, the heavy equipment to be used for investigation, buried or overhead utilities, fall hazards from the test pits utilized for investigation, and traffic.

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Site Status: Indicate current activity status and describe operations at the site.

☑ Active	☐ Inactive
☐ Partially active	☐ Other

The site is used for storage.

Site Plan:

Is a site plan or sketch available? ☑ Y ☐ N

Figure 2 from the investigation work plan it attached.

Work Areas:

List/identify each specific work area(s) on the job site and indicate its location(s) on the site plan:

1. Entire Site – Work will be conducted in all areas of the site.

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3. PROJECT TASK BREAKDOWN

List and describe each distinct work task below.

Task No.	Detailed Task Description	Employee(s)	Work Date(s) or Duration
1	Soil Investigation – Test Pits	Enter employees	Enter dates/duration
2	Monitoring Well Installation	Enter employees	Enter dates/duration'
3	Well Development	Enter employees	Enter dates/duration'
4	Well Sampling	Enter employees	Enter dates/duration'

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4. HAZARD ASSESSMENT

Material Safety Data Sheets (MSDS) of hazardous materials used during the execution of work shall be available on site. MSDSs are required for chemicals used to prepare samples, calibration gases, etc. MSDSs are not required for waste materials. MSDSs are available in Boston-based field vehicles and at the Roland Street Laboratory.

Chemical Hazards:

Does chemical analysis data indicate that the site is contaminated? ☑ Y ☐ N

Indicate the potential physical state of the hazardous materials at the site.

☑ Gas/Vapor	☑ Sludge
☑ Liquid	☑ Solid/Particulate

Indicate the anticipated or actual class of compounds at the site.

☐ Asbestos	☐ Inorganics
☑ BTEX	☐ Pesticides
☐ Chlorinated Solvents	☑ Petroleum products
☑ Heavy Metals	☑ Other VOCs

Impacted Environments:

Indicate media in which contamination is expected.

☐ Air	☑ Groundwater
☑ Soil	☐ Sediment
☐ Surface water	☐ Other Specify

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Estimated concentrations:

The following chemicals have been detected at the site above Mo CALM Scenario C STARC levels.

Work Activity	Media	Chemical	Anticipated Concentration
Test Pit Sampling and Monitoring Well Installation	SO	Arsenic Beryllium Lead Mercury 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene Benzo(a)pyrene Benzo(b)fluoranthene Di-n-octylphthalate Dibenzo(a,h)anthracene Naphthalene Total Extractable Hydrocarbons	20 mg/kg 1 mg/kg 14,000 mg/kg 2 mg/kg 1 mg/kg 250 mg/kg 2.7 mg/kg 1.5 mg/kg 1.1 mg/kg 0.72 mg/kg 430 mg/kg 65,000 mg/kg
Monitoring Well Sampling	GW	Arsenic Cadmium Iron Lead Manganese Chloroform Ethylbenzene n-Propylbenzene Toluene Xylene Bis(2-ethylhexel)phthalate	244 µg/l 7.6 µg/l 70,000 µg/l 31 µg/l 35,000 µg/l 230 µg/l 1,300 µg/l 1000,000 µg/l 54,000 µg/l 9,700 µg/l 47 µg/l

(Media key: A = Air; GW = Groundwater; SW = Surface Water; SO = Soil; SE = Sediment)

Chemicals of Concern:

Project action levels will be determined by the Haley & Aldrich Site Safety Officer based upon site conditions and information and will be presented in the task-specific health & safety requirements. The levels defined in Tables 1 and 2 of this HASP will serve as guidelines for project action levels.

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Chemicals of Concern:

Arsenic

The Occupational Safety and Health Administration has set limits of 10 microgram arsenic per cubic meter of workplace air (10 µg/m3) for 8 hour shifts and 40 hour work weeks. Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the EPA have determined that inorganic arsenic is a human carcinogen.

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Benzene

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death. The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

Beryllium

Beryllium is a hard, grayish metal naturally found in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and the beryllium is purified for use in nuclear weapons and reactors, aircraft and space vehicle structures, instruments, x-ray machines, and mirrors. Beryllium ores are used to make speciality ceramics for electrical and high-technology applications. Beryllium alloys are used in automobiles, computers, sports equipment (golf clubs and bicycle frames), and dental bridges. It enters water from erosion of rocks and soil, and from industrial waste. Some beryllium compounds will dissolve in water, but most stick to particles and settle to the bottom. Most beryllium in soil does not dissolve in water and remains bound to soil.

Beryllium can be harmful if you breathe it. The effects depend on how much you are exposed to and for how long. If beryllium air levels are high enough (greater than 1000 µg/m^3), an acute

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condition can result. This condition resembles pneumonia and is called acute beryllium disease Occupational and community air standards are effective in preventing most acute lung damage.

BTEX
BTEX is the common abbreviation for benzene, toluene, ethyl benzene and xylene. OSHA has set permissible exposure limits for all of these contaminants that may be found at this worksite during your work activity. The levels that are set are based on an 8-hour time weighted average. Below are those values-

Benzene	1 ppm / 8 TWA
Toluene	200 ppm / 8 TWA
Ethyl Benzene	100 ppm / 8 TWA
Xylene	100 ppm / 8 TWA

Chloroform

Chloroform is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. It will burn only when it reaches very high temperatures.
In the past, chloroform was used as an inhaled anesthetic during surgery, but it isn't used that way today. Today, chloroform is used to make other chemicals and can also be formed in small amounts when chlorine is added to water.

Exposure to chloroform can occur when breathing contaminated air or when drinking or touching the substance or water containing it. Breathing chloroform can cause dizziness, fatigue, and headaches. Breathing chloroform or ingesting chloroform over long periods of time may damage your liver and kidneys. It can cause sores if large amounts touch your skin.

The Occupational Safety and Health Administration (OSHA) has set the maximum allowable concentration of chloroform in workroom air during an 8-hour workday in a 40-hour workweek at 50 ppm.

Di-n-octylphthalate

Di-*n*-octylphthalate is a colorless, odorless, oily liquid that doesn't evaporate easily. It is a man-made substance used to keep plastics soft or more flexible. This type of plastic can be used for medical tubing and blood storage bags, wire and cables, carpetback coating, floor tile, and adhesives. It is also used in cosmetics and pesticides. Di-*n*-octylphthalate sticks tightly to soil, sediment, and dust particles.

Little information is known about the health effects that might be caused by di-*n*-octylphthalate. It is not known what happens when you breathe or ingest the chemical. Some rats and mice that were given very high doses of di-*n*-octylphthalate by mouth died. Mildly harmful effects have been seen in the livers of some rats and mice given very high doses of di-*n*-octylphthalate by mouth for short (14 days or less) or intermediate periods (15 to 365 days) of time, but lower doses given for short periods of time generally caused no harmful effects.

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Lead

The Occupational Safety and Health Administration (OSHA) limits the concentration of lead in workroom air to 50 µg/cubic meter for an 8-hour workday. Lead can affect almost every organ and system in your body. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and the immune system. The effects are the same whether it is breathed or swallowed. Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common after exposure to high levels of lead. In adults, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can cause abortion and damage the male reproductive system. The connection between these effects and exposure to low levels of lead is uncertain.

Manganese

Manganese is a naturally occurring metal that is found in many types of rocks. Pure manganese is silver-colored, but does not occur naturally. It combines with other substances such as oxygen, sulfur, or chlorine. Manganese occurs naturally in most foods and may be added to some foods.

Manganese is used principally in steel production to improve hardness, stiffness, and strength. It may also be used as an additive in gasoline to improve the octane rating of the gas. Manganese is routinely contained in groundwater, drinking water, and soil at low levels. Drinking water containing manganese or swimming or bathing in water containing manganese may expose you to low levels of this chemical.

The most common health problems in workers exposed to high levels of manganese involve the nervous system. These health effects include behavioral changes and other nervous system effects, which include movements that may become slow and clumsy. This combination of symptoms when sufficiently severe is referred to as "manganism". Other less severe nervous system effects such as slowed hand movements have been observed in some workers exposed to lower concentrations in the work place.

Workers exposed to high levels of airborne manganese in certain occupational settings may accumulate manganese dust on their work clothes. Manganese-contaminated work clothing should be removed before getting into your car or entering your home to help reduce the exposure hazard for yourself and your family.

Mercury

Mercury vapor is highly toxic via this route. Causes severe respiratory tract damage. Symptoms include sore throat, coughing, pain, tightness in chest, breathing difficulties, shortness of breath, headache, muscle weakness, anorexia, gastrointestinal disturbance, ringing in the ear, liver changes, fever, bronchitis and pneumonitis. Can be absorbed through inhalation with symptoms similar to ingestion. May cause burning of the mouth and pharynx, abdominal pain, vomiting, corrosive ulceration, bloody diarrhea. May be followed by a rapid and weak pulse, shallow breathing, paleness, exhaustion, tremors and collapse. Delayed death may occur from renal

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failure. Gastrointestinal uptake of mercury is less than 5% but its ability to penetrate tissues presents some hazard. Initial symptoms may be thirst, possible abdominal discomfort. Causes irritation and burns to skin. Symptoms include redness and pain. May cause skin allergy and sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage. Chronic exposure through any route can produce central nervous system damage. May cause muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain damage and kidney damage. Can cause skin allergies and accumulate in the body. Repeated skin contact can cause the skin to turn gray in color. A suspected reproductive hazard; may damage the developing fetus and decrease fertility in males and females. Persons with nervous disorders, or impaired kidney or respiratory function, or a history of allergies or a known sensitization to mercury may be more susceptible to the effects of the substance.

The OSHA Acceptable Ceiling Concentration for mercury and mercury compounds: 0.1 mg/m3 (TWA), skin contact is a parameter in determining exposure for mercury.

Naphthalene

Exposure to naphthalene, 1-methylnaphthalene, or 2-methylnaphthalene happens mostly from breathing air contaminated from the burning of wood, tobacco, or fossil fuels, industrial discharges, or moth repellents. Exposure to large amounts of naphthalene may damage or destroy some of your red blood cells. Naphthalene has caused cancer in animals.

Naphthalene is a white solid that evaporates easily. Fuels such as petroleum and coal contain naphthalene. It is also called white tar, and tar camphor, and has been used in mothballs and moth flakes. Burning tobacco or wood produces naphthalene. It has a strong, but not unpleasant smell. The major commercial use of naphthalene is in the manufacture of polyvinyl chloride (PVC) plastics. Its major consumer use is in moth repellents and toilet deodorant blocks.

Exposure to large amounts of naphthalene may damage or destroy some of your red blood cells. This could cause you to have too few red blood cells until your body replaces the destroyed cells. This condition is called hemolytic anemia. Some symptoms of hemolytic anemia are fatigue, lack of appetite, restlessness, and pale skin. Exposure to large amounts of naphthalene may also cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. Animals sometimes develop cloudiness in their eyes after swallowing high amounts of naphthalene. It is not clear whether this also develops in people. Rats and mice that breathed naphthalene vapors daily for a lifetime developed irritation and inflammation of their nose and lungs. It is unclear if naphthalene causes reproductive effects in animals; most evidence says it does not.

The Occupational Safety and Health Administration (OSHA) set a limit of 10 ppm for the level of naphthalene in workplace air during an 8-hour workday, 40-hour workweek. The National Institute for Occupational Safety and Health (NIOSH) considers more than 500 ppm of naphthalene in air to be immediately dangerous to life or health. This is the exposure level of a chemical that is likely to impair a worker's ability to leave a contaminate area and therefore, results in permanent health problems or death.

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Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides. In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

Toluene

Toluene affects the brain. Low-to-moderate levels from long-term exposure can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea and loss of appetite, and hearing loss. Inhaling a high level of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can cause unconsciousness, and even death. Repeated exposure to high levels can cause permanent brain and speech damage, vision and hearing problems, loss of muscle control, and poor balance. It can also cause memory loss and decreased mental ability. Toluene also affects the kidneys. Several studies have shown that unborn animals were harmed when high levels of toluene were breathed by their mothers. Babies can have neurological problems and retarded growth and development if their mothers.

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products, which can contaminate the environment. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site. TPH is a mixture of chemicals, but they are all made mainly from hydrogen and carbon, called hydrocarbons. Scientists divide TPH into groups of petroleum hydrocarbons that act alike in soil or water. These groups are called petroleum hydrocarbon fractions. Each fraction contains many individual chemicals. Some chemicals that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorene, as well as other petroleum products and gasoline components. However, it is likely that samples of TPH will contain only some, or a mixture, of these chemicals.

Some of the TPH compounds can affect your central nervous system. One compound can cause headaches and dizziness at high levels in the air. Another compound can cause a nerve disorder called "peripheral neuropathy," consisting of numbness in the feet and legs. Other TPH compounds can cause effects on the blood, immune system, lungs, skin, and eyes. Animal studies have shown effects on the lungs, central nervous system, liver, and kidney from

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exposure to TPH compounds. Some TPH compounds have also been shown to affect reproduction and the developing fetus in animals.

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TABLE 1
OCCUPATIONAL EXPOSURE LIMITS (CONCENTRATIONS IN AIR)

(CIRCLE CONTAMINANTS OF CONCERN, WRITE ADDITIONAL CONTAMINANTS AND EXPOSURE ON LAST PAGE)

CHEMICAL	ROUTES OF EXPOSURE	IDLH	Ceiling	STEL	PEL	TLV	REL	PID (IP eV)	FID	ODOR THRES-HOLD	IRRITATION THRESHOLD	ODOR DESCRIPTION
VAPORS & GASES												
Acetone	R, I, C	2500	-	750 [ACGIH]	1000	500	250	9.69	60	13	-	fragrent, mint-like
Ammonia	R, I, C	300	-	35 [NIOSH, ACGIH]	50	25	25	10.18**	-	0.5-2	10	Pungent suffocating odor
Benzene	R,A,I,C	Ca [500]	-	1 [NIOSH]; 2.5 [ACGIH]	1	0.5	0.1	9.24	150	4.68	-	Solvent, aromatic
Carbon tetrachloride (Tetrachloromethane)	R,A,I,C	Ca [200]	25 [instantaneous] 200 [5 min peak in any 4 hrs]	2 [NIOSH, 60-min]; 10 [ACGIH]	2	5	Ca	11.47**	10	50	-	Sweet, pungent, ether-like
Chlorobenzene	R,I,C	1000	-	-	75	10	-	9.07	200	0.68	-	Almond-like
Chloroform	R,I,C	Ca [500]	50 [OSHA]	2 [NIOSH, 60-min]	-	10	-	11.42**	65	50	-	Sweet, pleasant
o-Dichlorobenzene	R,A,I,C	200	50 [NIOSH, OSHA]	50 [ACGIH]	-	25	-	9.06	50	0.3	E 20-30	Pleasant, aromatic
p-Dichlorobenzene	R,A,I,C	Ca [150]	-	-	75	10	Ca	8.98	-	0.18	E 80-160	Distinct, aromatic, mothball-like
Dichlorodifluoromethane (Freon 12)	R,C	15000	-	-	1000	1000	1000	11.75**	15	-	-	Ether-like when at very high concs.
1,1-Dichloroethane	R,I,C	3000	-	-	100	100	100	11.06**	80	200	-	Distinct, chloroform-like
1,2-Dichloroethane (Ethylene dichloride)	R,I,A,C	Ca [50]	100 [OSHA]	2 ppm [NIOSH]; 200 ppm [OSHA, 5-min max peak in any 3 hours]	50	10	1	11.05**	80	88	-	Chloroform-like
1,1-Dichloroethylene (1,1-DCE, Vinylidene chloride)	R,A,I,C	Ca [ND]	-	-	-	5	Ca	10.00**	40	190	-	Chloroform-like
1,2-Dichloroethylene	R,I,C	1000	-	-	200	200	200	9.65	50	0.85	-	Bitter, chloroform-like
Ethanol	R,I,C	3300	-	-	1000	1000	1000	10.47**	25	10	-	Weak, ether-like, wine-like
Ethylbenzene	R,I,C	800	-	125 [NIOSH; ACGIH]	100	100	100	8.76	100	2.3	E 200	Aromatic
Ethylene Glycol	R,I,C	ND	50 [OSHA]; 100 mg/m^3 [ACGIH]	-	-	-	-	-	-	-	-	Odorless
Formaldehyde	I,C	Ca [20]	0.1 [NIOSH, 15-min]; 0.3 [ACGIH]	2	0.75	-	Ca [0.016]	10.88**	-	0.83	-	Pungent, suffocating
Gasoline	R,I,A,C	Ca [ND]	-	500 [OSHA; ACGIH]	300	300	-	-	-	-	E 0.5	Petroleum-like
n-Hexane	R,I,C	1100	-	-	500	50	50	10.18	70	130	E.T 1400-1500	Gasoline-like
Hydrogen Cyanide	R,A,I,C	50	4.7 [ACGIH; Skin]	4.7 [NIOSH - skin]	10 [skin]		-	-	-	0.58	-	Bitter almond
Hydrogen peroxide	R,I,C	75	-	-	1	1	1	10.54**	-	-	-	Sharp
Methanol	R,I,A,C	6000	-	250 [NIOSH; ACGIH; skin]	200	200 [skin]	200	10.84**	12	1000	-	Pungent
Methyl Ethyl Ketone Peroxide	R,I,C	ND	0.2 [NIOSH; ACGIH] 0.7 [OSHA]	-	-	-	-	-	-	-	-	Characteristic odor
Methyl Chloroform (1,1,1-TCA)	R,I,C	700	350 [NIOSH, 15-min]	450 [ACGIH]	350	350	Ca	11.00**	105	20-100	-	Chloroform-like
Methylene Chloride (Dichloromethane, Methylene dichloride)	R,I,A,C	Ca [2300]	-	125	25	50	Ca	11.32**	100	25-50	E 5000	Chloroform-like
Methyl Mercaptan	R,C	150	10 [OSHA] 0.5 [NIOSH, 15-min]	-	-	0.5	-	9.44	-	-	-	Garlic, rotten cabbage
MIBK (Hexone)	R,I,C	500	-	75 [NIOSH; ACGIH]	100	50	50	9.30	-	-	-	Pleasant
Naptha (coal tar)	R,I,C	1000	-	-	100	400	100	-	-	-	-	Aromatic
Naphthalene	R,A,I,C	250	-	15 [NIOSH; ACGIH]	10	10	10	8.12	-	0.3	E 15	Mothball-like
Octane	R,I,C	1000	385 [NIOSH, 15-min]	-	500	300	75	9.82	80	48	-	Gasoline-like
Pentachlorophenol	R,A,I,C	2.5 mg/m^3	-	-	0.5 mg/m^3 [skin]	0.5 mg/m^3 [skin]	0.5 mg/m^3 [skin]	-	-	-	-	Pungent when hot, benzene-like
Phenol	R,A,I,C	250	15.6 [NIOSH, 15-min]	-	5 [skin]	5 [skin]	5 [skin]	8.50	-	0.04	E.N.T. 68	Sweet, acrid
Propane	R,C	2100	-	-	1000	1000	1000	11.07**	80	1600	-	Odorless (commonly smells foul due to additive for odor detection)
Stoddard Solvent (Mineral Sprits)	R,Cl,I	20000 mg/m^3	1800 mg/m^3 [NIOSH, 15-min]	-	500	100	350 mg/m^3	-	-	1	E 400	Kerosene-like
Styrene	R,I,A,C	700	200 [OSHA]	100 [NIOSH]; 600 [OSHA, 5-min max peak in any 3 hours]; 40 [ACGIH]	100	20	50	8.40	85	0.047	E 200-400	Sweet, floral
1,1,2,2-Tetrachloroethane	R,I,A,C	Ca [100]	-	-	5 [skin]	1 [skin]	1 [skin]	11.10**	100	1.5	-	Pungent, chloroform-like
Tetrachloroethylene (Perchloroethylene, Perc, PCE)	R,I,A,C	Ca [150]	200 [OSHA]	300 [OSHA, 5-min max peak in any 3-hours]; 100 [ACGIH]	100	25	Ca	9.32	70	4.68	N.T513-690	Chloroform-like
Toluene	R,A,I,C	500	300 [OSHA]	150 [NIOSH]; 500 [OSHA, 10-min max peak]	200	50	100	8.82	110	2.14	E300-400	Sweet, pungent, benzene-like
Trichloroethylene (TCE)	R,I,A,C	Ca [1000]	200 [OSHA]	300 [OSHA, 5-min max peak in any 2-hours]; 100 [ACGIH]	100	50	Ca	9.45	70	21.4	-	Chloroform-like
1,2,3-Trimethylbenzene	R,I,C	ND	-	-	-	-	25	8.48	-	-	-	Distinctive, aromatic
1,2,4-Trimethylbenzene	R,I,C	ND	-	-	-	-	25	8.27	-	-	-	Distinctive, aromatic
1,3,5-Trimethylbenzene	R,I,C	ND	-	-	-	-	25	8.39	-	-	-	Distinctive, aromatic
Turpentine	R,A,I,C	800	-	-	100	20	100	-	-	200	E.N 200	Pine-like
Vinyl Chloride	R,C	Ca [ND]	5 [OSHA, 15-min]	-	1	1	Ca	9.99	-	3000	-	Pleasant odor at high concs.
Xylenes	R,A,I,C	900	-	150 [NIOSH, ACGIH]	100	100	100	8.56 (m- and o-) 8.44 (p-)	111/116	1.1	E.N.T. 200	Aromatic

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TABLE 1
OCCUPATIONAL EXPOSURE LIMITS (CONCENTRATIONS IN AIR)

(CIRCLE CONTAMINANTS OF CONCERN, WRITE ADDITIONAL CONTAMINANTS AND EXPOSURE ON LAST PAGE)

CHEMICAL	ROUTES OF EXPOSURE	IDLH	Ceiling	STEL	PEL	TLV	REL	PID (IP eV)	FID	ODOR THRES-HOLD	IRRITATION THRESHOLD	ODOR DESCRIPTION
DUSTS, MISTS, FUMES, AND MISCELLANEOUS COMPOUNDS												
Asbestos	R	Ca (ND)	-	-	0.1 fiber/cc	0.1 fiber/cc	0.1 fiber/cc	-	-	-	-	-
PCBs-42% Chlorine	R,A,I,C	Ca [5 mg/m^3]	-	-	1 mg/m^3 [skin]	1 mg/m^3 [skin]	0.001 mg/m^3	-	-	-	-	Mild, hydrocarbon
PCBs-54% Chlorine	R,A,I,C	Ca [5 mg/m^3]	-	-	0.5 mg/m^3 [skin]	0.5 mg/m^3 [skin]	0.001 mg/m^3	-	-	-	-	Mild, hydrocarbon
Aluminum - metal dust	R,C	ND	-	-	15 mg/m^3 (total); 5 mg/m^3 (respirable)	10 mg/m^3	10 mg/m^3 (total), 5 mg/m^3 (respirable)	-	-	-	-	-
Aluminum - soluble salts	R,I,C	ND	-	-	2 mg/m^3	2 mg/m^3	2 mg/m^3	-	-	-	-	-
Arsenic- inorganic	R,A,I,C	Ca [5 mg/m^3]	0.002 mg/m^3 [NIOSH, 15-min]	-	0.01 mg/m^3	0.01 mg/m^3	Ca	-	-	-	-	-
Barium:soluble compounds	R,I,C	50 mg/m^3	-	-	0.5 mg/m^3	0.5 mg/m^3	0.5 mg/m^3	-	-	-	-	-
Beryllium	R,C	Ca [4 mg/m^3]	0.005 mg/m^3 [OSHA]; 0.025 mg/m^3 [OSHA, 30-min max peak]; 0.0005 mg/m^3	0.01 mg/m^3 [ACGIH]	0.002 mg/m^3	0.002 mg/m^3	Ca	-	-	-	-	-
Cadmium dusts	R,I	Ca [9 mg/m^3]	-	-	0.005 mg/m^3	0.01 mg/m^3	Ca	-	-	-	-	-
Chromates (Cr(VI) Compounds) & Chromic Acid	R,I,C	Ca [15 mg/m^3]	0.1 mg/m^3 [OSHA]	-	0.001 mg/m^3	0.05 mg/m^3 [water soluble]; 0.01 mg/m^3 [insoluble]	Ca	-	-	-	-	-
Chromium (III) Compounds	R,I,C	25 mg/m^3	-	-	0.5 mg/m^3	0.5 mg/m^3	0.5 mg/m^3	-	-	-	-	-
Chromium Metal	R,I,C	250 mg/m^3	-	-	1 mg/m^3	0.5 mg/m^3	0.5 mg/m^3	-	-	-	-	-
Copper - dust & mist	R,I,C	100 mg/m^3	-	-	1 mg/m^3	1 mg/m^3	1 mg/m^3	-	-	-	-	-
Lead	R,I,C	100 mg/m^3	-	-	0.050 mg/m^3	0.05 mg/m^3	0.050 mg/m^3	-	-	-	-	-
Manganese (compounds and fume)	R,I	500 mg/m^3	5 mg/m^3 [OSHA]	3 mg/m^3 [NIOSH]	-	0.2 mg/m^3	1 mg/m^3	-	-	-	-	-
Mercury & Inorganic Mercury Compounds	R,I,A,C	10 mg/m^3	0.1 mg/m^3 [NIOSH, Skin]; 0.1 mg/m^3 [OSHA]	-	-	0.025 mg/m^3	0.05 mg/m^3 [skin]	-	-	-	-	-
Organo-Mercury Compounds	R,A,I,C	2 mg/m^3	0.04 mg/m^3 [OSHA]	0.03 mg/m^3 [NIOSH]	0.01 mg/m^3	0.01 mg/m^3 [alkyl]; 0.1 mg/m^3 [aryl]	0.01 mg/m^3	-	-	-	-	-
Nickel (metal and compounds)	R,I,C	Ca [10 mg/m^3]	-	-	1 mg/m^3	1.5 mg/m^3 [metal]; 1 mg/m^3 [soluble inorganic compounds]; 1 mg/m^3 [insoluble	0.015 mg/m^3	-	-	-	-	-
Particulate (Not otherwise regulated)	R, C	ND	-	-	15 mg/m^3 (total); 5 mg/m^3 (respirable)	10 mg/m^3 (inhalable); 3 mg/m^3 (respirable)	-	-	-	-	-	-
Portland cement	R,I,C	5000 mg/m^3	-	-	50 mppcf	10 mg/m^3	10 mg/m^3 (total); 5 mg/m^3 (respirable)	-	-	-	-	-
Selenium compounds	R,I,C	1 mg/m^3	-	-	0.2 mg/m^3	0.2 mg/m^3	0.2 mg/m^3	-	-	-	-	-
Silica, crystalline	R, C	Ca [25 mg/m^3 (cristobalite, tridymite); 50 mg/m^3 (quartz, tripoli)]	-	-	Dependent on silicon dioxide content of silica (see Appendix C of the NIOSH Pocket Guide to Chemical Hazards, 2000)	Dependent on minerology [see ACGIH 2005 TLVs and BEIs Handbook]	0.05 mg/m^3	-	-	-	-	-
Silver (metal and soluble compounds)	R,I,C	10 mg/m^3	-	-	0.01 mg/m^3	0.1 mg/m^3	0.01 mg/m^3	-	-	-	-	-
Thallium, soluble	R,A,I,C	15 mg/m^3	-	-	0.1 mg/m^3 [skin]	0.1 mg/m^3 [skin]	0.1 mg/m^3 [skin]	-	-	-	-	-
Tin (metal)	R,C	100 mg/m^3	-	-	2 mg/m^3	2	2 mg/m^3	-	-	-	-	-
Tin (organic compounds)	R,A,I,C	25 mg/m^3	-	-	0.1 mg/m^3	0.1 mg/m^3 [skin]	0.1 mg/m^3 [skin]	-	-	-	-	-
Zinc oxide dust & fume	R	500 mg/m^3	15 mg/m^3 [NIOSH, dust]	10 mg/m^3 [NIOSH; ACGIH fume]	15 mg/m^3 (total dust), 5 mg/m^3 [respirable dust]; 5 mg/m^3 [fume]	2 mg/m^3 [respirable]	5 mg/m^3 (total dust), 5 mg/m^3 [fume]	-	-	-	-	-

NOTES & ABBREVIATIONS:

All units in parts per million (ppm) unless otherwise noted.
R = Respiratory (Inhalation)
I = Ingestion
A = Skin Absorption
C = Skin Contact
-: Not available
ND: Not detectable.
Ca = Carcinogen
** = Use 11.7 eV lamp
IP: Ionization potential
eV: Electrovolts

IDLH: Immediately dangerous to life and health
Ceiling: Highest allowable instantaneous
C = Skin and/or Eye Contact
STEL: Short-term exposure limit. Exposure period is 15 minutes unless otherwise indicated
PEL: OSHA Permissible Exposure Limit (legally-enforceable)
REL: NIOSH Recommended Exposure Limit
PID: Photoionization Detector
OSHA: United States Occupational Safety and Health Administration
NIOSH: National Institute of Occupational Safety and Health
TLV: ACGIH Threshold Limit Value
ACGIH: American Conference of Governmental Industrial Hygienists

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Physical Hazards:

Indicate all hazards that may be present for each task. If any of these potential hazards are checked, it is the project manager's responsibility to determine how to eliminate/minimize the hazard to protect onsite personnel.

Copy and paste a checkmark "✓"into appropriate boxes.

Physical Hazard Checklist				
Potential Job Hazards	**Task 1**	**Task 2**	**Task 3**	**Task 4**
	Test Pits	MW Install	Well Development	Well Sampling
Confined space entry*				
Underground utilities	✓	✓		
Overhead utilities	✓	✓		
Electrical hazards				
Excavations greater than 4' depth	✓			
Open excavation fall hazards	✓			
Heavy equipment	✓	✓		
Drilling hazards		✓		
Noise (above 85 dBA)	✓	✓		
Traffic concerns	✓	✓	✓	✓
Extreme weather conditions	✓	✓	✓	✓
Rough terrain for drilling equipment				
Buried drums				
Heavy lifting (more than 50 lbs)	✓	✓	✓	✓
High risk fire hazard				
Poisonous insects or plants				
Water hazards				
Use of a boat				
Lockout/Tagout requirements				
Other: Specify				

***CONFINED SPACE ENTRY REQUIRES SPECIAL PROCEDURES, PERMITS AND TRAINING AND MUST BE APPROVED BY THE CORPORATE HEALTH & SAFETY MANAGER.**

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Potential Activity Hazards and Hazard Controls:

Copy and paste a checkmark "✓" adjacent to potential activity hazards and relevant hazard controls.

POTENTIAL ACTIVITY HAZARDS

Abrasions and Cuts ✓
Access
Asphyxiation
Bacteria
Biological Hazards
Bloodborne Pathogens
Cave Ins
Chemical/Thermal Burns
Chemicals
Cold Stress ✓
Compressed Gases
Confined Spaces
Congestion
Defective Equipment
Dermatitis
Dropping Materials/Tools to Lower Levels
Drowning or Flowing Water
Electrical Shock
Energized Equipment
Equipment Misuse ✓
Ergonomics
Excavations ✓
Explosions
Fatigue
Fire ✓
Flammability
Flying debris ✓
Foreign Body in Eye ✓
Frostbite/Cold
Fueling and Fuel Storage ✓
Fugitive Dust ✓
Fumes ✓
Generated Wastes
Guards removed
Hazardous Materials ✓
Heat Stress (cramps, exhaustion, stroke)
Heavy Equipment Operation ✓
Heavy Equipment/Stability ✓
Heavy Lifting ✓
High crime area (violence)
High Winds
Hoists, Rigging, Slings, Cables ✓
Housekeeping – Improper ✓ Illumination - Poor
Impact ✓
Inability to Maintain Communication
Inclement Weather ✓
Inclines
Insects/Reptiles
Mold
Moving Equipment, Conveyors or Vehicles ✓
Muddy Site Conditions
New Personnel
Noise ✓
Odor ✓
Overhead Utilities ✓
Overhead Work
Overloaded Equipment
Oxygen deficiency
Pinch Points ✓
Poisonous Plants
Pressure
Pressurized Lines ✓
Radiation
Repetitive Motion
Rigging - Improper ✓
Sharp Objects ✓
Silicosis
Slips, Trips, and Falls ✓
Sprains and Strains ✓
Steam
Sunburn
Surface Water Run-off
Toxicity ✓
Traffic ✓
Underground Utilities ✓
Uneven Terrain
Unsafe Atmosphere
Vibration
Visibility - Poor
Visitors Known/Unknown
VOC Emissions ✓
Weight ✓
Work at Depth
Work at Heights
Work over Water
Working on Ice

HAZARD CONTROLS

Air Monitoring ✓
Appropriate Clothing/Monitoring Of Weather ✓
Appropriate Labels/Signage ✓
Barricades/Fencing/Silt Fencing ✓
Buddy System - Attendant
Chock Blocks ✓
Confined Space Procedures
Decontamination Procedures ✓
Derived Waste Management Plan
Drinking Water/Fluids ✓
Dust Abatement Measures ✓
Emergency Action Plan Procedures
Equipment Inspection ✓
Equipment Manuals/Training
Exclusion/Work Zones ✓
Exhaust Ventilation
Eye Protection ✓
Fall Protection
Fire Extinguisher ✓
Flotation Devices/Lifelines
Gloves ✓
Ground Fault Interrupter
Grounded Hydraulic Attachments
Grounded Equipment/Tanks
Hand Signal Communication✓
Hard Hat ✓
Hazardous/Flammable Material Storage
Hearing Protection ✓
High Visibility Safety Vest ✓
Hoses, Access to Water
Hotwork Procedures
Isolation of Energy Sources(Lockout/Tagout)
Machine/Equipment Guards
Manual Lifting Equipment
Police Detail ✓
Proper Lifting Techniques ✓
Proper Tool for Job ✓
Proper Work Position/Tools ✓
Protective Equipment ✓
Radio Communication
Respirator, (Specify Type)
Safety Harness /Lanyard/Scaffold
Security Escort
Sloping, Shoring, Trench Box
Spill Prevention Measures
Spill Kits
Stormwater Control
Traffic Controls ✓
Procedures/Methods
Vehicle Inspection ✓
Visitor Orientation Escort
Window Cleaning/Defrost ✓

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Specific Activity Hazards and Precautions

None

Safety Meetings

All H&A personnel visiting the site will be given an orientation safety meeting and are required to read and sign this HASP. Daily safety meetings will be conducted onsite and documented on a Health & Safety Tailgate Meeting Form.

Utility Locators and Underground Hazards

Prior to drilling, Haley & Aldrich staff members will ensure that permission has been gained from the property owner to access the property. Before marking any proposed exploration or drilling location, it is critical that all readily available information on underground utilities and structures be obtained. The estimated location of utility installations, such as sewer, telephone, fuel, electric, water, or any other underground installation that may be expected to be encountered during drilling work, will be identified with the appropriate authority. Appropriate authorities include client representatives, utility companies, nonprofit organizations (e.g., "Dig-Safe), and others. A list of all state “utility locators” is posted on the Health and Safety Homepage under “Guidance Documents”.

> *Note: It is important to note that not all utilities are participants in the “one-call” agency or process. As such, inquiries must be made with the “one-call” agency to determine which entities do not participate, so they can be contacted independently.*
>
> *Also, most stake-outs or markings have a limited time period for which they remain valid, typically 2 to 3 weeks. It is critical that this time period be taken into account to prevent expiration of clearance prior to completion of the invasive activities, and the need to repeat the process.*

Completion of the utility stake out is not a guarantee that the underground facilities will not be encountered in the boreholes; Very few if any guarantee their work nor do they accept the liability for damage or losses if one may occur. Accordingly, Haley & Aldrich field staff are expected to use extreme caution in the upper 4-5 feet in the event the clearance has failed to identify an existing facility. This may necessitate hand-excavation or probing to confirm the presence of shallow utilities.

When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, geophysical techniques, such as ground penetrating radar and/or magnetometery can be utilized to locate the potential underground hazards. Using any information that can be obtained, the site should be viewed in detail for physical evidence of buried lines or structures. Evidence of surface elements of buried utilities should be documented, such as manholes, gas or water valves, catch basins, etc.

No subsurface drilling activities will be allowed until “all” utilities have been properly located and marked.

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Marking locations can be accomplished using spray paint on the ground, stakes, or other similar method. All markings of proposed locations shall be made in white, in accordance with the generally-accepted universal color code for facilities identification (AWMA 4/99).

White:	Proposed excavation or drilling location
Pink:	Temporary Survey Markings
Red:	Electrical, Power Lines, Cables, Conduit, and Lightening Cables.
Yellow:	Gas, Oil, Steam, Petroleum , and Gaseous Materials.
Orange:	Communications, Alarm, or Signal Lines, Cables, and Conduits.
Blue:	Potable Water.
Purple:	Reclaimed Water, Irrigation, and Slurry Lines.
Green:	Sewers and Drain Lines.

The public and private utility entities generally only mark the locations of their respective underground facilities within public rights-of-way. Determination of the locations on private property will most likely be the responsibility of Haley & Aldrich or the contractor. In some cases, it may be necessary to put the ultimate responsibility back on the owner, to assist in the location of the utilities. It is incumbent on Haley & Aldrich and the Contractor to exercise caution and use good judgement when faced with uncertainty.

Excavation and Trenching Safety

The following is a list of minimum requirements for trenching and excavating. Each excavation/trench/shoring project is different, therefore the Contractor/Consultant Project Manager is responsible for evaluating site specific conditions and making appropriate provisions in the task-specific health and safety requirements in conformance with 29 CFR 1926 Subpart P - Excavations.

- Contact the proper utilities to obtain clearance. Prior to work, review the utilities in the area and be sure they have been staked properly. Before work begins, a Safe Work Permit must be obtained from the Client/Site manager of Operations Safety Representative.

- Be aware that trenches and excavations deeper than four feet are considered confined spaces and require additional safety precautions, such as shoring. If an excavation exceeds four feet in depth, contact the Client or H&A Safety Representative to review the original Safe Work Permit and ensure that it is adequate.

- The walls and faces of all excavations and trenches more than four feet deep, in which an staff member is exposed to danger from moving ground, will be guarded by a shoring system, sloping of the ground, or some other equivalent means. The design of shoring systems must be done by a registered Professional Engineer as per 29 CFR 1926 Subpart P.

- Staff members are not allowed to enter test pits. Sample collection will be performed with the bucket of the excavator.

- Hard hats and other personal protective equipment will be worn at all times during any type of excavating or trenching operation.

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- Determine soil composition (e.g., through soil sampling, soil maps, etc.) and other relevant site conditions, with special emphasis on conditions conducive to cave-ins.

- Monitor the atmosphere in and around trenches on a regular basis to check for explosive, toxic or otherwise dangerous gases and vapors.

- The Contractor/Consultant Project Manager will insure that all staff members involved in the excavation activity have appropriate training in safe trenching practices, with emphasis on factors such as:
    - utility line identification
    - cave-in prevention measures
    - recognition of conditions which may cause cave-ins

- Water will not be allowed to accumulate in any excavation. Utilize ditches, dikes, pumps, or other means to keep surface water out of trenches.

- All open excavations must be well marked and barricaded.

Excavation Cave-In Hazards

- The following conditions increase the likelihood of cave-in: Soil materials composed of unconsolidated, uncompacted, and/or rounded particles (See 29 CFR 1926 Subpart P - Excavation Standard). Special care must be used when trenching in areas that have previously been excavated and backfilled.

- Soils, which have a high water, content, or have been subjected to freeze-thaw or frost-heaving.

- Loading of trench walls by adjacent equipment, supplies, structures, "back-dirt" piles, etc.

- Vibration due to equipment operating near excavations.

- Trench walls that are steeper than the angle of repose of the material composing the walls.

- Deep trenches (i.e., high trench walls).

  The following precautions should be used to prevent cave-ins in all trenches in excess of 4 ft. deep. These precautions should also be used in trenches less than 4 ft. deep whenever those site conditions just listed indicate the likelihood of a cave-in:

  - Sloping: Trench walls should be sloped to the correct angle of repose.

  - Shoring: Vertical trench walls (unless composed of solid rock) must be shored and braced, or restrained with movable trench boxes, to prevent cave-in. A registered professional engineer must design shoring systems and meet accepted engineering requirements.

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Heavy Equipment

Staff Members must be especially careful and alert when working with contractors who use heavy equipment, since equipment failure or breakage can lead to accidents and worker injury. Cranes and equipment for drilling, pile driving, test pitting and coring is of special concern. Should these devices fail during operation the likelihood of worker injury is high. Equipment of this nature should be visually inspected and checked for proper working order prior to the commencement of field work. Those that operate heavy equipment must meet all of the requirements to operate heavy equipment. Haley & Aldrich, Inc. staff members that supervise projects or are associated with such high risk projects that involve digging should use due diligence when working with a construction firm. Maintain visual contact with operators at all times and keep out of the strike zone whenever possible. Always approach heavy equipment with an awareness of the swing radius and traffic routes of each piece of equipment and never go beneath a hoisted load. High-visibility safety vests must be worn onsite at all times. Avoid fumes created by heavy equipment exhaust.

Rig Inspection

Each day, prior to the start of work, the driller will inspect the drill rig and associated equipment. The following checks will be made:

- Vehicle condition: Check proper operation of brakes, lights, steering mechanism, and horn.
- Equipment storage: All equipment such as auger flights, split spoon samplers, hammers, hand tools, etc. will be properly stored in an appropriate location and will be secured before moving the rig.
- Wire rope, Cat Line: All wire rope, cable and Cat Line will be inspected for signs of wear such as broken wires, a reduction in rope diameter, abrasion, or signs of rust. Worn, frayed, or otherwise damaged wire, rope or cable will be replaced.
- Safety equipment: Each rig will have at least one fire extinguisher (Type B/C) and one First Aid Kit.

Rig Set-Up

Each drill rig will be properly blocked and leveled prior to raising the derrick. The rig will be moved only after the derrick has been lowered. The leveling jacks will not be raised until the derrick has been lowered.

Blocking provides a more stable drilling structure by evenly distributing the weight of the rig. Proper blocking ensures that a differential settling of the rig does not occur. Wooden blocks, at least 12 by 12 inches and four to eight inches thick, are recommended and should be placed between the jack swivels and the ground. The emergency brake will be engaged and the wheels that are on the ground chocked.

Site drilling will comply with the following rules:

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- Before drilling, the Contractor/Consultant Site Coordinator will ensure an adequate safety zone around the drill rig and associated operations.

- Before drilling, the existence of underground utilities in the work area will be determined and conspicuously marked.

- If drilling is conducted in the vicinity of overhead power lines, proper distance will be maintained between the drill rig and the lines as per OSHA 29 CFR 1926, Subpart N. The proper distance or shielding technique will be stated in the project-specific HASP.

Noise Reduction

Site activities in proximity to heavy equipment often expose workers to excessive noise. It is anticipated that situations may arise when noise levels may exceed the OSHA Action Level of 85 dBA in an 8-hour time-weighted average (TWA). An example of this possibility is working in close proximity to the subcontractor during drilling activities onsite. If excessive noise levels occur, efforts will be made to control this by issuance of earplugs to all personnel and by implementing a system of hand signals understood by all.

Work Site Access & Controls (Standard Precautions)

The work area is restricted to authorized personnel. Clearly define the work area before beginning activities for the day. Caution tape and safety cones must be provided as necessary for vehicular traffic concerns and to protect passers-by. Proper housekeeping is essential to avoid creating hazards to pedestrian and vehicular traffic. Excavations in progress will not be left unattended at any time. Running equipment will not be left unattended at any time. Test borings and test pits will be backfilled upon completion and the area restored. Drilling equipment will be secured above test borings during work stoppages and at the end of the workday.

Site Security

Site is fenced.

Weather Related Hazards

H&A employees and their subcontractors should be aware of potential health effects and/or physical hazards of working during inclement weather. Refer to OP1003-Cold Stress and OP1015-Heat Stress for discussion on weather hazards.

Lightning

- Always pay attention to the weather conditions. You are responsible for your own safety. Use common sense and do not feel pressure to continue to work if you feel there is a threat and others don't, such as contractors and co-workers.
- If you are using conductive tools and equipment, separate yourself from them as far as practical.
- If you are near a drilling rig, lower the mast and move away from the rig.

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- Rule of thumb- wait until 30 minutes after the last observed lightning strike or thunderclap before resuming your outdoor activities, warns the National Lightning Safety Institute.
- Protect yourself by taking cover in the best shelter you can find.
- If you are in or near the water, go to land immediately and find shelter. Take extra precaution when on the water and in a boat.
- If choosing between a building and a car, choose the building.
- If choosing between a hardtop and a convertible, choose the hardtop.
- If you're in a car, keep the windows closed.
- If there is no shelter, find a low-lying, open place that is a safe distance from trees, poles, or metal objects that can conduct electricity. Make sure it is not likely to flood.
  Assume a tucked position: Squat low to the ground. Place your hands on your knees with your head tucked between them. Try to touch as little of your body to the ground as possible.
- Do not lie flat on the ground, as your fully extended body will provide a larger surface to conduct electricity. Stay in a tuck position well after the storm passes.
- Watch for local flooding you may have to move if water begins to accumulate.
- If you feel your hair stand on end in a storm, drop into the tuck position **immediately.** This sensation means electric charges are already rushing up your body from the ground toward an electrically charged cloud. Minimize your contact with the ground to minimize your injury.

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5. PROTECTIVE MEASURES

Personal Protective Equipment Requirements:

Copy and paste a checkmark "✓"into appropriate boxes.

Required PPE	Task 1	Task 2	Task 3	Task 4
	Test Pits	MW Install	Well Development	Well Sampling
Hard hat	✓	✓		
Safety glasses w/side shields	✓	✓	✓	✓
Steel-toe footwear	✓	✓	✓	✓
Hearing protection (plugs, muffs)	✓	✓		
Tyvek ™ coveralls				
PE-coated Tyvek™ coveralls				
Boots, chemical resistant				
Boot covers, disposable				
Leather work gloves				
Inner gloves - Nitrile	✓	✓	✓	✓
Outer gloves -				
Tape all wrist/ankle interfaces				
Half-face respirator*				
Full-face respirator*				
Organic vapor cartridges				
Acid gas cartridges				
Other cartridges: Enter type here				
P-100 (HEPA) filters				
Face shield				
Personal Flotation Device (PFD)				
High-Visibility Safety Vest	✓	✓	✓	✓
Other:				
Level of protection required [C or D]:	D	D	D	D

* In the event of respirator use, H&A staff must be medically qualified, fit tested and clean shaven with no facial hair that will interfere with the seal.

The required PPE checked in any box above must be on site during the task being performed. Work shall not commence unless the required PPE is present.

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Site Safety Equipment Requirements:

Check all items that are required to be on site.

Site Safety Equipment

☑ Fire Extinguisher	☑ First Aid Kit	☐ Flashlight
☐ Air horn/signaling device	☑ Cellular Phone	☐ Duct tape
☐ Ladder	☑ Barricade tape	☐ Drum dolly
☐ Two-way radio	☑ Safety cones	☐ Harness/Lanyard
☐ Other Specify		

The required equipment checked in any box above must be on site during the task being performed. Work shall not commence unless the equipment is present.

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6. MONITORING PLAN AND EQUIPMENT

Is air/exposure monitoring required at this work site for personal protection? ☑ Y ☐ N

Is perimeter monitoring required for community protection? ☐ Y ☑ N

Monitoring/Screening Equipment **Requirements:**

Check all items that are required to be on site.

Required Monitoring/Screening Equipment

- ☐ Photo-Ionization Detector (PID) 10.2eV
- ☐ Photo-Ionization Detector (PID) 11.7eV
- ☑ Photovac Micro Tip (PID) 10.6eV
- ☐ Organic Vapor Monitor (FID)
- ☐ Photovac Gas Chromatagraph (GC)
- ☐ Combustible Gas Indicator (CGI) (LEL)
- ☐ Multiple Gas Detector LEL/O2/H2S/CO
- ☐ Dust Monitors (RAMs)
- ☐ Colorimetric tubes
- ☐ Other

The required equipment checked in any box above must be on site. Work shall not commence unless the equipment is present.

Standard Action Levels and Required Responses:

Exposure Guidelines for common contaminants are listed in Table 1 - Occupational Exposure Limits in the Chemical Hazards section above.

Requirements for PPE upgrades based on monitoring are in Table 2 - Monitoring Methods, Action Levels and Protective Measures following the Specific Monitoring Requirements section below.

Action levels for readings obtained with a multiple gas detector are listed below.

Instrument	Normal	Operating levels	Action levels – required responses
Oxygen Meter	20.9%	Between 19.5-23.5%	Below 19.5 %: leave area, requires supplied air Above 23.5%: leave area, fire hazard
CGI	0%	Less than 10%	Greater than 10%: fire/explosion hazard; cease work
Hydrogen Sulfide	0%	Less than 10 ppm.	Greater than 15 ppm (or 10 ppm for 8 hrs) requires supplied air respirator
Carbon Monoxide	0%	Less than 25 ppm	Greater than 200 ppm for 1 hour (or 25 ppm for 8 hrs) requires supplied air respirator

Note: This HASP is developed for Haley & Aldrich purposes only and not for use by others.

Standard Air Monitoring Plan (Volatiles):

- Prior to the beginning of work obtain background readings with the PID away from the site.
- Monitor the breathing zone when site soil is exposed (e.g., while drilling or excavating is occurring, etc.) with the PID.
- Monitoring should be conducted most frequently (e.g., every 15-30 minutes) when drilling or excavation first begins in a particular area and when soil is removed from the hole. After this, and if no exceedances of exposure limits are noted (see below), monitoring may be conducted less frequently (e.g., every 60 minutes).
- H&A general exposure limits will be used when a mixture of potentially volatile chemicals are suspected to be present in soil at the site.

In summary, if a reading of 10 ppm above background is detected with the PID for 5 minutes or longer, back away for a few minutes. Screen the air again after any vapors/gases have been given a chance to dissipate. If 10 ppm above background is still noted, evacuate the area and call the RHSC and PM for further guidance.

- Record monitoring data and PPE upgrades in field book or on Record of Field Monitoring form and maintain with project files.

- Air monitoring for exposure should be based on the frequency established under the Standard Air Monitoring Plan or under the Specific Monitoring Requirements. Record time, location and results of monitoring and actions taken based upon the readings.

Standard Dust Control Measures and Monitoring Plan:

Dust Control Measures:

It is anticipated that exposure to airborne dust can be mitigated during work operations as necessary to control dust emissions by means of limiting the area of exposed soils and through the use of water sprays. If dust emissions cannot be controlled by these standard measures, additional measures may be employed such as the use of a tackifier (if approved) to stabilize soil exposures or by covering exposed soil and stockpiles with tarpaulins, plastic sheeting or geotextile fabric. Otherwise cease work immediately and contact the Project Manager or the Corporate Health & Safety Manager for assistance. It is not permissible for dust emissions to escape from the site at any time and perimeter dust monitoring may be required to insure public safety.

Dust Monitoring:

Respirable Aerosol Monitors (RAM) can be used to monitor total dust levels in work zones and/or at the site perimeter. These instruments do not give specific readings of contaminant concentration (e.g. metals, asbestos, etc.). Depending upon the contaminants present, it may be mandatory for all workers to upgrade to level C protection using a half-face air-purifying respirator with HEPA (P-100) filters if dust levels cannot be adequately controlled during any of the on-site tasks. The H&A Site Safety Officer (SSO) will determine PPE upgrades based upon visual determination as necessary and the OSHA PEL for each known or suspected contaminant. The OSHA PEL/STEL for Respirable Nuisance Dust is 5 mg/m^3 (8 hour TWA).

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Action levels for fugitive dust at the site perimeter are based upon the daily PM_{10} dust standard of 0.15 mg/m^3 in the National Ambient Air Quality Standard for Inhalable Dust (NAAQS).

Personal dust monitoring using an industrial hygiene pump and a filter cassette may be conducted on each day of operations. In such cases samples are collected from workers with the greatest potential dust exposure and analyzed by an accredited laboratory for specific contaminants.

Specific Monitoring Requirements:

Monitoring requirements and frequency is indicated by task and location below.

Task Number:	1	Frequency	1	times per	15 min

Task Number:	2	Frequency	1	times per	15 min

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TABLE 2
Last Revised September 2002

MONITORING METHOD, ACTION LEVELS AND PROTECTIVE MEASURES

INSTRUMENT	HAZARD	ACTION LEVEL	ACTION RESPONSE
Respirable Dust Monitor	Total Particulates	> 5 mg/m^3	Upgrade to Level C Protection
OVA, HNU[2], Photovac Microtip	Total Organic Vapors	Background	Level D Protection
		10 ppm > background or lowest OSHA permissible exposure limit, whichever is lower, or as modified for this task. Sustained for >5 minutes in the breathing zone.	Upgrade to Level C - site evacuation may be necessary for specific compounds
		50 ppm over background, unless lower values required due to respirator protection factors	Cease work; upgrade to Level B[3] may be required
Explosimeter[4] (LEL)	Flammable/Explosive Atmosphere	<10% Scale Reading	Proceed with work
		10-15% Scale Reading	Monitor with extreme caution
		>15% Scale Reading	Evacuate site
0xygen Meter[5]	Oxygen-Deficient Atmosphere	19.5% - 23.5% 0_2	Normal - Continue work
		< 19.5% 0_2	Evacuate site; oxygen deficient
		> 23.5% 0_2	Evacuate site; fire hazard
Radiation Meter[6]	Ionizing Radiation	0.1 Millirem/Hour	If > 0.1, radiation sources may be present[7]
		> 1 Millirem/Hour	Evacuate site; radiation hazard
Drager Tubes	Vapors/Gases	Species Dependent > 1 ppm vinyl chloride > 1 ppm benzene > 1 ppm 1,1-DCE	Consult Table 1 or other resources for concentration toxicity/detection data. Upgrade to Level C if concentration of compounds exceed thresholds shown at left; May need to cease work if other levels exceeded - site specific
Gas Chromatograph (GC)	Organic Vapors	3 ppm total OV > background or > lowest specific OSHA permissible exposure limit, whichever is lower	On-site monitoring or tedlar bag sample collection for off-site/laboratory analysis

Notes:
1. Monitor breathing zone.
2. Can also be used to monitor some inorganic species.
3. Positive pressure demand self contained breathing apparatus
4. Lower explosive limit (LEL) scale is 0-100%. LEL for most gasses is 15%.
5. Normal atmospheric oxygen concentration at sea level is 20%
6. Background gamma radiation is ~0.01-0.02 millirems/hour.
7. Contact H&A Health and Safety staff immediately.

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Calibration and Use of Equipment:

Calibrate all monitoring equipment in accordance with manufacturers requirements, H&A calibration (OP) standards and site specific requirements (e.g., at the beginning and end of each work day). Calibration of equipment shall be documented in the field notes or Daily Field Report (DFR). Documentation should include:

- Date/time
- Zero reading before calibration
- Concentration of calibration gas
- Reading obtained with calibration gas before adjusting span\
- Final reading obtained with calibration gas after adjusting span

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7. DECONTAMINATION AND DISPOSAL METHODS

Personal Hygiene Safeguards:

The following minimum personal hygiene safeguards shall be adhered to:

- No smoking or tobacco products on any Hazwoper project.
- No eating or drinking in the exclusion zone.
- It is required that personnel present on site wash hands before eating, smoking, taking medication, chewing gum/tobacco, using the restroom, or applying cosmetics and before leaving the site for the day.
- It is recommended that personnel present on site shower or bathe at home at the end of each day of working on the site.

Standard Personal Decontamination Procedures:

Outer gloves and boots should be decontaminated periodically as necessary and at the end of the day. Brush off solids with a hard brush and clean with soap and water or other appropriate cleaner whenever possible. Remove inner gloves carefully by turning them inside out during removal. Wash hands and forearms frequently. It is good practice to wear work-designated clothing while on-site which can be removed as soon as possible. Non-disposable overalls and outer work clothing should be bagged onsite prior to laundering. If gross contamination is encountered on-site contact the Project Manager and RHSC to discuss proper decontamination procedures. The steps required for decontamination will depend upon the degree and type of contamination but will generally follow the sequence below.

1. Remove and wipe clean hard hat
2. Rinse boots and gloves of gross contamination
3. Scrub boots and gloves clean
4. Rinse boots and gloves
5. Remove outer boots
6. Remove outer gloves
7. Remove Tyvek coverall
8. Remove respirator, wipe clean and store
9. Remove inner gloves

Location of Decontamination Station:

N/A

Disposal of PPE:

PPE that is not grossly contaminated can be bagged and disposed in regular trash receptacles. PPE that is grossly contaminated must be bagged (sealed) and field personnel should communicate with the Project Manager to determine proper disposal.

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Tools & Equipment Decontamination:

All decontamination should be conducted at the site and not at the office or lab.

Check all equipment and materials needed for decontamination of tools and other equipment.

☐ Acetone	☑ Distilled water	☑ Poly sheeting
☑ Alconox soap	☑ Drums for water	☐ Steam cleaner
☑ Brushes	☐ Hexane	☐ Tap water
☑ Disposal bags	☐ Methanol	☑ Washtubs
☑ 5 gallon pails	☑ Other Paper towels	

Standard Equipment Decontamination Procedures:

Air monitoring instrumentation and delicate instruments that are difficult to decontaminate or sensitive to water should be protected from contamination during use through the use of plastic sheeting. To the extent possible, efforts should be taken to limit the degree of contamination to hand tools and sampling equipment during use. Proper PPE must be worn while performing decontamination, including the wearing of chemical safety goggles and gloves. Storage or transport of decontamination solvents in squirt bottles is not permitted as they may discharge their contents upon ambient temperature change or leak if overturned. Standard equipment decontamination procedures are as follows. Any additional requirements are listed under Specific Equipment Decontamination Procedures below.

Pretreatment of heavily contaminated equipment may be conducted as necessary:

1. Remove gross contamination using a brush or wiping with a paper towel
2. Soak in a solution of Alconox and water (if possible)
3. Wipe off excess contamination with a paper towel
4. Clean with hexane or acetone and allow to dry

Standard decontamination procedure:

1. Wash using a solution of Alconox and water
2. Rinse with potable water
3. Rinse with methanol
4. Rinse with distilled water

Specific Equipment Decontamination Procedures:

Not Applicable

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Standard Disposal Methods for Contaminated Materials:

Excess sample solids, decontamination materials, rags, brushes, poly sheeting, etc. that are determined to be free of contamination through field screening can usually be disposed into client-approved, on-site trash receptacles. Uncontaminated wash water may be discarded onto the ground surface away from surface water bodies in areas where infiltration can occur. Contaminated materials must be segregated into liquids or solids and drummed separately for off site disposal. Any additional requirements are listed under Specific Disposal Methods for Contaminated Materials below.

Specific Disposal Methods for Contaminated Materials:

Not Applicable

Disposal Methods for Contaminated Soils:

Contaminated soil cuttings and spoils must be drummed for disposal off-site unless otherwise specifically directed. Soil cuttings and spoils determined to be free of contamination through field screening can usually be returned to the boreholes or excavations from which they came. Any additional requirements are listed under Specific Disposal Methods for Contaminated Soils below.

Specific Disposal Methods for Contaminated Soils:

Not Applicable

Contaminated Soil Sent to Geotechnical Lab:

Assignments that include geotechnical lab testing on contaminated samples must be accompanied with written data that will provide information on the type and extent of contamination. Project Managers must communicate any anticipated or known chemical hazards to the lab when assigning geotechnical tests. Preferably, a copy of this HASP should be forwarded to the laboratory for their review. If the contamination is not known, the PM must contact the laboratory and discuss the source of the sample to help identify any potential hazards that may be associated with the sample.

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8. CONTINGENCY PLANNING

How H&A responds to an emergency depends on whether we are at an active facility or another other location. Many active facilities have very stringent requirements for the mitigation of emergencies. Therefore, the PM is responsible for identifying any specific requirements from the client contact.

As a rule of thumb, the following are H&A's basic responses to handling Emergencies. Typically, H&A does not mitigate emergencies. When Clients request or require specific functions such as First Aid/CPR trained personnel on site, we typically conform. Before any Project Manager or RHSC agrees to something more stringent, many issues should be considered such as training, safety, feasibility of an adequate response, insurance requirements, and much more.

Fire:

- Major Fires - Major fires will be mitigated by the local fire departments or by client's on-site fire/emergency response departments.
- Incipient Stage Fires -Incipient stage fires will be extinguished by on-site personnel using fire extinguishers. Only those who have received annual training may use an extinguisher.

Medical:

All H&A employee injuries and illnesses will be documented using the Supervisor's Accident / Injury / Near Miss Report (SAIR). This form is available on the Intranet.

- First Aid - First aid will be addressed using the on-site first aid kit. H&A employees are not required or expected to administer first aid/CPR to any H&A, Contractor, or Civilian personnel at any time and it is H&A's position that those who do are doing it on their behalf and not as a function of their job.
- Trauma - Based upon the nature of the injury, the injured party may be transported to the nearest hospital or emergency clinic by on-site personnel or by ambulance. First response to a trauma incident is to call 911 or facility security. H&A staff members are expected to assist in ancillary roles only such as directing ambulances to the scene. It is the discretion of the staff member on site whether an ambulance should be procured in remote locations where ambulance services will not be effective.

Hazardous Materials Spill:

- Small incidental spills (e.g. pint of motor oil) caused by H&A employees and/or by the contractor will be mitigated by the H&A staff member and/or the contractor.
- Large spills (e.g. large leak from heavy equipment fuel tank). The contractor is responsible for cleanup. In the event that it posses a serious human or environmental threat, the local Fire Department and/or client emergency response department will be contacted. Once emergency has been mitigated typically clean up will be provided by a vendor.

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Rescue:

H&A employees will not enter any confined spaces for rescue purposes.

Weather Related Emergencies:

H&A employees and their subcontractors should be aware of potential health effects and/or physical hazards of working during inclement weather. If applicable, safeguards against the effects and hazards of heat stress, cold stress, frostbite, thunderstorms, and lightning, etc., should be included with the section pertaining to physical hazards in this HASP.

Evacuation Alarms:

Evacuation alarms and/or emergency information will be communicated among personnel on site through verbal communication.

Emergency Services:

Emergency services will be summoned via on-site or cellular phone.

Emergency Evacuation Plan:

The site evacuation plan is as follows:

1. Establish a designated meeting area to conduct a head count in the event of an emergency evacuation.
2. If the work area is not near an emergency exit, exit via the closest route and meet at the designated meeting area.
3. Notify emergency response personnel (fire, police and ambulance) of the number of missing or unaccounted for employees and their suspected location.
4. Administer first aid will in the meeting area as necessary.

Under no circumstances should any personnel re-enter the site area without the approval of the corporate H&S manager, the H&S coordinator, and the fire department official in charge.

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9. HEALTH & SAFETY PLAN ACKNOWEDGMENT FORM

Note: Only H&A employees sign this page.

I hereby acknowledge receipt and briefing on this Health & Safety Plan prior to the start of on-site work and declare that I understand and agree to follow the provisions and procedures set forth herein while working on this site.

PRINTED NAME	SIGNATURE	DATE

Note: This HASP is developed for Haley & Aldrich purposes only and not for use by others.

10. PRE-JOB SAFETY CHECKLIST

The following checklist is designed to help Project Managers verify that all Health & Safety requirements are satisfied for projects involving site work and to aid in the preparation of the site-specific HASP.

Please initial and date the appropriate box once each requirement has been satisfied prior to commencement of site work.

#	Project H&S Requirements	Approval by PM or RHSC (initial each box or place NA)	Date Approved
1	Project site history has been researched and summarized, current site conditions have been determined and documentation of previous investigations, risk analyses and chemical data has been assembled and summarized.		
2	Project work scope has been outlined and potential chemical and physical hazards associated with work tasks have been identified.		
3	Task Safety Analysis has been performed and attached to the HASP.		
4	H&A personnel to be involved with the project have been identified and are current with medical surveillance, OSHA 40 hour and 8 hour refresher training. Hazwoper site supervisor requirements are satisfied.		
5	Additional training requirements have been met: e.g. nuclear density gauge, DOT, Confined Space Entry, Competent Person Training for Excavation, OSHA 10 hour certification, Railway Safety Training, etc.		
6	H&A personnel that may be required to wear a respirator are medically qualified and have current certification of fit testing.		
7	Client's additional H&S requirements have been met: e.g. facility safety orientations, safety documentation, meetings, special PPE requirements		
8	H&A subcontractors have met H&A's minimum requirements including: current OSHA 40 hour training, medical surveillance, written HASP, insurance, MSDSs.		
9	MSDSs are on site and available for chemicals on site.		
10	Safety equipment is available: e.g. flashlight, telephone, ladders, traffic cones, barricade tape, fire extinguisher, first aid kit, PPE, respiratory protection, air and dust monitoring instrumentation (calibrated), personal flotation device (PFD), 90' life line with ring, decontamination equipment, etc.		
11	HASP and supporting documentation is complete and signed by all members.		

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APPENDIX A
HASP Amendment Form

This Appendix is to be used whenever there is an immediate change in the project scope that would require an amendment to the HASP. For project scope changes associated with "add-on" tasks, the changes must be made in the body of the HASP. Before changes can be made, a review of the potential hazards must be initiated by the H&A Project Manager.

Amendment No.	
Site Name:	
Work Assignment No.:	
Date:	
Type of Amendment:	
Reason for Amendment:	
Alternate Safeguard Procedures:	
Required Changes in PPE:	

Project Manager Signature: _____ Date: _____

Regional Health and Safety Coordinator: _____ Date: _____

This original form must remain on site with the original HASP. If additional HASPs are in the field, it is the Project Manager's responsibility to forward a signed copy of this amendment to those who have copies.

Note: This HASP has been developed for Haley & Aldrich purposes only and is not for use by others.

APPENDIX B
Issuance and Compliance
Site Safety Officer Role and Responsibilities
Training Requirements

This Health & Safety Plan (HASP) has been prepared in accordance with the requirements of Title 29 the Code of Federal Regulations (CFR) Section 1910.120/1926.65 to provide guidance for the protection of onsite personnel from physical harm and chemical exposure while working at the subject site.

The specific requirements of this HASP include precautions for hazards that exist during this project and may be revised as new information is received or as site conditions change.

- This HASP must be signed by all Haley & Aldrich (H&A) staff members who will work on the project, including H&A visitors. By signing the Health and Safety Plan Acknowledgement Form personnel are acknowledging that they are aware of the specific hazards of the site and agree to follow the provisions and procedures required to safeguard themselves and others from those hazards.
- This HASP or a current signed copy must be retained at the site at all times when H&A staff members are present.
- Deviations from this HASP are not permitted without prior approval from the above signed. Unauthorized deviations may constitute a violation of H&A company procedures/policies and may result in disciplinary action.
- Revisions to this HASP must be outlined within the contents of the HASP. If immediate or minor changes are necessary, the RHSC and H&A Project Manager may use Appendix A (HASP Amendment Form), located in the back of this HASP. Any revision to the HASP requires personnel to be informed of the changes and that they understand the requirements of the change.
- This HASP is not for H&A Subcontractor use. Each subcontractor engaged is responsible for all matters relating to the health and safety of their personnel and the safe operation of their equipment. This HASP will be made available as a reference so that subcontractors are informed of the potential hazards associated with the site to the extent we are aware. Subcontractors must develop their own HASP which must be, at a minimum, at least as protective as this HASP.
- This Site Specific HASP provides only site-specific descriptions and work procedures. General safety and health compliance programs in support of this HASP (e.g., injury reporting, medical surveillance, personal protective equipment (PPE) selection, etc. are described in detail in the H&A Corporate Health and Safety Program Manual and within Standard Operating Procedures (OPs). Both the manual and OPs can be located on the Company Intranet. When appropriate, users of this HASP should always refer to these resources and incorporate to the extent possible. The manual and OPs are available to clients and regulators per request.

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Site Safety Officer:

The site safety officer (SSO) is defined as the individual responsible to the employer with the authority and knowledge necessary to implement the HASP and verify compliance with applicable health and safety requirements.

The H&A Project Manager may designate any person as the site safety officer (SSO) and determines the order of authority on site. Usually the highest ranking person on site is the SSO. A site safety officer must be on site at all times. When none of the designated SSOs are present on site, the senior person for H&A on site will default to the SSO. This project has identified the following hierarchy for SSO.

1. Enter name of site safety officer here

2. Enter name of site safety officer here

Site Safety Officer Roles and Responsibilities:

The SSO is responsible for field implementation of this HASP and enforcement of safety rules and regulations. SSO functions include:

- Act as H&A's liaison for health and safety issues with client, staff, subcontractors, and agencies.
- Verify that utility clearance has been performed by H&A subcontractors.
- Oversee day-to-day implementation of the HASP by H&A employees on site.
- Interact with subcontractor project personnel on health and safety matters.
- Verify use of required PPE as outlined in the HASP.
- Inspect and maintain H&A safety equipment, including calibration of air monitoring instrumentation used by H&A.
- Perform changes to HASP and document in Appendix A of the HASP as needed and notify appropriate persons of changes.
- Investigate and report on-site accidents and incidents involving H&A and its subcontractors.
- Verify that site personnel are familiar with site safety requirements (e.g., the hospital route and emergency contact numbers).
- Report accidents, injuries, and near misses to the H&A PM and Regional Health and Safety Coordinator (RHSC) as needed.

The SSO will conduct initial site safety orientations with site personnel (including subcontractors) and conduct toolbox and safety meetings thereafter with H&A employees and H&A subcontractors at regular intervals and in accordance with H&A policy and contractual obligations. The SSO will track the attendance of site personnel at H&A orientations, toolbox talks, and safety meetings. Subcontractors will document training and provide training rosters to the H&A SSO.

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The SSO will report accidents such as injury, overexposure, or property damage to the Regional Health and Safety Coordinator, to the Project Manager, and to the safety managers of other on-site consultants and contractors. The SSO will consult with the safety managers of other on-site consultants and subcontractors on specific health and safety issues arising over the course of the project, as needed.

Health and Safety Training Requirements:

Personnel will not be permitted to supervise or participate in field activities until they have been trained to a level required by their job function and responsibility. H&A staff members, contractors, subcontractors, and consultants who have the potential to be exposed to contaminated materials or physical hazards must complete the training described in the following sections.

The H&A Project Manager/RHSC will be responsible for maintaining and providing to the client/site manager documentation of H&A staff members' compliance with required training as requested. Records shall be maintained per OSHA requirements.

40-Hour Health and Safety Training

The 40-Hour Health and Safety Training course provides instruction on the nature of hazardous waste work, protective measures, proper use of personal protective equipment, recognition of signs and symptoms which might indicate exposure to hazardous substances, and decontamination procedures. It is required for all personnel working on-site, such as equipment operators, general laborers, and supervisors, who may be potentially exposed to hazardous substances, health hazards, or safety hazards consistent with 29 CFR 1910.120.

8-hour Annual Refresher Training

Personnel who complete the 40-hour health and safety training are subsequently required to attend an annual 8-hour refresher course to remain current in their training. When required, site personnel must be able to show proof of completion (i.e., certification) at an 8-hr refresher training course within the past 12 months.

8-Hour Supervisor Training

On-site managers and supervisors directly responsible for, or who supervise staff members engaged in hazardous waste operations, should have eight additional hours of Supervisor training in accordance with 29 CFR 1910.120. Supervisor Training includes, but is not limited to, accident reporting/investigation, regulatory compliance, work practice observations, auditing, and emergency response procedures.

Additional Training for Specific Projects

H&A personnel will ensure their personnel have received additional training on specific instrumentation, equipment, confined space entry, construction hazards, etc., as

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necessary to perform their duties. This specialized training will be provided to personnel before engaging in the specific work activities including:

- Client specific training or orientation
- Competent person excavations
- Confined space entry (entrant, supervisor, and attendant)
- Heavy equipment including aerial lifts and forklifts
- First aid/ CPR
- Diving certification
- Use of fall protection
- Commercial drivers license
- Use of nuclear density gauges
- Asbestos awareness

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APPENDIX C

Field Forms

Well Boring Log
Well Installation Log
Monitoring Well Development Form
Low-Flow Groundwater Sampling Record
Environmental Test Pit Log

HALEY & ALDRICH

WELL BORING LOG

BORING NO.

Page 1 of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft.	Datum	Boring Location

Item	Casing	Sampler	Core Barrel
Type			
Inside Diameter (in.)			
Hammer Weight (lb.)			
Hammer Fall (in.)			

Rig Make & Model

☐ Truck ☐ Tripod ☐ Cat-Head

☐ ATV ☐ Geoprobe ☐ Winch

☐ Track ☐ Air Track ☐ Roller Bit

☐ Skid ☐ _____ ☐ Cutting Head

Hammer Type: ☐ Safety ☐ Doughnut ☐ Automatic

Drilling Mud: ☐ Bentonite ☐ Polymer ☐ None

Casing Advance: Type Method Depth

Drilling Notes:

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O	Open End Rod
T	Thin Wall Tube
U	Undisturbed Sample
S	Split Spoon Sample
G	Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.) _____

Rock Cored (Linear ft.) _____

Number of Samples _____

BORING NO.

Field Tests

Dilatancy: R - Rapid S - Slow N - None

Toughness: L - Low M - Medium H - High

Plasticity: N - Nonplastic L - Low M - Medium H - High

Dry Strength: N - None L - Low M - Medium H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

J:forms\final\3700.xls

HALEY & ALDRICH

WELL INSTALLATION LOG

Well No.

Boring No.

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP.**	
CONTRACTOR		**DATE INSTALLED**	
DRILLER		**WATER LEVEL**	

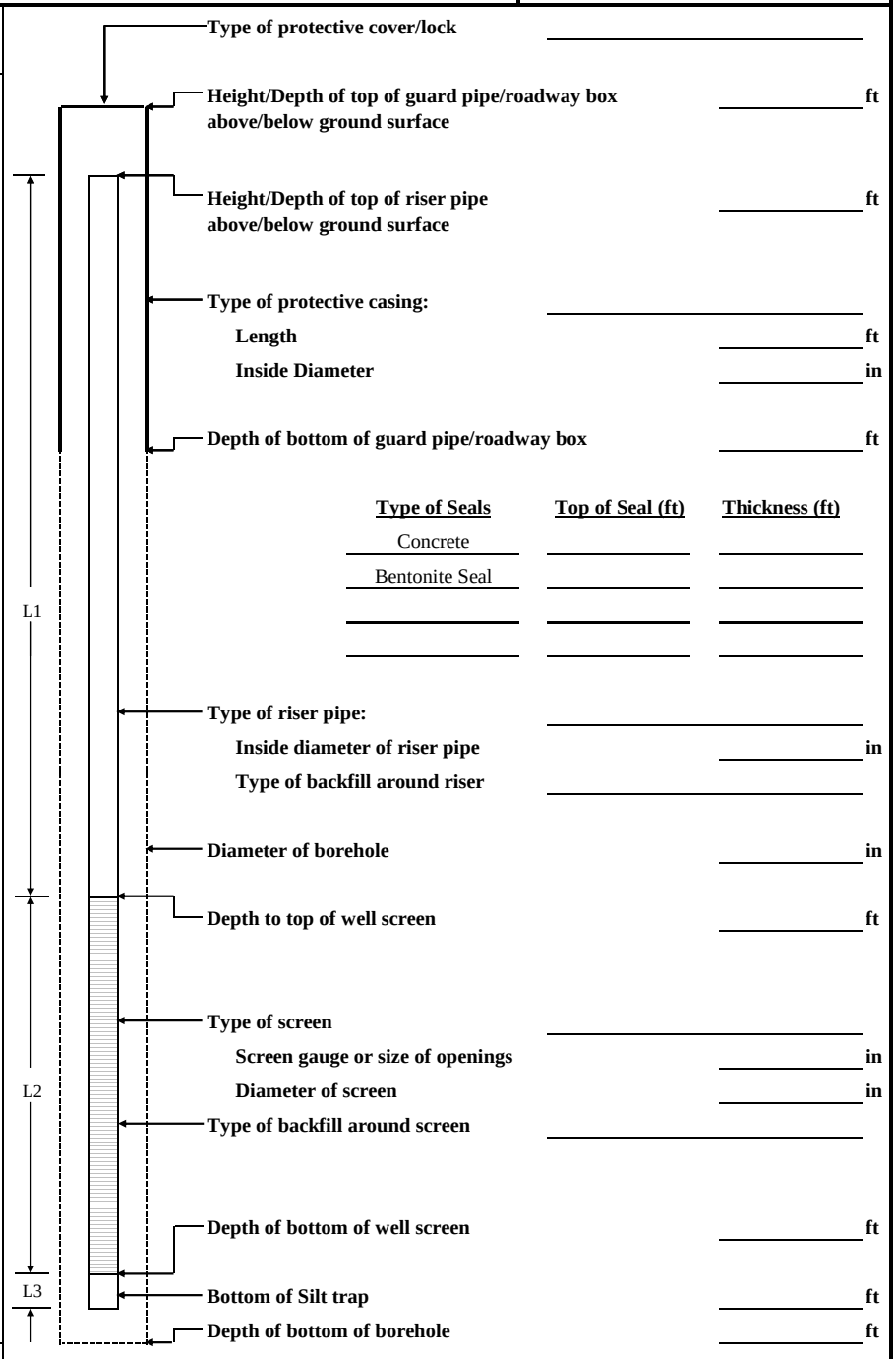
Ground El. _____ ft **Location** _____ ☐ **Guard Pipe**

El. Datum _____ ☐ **Roadway Box**

SOIL/ROCK CONDITIONS	**BOREHOLE BACKFILL**

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock _____

Height/Depth of top of guard pipe/roadway box above/below ground surface _____ ft

Height/Depth of top of riser pipe above/below ground surface _____ ft

Type of protective casing: _____

Length _____ ft

Inside Diameter _____ in

Depth of bottom of guard pipe/roadway box _____ ft

Type of Seals	**Top of Seal (ft)**	**Thickness (ft)**
Concrete		
Bentonite Seal		

Type of riser pipe: _____

Inside diameter of riser pipe _____ in

Type of backfill around riser _____

Diameter of borehole _____ in

Depth to top of well screen _____ ft

Type of screen _____

Screen gauge or size of openings _____ in

Diameter of screen _____ in

Type of backfill around screen _____

Depth of bottom of well screen _____ ft

Bottom of Silt trap _____ ft

Depth of bottom of borehole _____ ft

(Not to Scale)

_____ ft	+ _____ ft	+ _____ ft	= _____ ft
Riser Pay Length (L1)	Length of screen (L2)	Length of silt trap (L3)	Pay length

COMMENTS: _____

Form 2007

HALEY & ALDRICH

MONITORING WELL DEVELOPMENT FORM

Well No.

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP.**	
CONTRACTOR		**DATE**	
ELEVATION SUBTRAHEND			

Estimated Volume of Water Lost During Drilling: _____ gallons

Comments: _____

_____

Depth to Water Before Development: _____ feet

Comments: _____

_____

Depth to Well Bottom Before Development: _____ feet

Comments: _____

_____

Turubitiy of Water Before Development: _____ NTU

Comments: _____

_____

Volume of Water Removed: _____ gallons

Comments: _____

_____

Method of Removal (bailing, pumping): _____

Comments: _____

_____

Depth to Well Bottom After Development: _____ feet

Comments: _____

_____

Depth to Water After Development: _____ feet

Comments: _____

_____

Turubitiy of Water After Development: _____ NTU

Comments: _____

_____

HALEY & ALDRICH

LOW-FLOW GROUNDWATER SAMPLING RECORD

Page of

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

GROUNDWATER SAMPLING INFORMATION

Well ID													
Depth Of Well (ft.) per Log													
Reference Mark													
Depth to Water from Reference Mark (ft.)													
Time													
Depth to Product (ft.)													
Field Measured Depth Of Well (ft.)													
Inside Diameter (in.)													
Standing Water Depth (ft.)													
Volume Of Water In Well (gallons/liters)													
Purging Device													
Volume of Bailer/Pump Capacity													
Cleaning Procedure													
Bails Removed/ Volume Removed													
Time Purging Started													
Time Purging Stopped													
Instrument Used to Monitor Field Parameters													
Sampling Device													
Cleaning Procedure													
Color													
Odor													
TIME SAMPLES TAKEN: VOA													
ABN													
Metals													
PARAMETERS: Time													
Temp, C													
Conductivity (umhos/cm)													
Dissolved Oxygen (mg/L)													
pH													
ORP													
Drawdown Ft													
Volume purged/Gals													
Turbidity (NTU)													

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

HALEY & ALDRICH

ENVIRONMENTAL TEST PIT LOG

Test Pit No.

Page **of**

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	
EQUIPMENT		**WEATHER**	

Ground El. _____ ft. **Location** _____ **Groundwater depths/entry rates (in./min.):**

El. Datum _____

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand			% Fines	Field Test			
						% Coarse	% Fine	% Coarse	% Medium	% Fine		Dilatancy	Toughness	Plasticity	Strength

Obstructions:

Remarks:

Bucket Decontamination Method:

Field Tests

Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:

at depth _____ ft.

measured after _____ hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24		=	
over 24		=	

Test Pit Dimensions (ft.):

Pit Depth _____

Pit Length X Width _____

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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